ABSTRACTS – 2009
JOINT MEETING OF ICHTHYOLOGISTS & HERPETOLOGISTS
COMPILED BY M.A. DONNELLY
(for co-authored abstracts, the underlined name indicates the presenter)

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609 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Kenneth Able[1], Michael Fahay[1]

[1]Rutgers University, New Brunswick, NJ, United States, [2]NMFS-NOAA (retired), Sandy Hook, NJ, United States

Ecology of Estuarine Fishes: A Synthesis from the Temperate Waters of the Western North Atlantic

The life history and ecology of fishes in estuaries is poorly known relative to the interest and needs of ichthyologists, estuarine ecologists, pollution biologists and resource managers at local, state and federal levels. Also, it is while they are in estuaries that they encounter several critical "bottlenecks" that can greatly affect survival rates and the resulting abundance of certain populations that we wish to harvest or are important components of these ecosystems. We intend to provide this missing information in a data-rich synthesis based on both historical and new information from a variety of sources embracing both temperate estuaries and the adjacent Atlantic Ocean where many of these species are spawned and spend the winter. This monograph will comprehensively treat the how, when, and why of the dominant fishes in estuaries. Synthesis chapters summarizing the patterns of reproduction and development, larval supply, settlement, growth, mortality, habitat use and migrations will be foci for 94 species. Examples of the breadth of these treatments will be provided.

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209 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Silvana Acevedo, Greg P. Jenkins, Julia Kent

Marine and Freshwater Fisheries Research Institute, Department of Primary Industries, Queenscliff, Australia

The Vertical and Horizontal Distribution of Fish Larvae in Central Bass Strait, South-Eastern Australia

Variation in the vertical distribution of fish larvae can have a strong influence on larval dispersal and therefore patterns of conectivity. The vertical and horizontal distribution of fish larvae in central Bass Strait was examined monthly from September 2007 to August 2008. Sampling was conducted at 0.5 m under the surface and 1-2 m above the

bottom at 1, 2 and 5 km from shore along transects off Kilcunda and Wonthaggi. Seasonal stratification of fish larvae was strong, possibly due to species-specific patterns of distribution, or to seasonal changes in hydrodynamic dynamics affecting vertical distribution. Distribution of some taxa was also influenced by factors such as distance from shore. For instance, the Australian anchovy, *Engrulis australis*, was more concentrated near the bottom close to shore, but evenly distributed between surface and bottom further offshore (5 km). Patterns of vertical distribution may relate to larval behaviour, or possibly to seasonal changes in hydrographic dynamics.

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569 Poster Session I, Exhibit Hall, Friday 24 July 2009

Gerardo Aceves-Medina, Sylvia Patricia A. Jimenez-Rosenberg, Ricardo Javier Saldierna-Martínez

CICIMAR-IPN, COFAA/SIP/SNI, La Paz, Baja California Sur, Mexico

Changes in the Fish Larvae Community of Bahia Vizcaino, Baja California, and the Adjacent Oceanic Region (2001-2003)

As part of IMECOCAL Program activities, fish larvae collected in oblique zooplankton tows, made off the northwestern coast of the Baja California Peninsula between 2001 and 2003 are analyzed. The goal is to determine the composition of the fish larvae community in Bahía Vizcaíno area, and how it changes along the study period. A total of 75 and 82 fish larvae species have been identified for 2001 and 2002 respectively. Mesopelagic fish larvae dominate during both years. Larvae of warm water species are more abundant during fall, with an important presence until winter, while fish larvae of temperate water species are more abundant during spring and summer. Trough the year, Myctophidae and Phosichthyidae showed higher larval abundances; families Synodontidae and Clupeidae larval abundances are important to during fall and winter respectively. Hydrographic conditions in the area during 2003 were similar to those observed during 2001 and 2002; hence we expect no significant change in the fish larvae community distribution pattern.

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570 ELHS/LFC Ecology I, Galleria South, Broadway 1&2 25 July 2009

Gerardo Aceves-Medina[1], Ricardo Palomares-García[1], Jaime Gómez-Gutiérrez[1], Carlos Robinson[2], Ricardo Javier Saldierna-Martínez[1]

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Multivariate Characterization of Spawning and Larval Environment of Small Pelagic Fishes in the Gulf of California

The spawning environment of *Sardinops sagax* and *Engrauslis mordax* was characterized using sea surface temperature and Chl-a from field surveys and/or satellite imagery as useful descriptor of the spawning habitat for clupeiformes fish, however we also used other considerable less studied biological variables that have a stronger effect on the selection of the fish spawning area. High densities of small pelagic fish eggs were associated with high zooplankton densities as a strategy that promotes adequate food supply for larval development and/or adult nutrient requirements for spawning process. We made a multi-factorial characterization of environmental conditions (November 20005) in the Gulf of California, associated with adult distribution (estimated using hydroacoustic and submarine video), spawning areas (indicated by eggs distribution) and nursery areas (indicated by preflexion to postflexion larvae). Our main goal was to explain small pelagic fish adult selection of the spawning areas. We recorded physical (temperature, density, thermocline depth, stratification of the water column, and dissolved oxygen) and biological variables (abundance of: photosynthetic and accessory pigments, zooplankton biomass, and copepod abundance). We detected high zooplankton biomass had a stronger correlation with the spawning areas compared with the influence of several physical variables but this effect is distinct for larvae that for adults. We demonstrated a spatial ontogenetic segregation of the oldest larvae present on regions with moderate zooplankton and phytoplankton biomass. We conclude that high zooplankton biomass was not related with adequate food supply for larval development but with adult feeding requirements during the spawning process.

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177 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Cory Adams[1], Daniel Saenz[1], Josh Pierce[1], David Laurencio[2]

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Occurrence of *Batrachochytrium dendrobatidis* in Kèköldi Indigenous Reserve, Costa Rica

Batrachochytrium dendrobatidis (*Bd*) is a fungus that is known to cause potentially fatal disease, chytridiomycosis, which may contribute to amphibian declines worldwide. We searched for the presence of *Bd* in the Kèköldi Indigenous Reserve in the lower elevations of the Talamancan region of Costa Rica to determine *Bd* infection rates in the anuran community. Also, we attempted to determine which species might be at greatest risk to *Bd* and the effect of elevation on detection rates. We collected a total of 126 individual adult frogs of 20 different species, from 10 different families. Of the 20 species sampled, only 8 tested positive for *Bd*. Ten individuals, out of 126, tested positive for an overall detection rate of 7.9% for the anuran community. Too few individuals were sampled to determine rates of the incidence of *Bd* for each species and too few individuals tested positive to determine if elevation affected detection rates of *Bd*.

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607 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Kyle Adamski[1], Jeffrey Buckel[1], Gretchen Bath-Martin[2], Chris Taylor[2], Kyle Shertzer[2]

[1]North Carolina State University - CMAST, Raleigh, NC, United States, [2]NOAA-NMFS, Beaufort, NC, United States

Developing an Index of Abundance for Gag Grouper in North Carolina: An Analysis of Larval and Juvenile Catch

One of the recommendations from the most recent stock assessment of gag grouper was the development of a fishery-independent index of abundance. The goal of this study was to gather information that would be useful for developing a larval or juvenile index of abundance in North Carolina. Larval gag were sampled on night flood tides at Beaufort Inlet from 1986 to 2008 as part of the NOAA bridgenet program. A 5-m otter trawl was used to sample juvenile gag in seagrass beds at randomly selected stations from June through September in both 2007 and 2008. Ages were calculated using lapillar otoliths. Concentrations (#/m^3) of larval gag peaked in late April to mid-May. Juvenile gag were caught in seagrass beds from June through September with peak catches in

July and August. A delta-lognormal modeling approach was used to compare fits of several models to larval and juvenile gag catch data and to calculate indices of abundance. For larval gag, models including peak abundance at full moon or a peak at full moon with a smaller peak near new moon had equal support; this suggests that peak flood tides are important predictors of gag ingress. A model including time of year, percent seagrass coverage, and sound best fit juvenile gag catch data. Back-calculated hatch dates ranged from February through April. The North Carolina Division of Marine Fisheries will begin sampling for juvenile gag in summer 2009 and are using these results to help design their survey.

1032 Fish Behavior, Parlor ABC, Monday 27 July 2009

Mia Adreani

Florida State University, Tallahassee, FL, United States

Reduced Fertilization Rate in the Presence of Streak Spawners in the Hermaphroditic Seabass, *Serranus subligarius*

In the simultaneously hermaphroditic marine fish, *Serranus subligarius*, male role individuals are known to pair spawn, group spawn and streak spawn. These mating strategies are common among marine reef fish and their spawning behavior has been well studied. What is unclear is how each behavior translates into reproductive success and how these competing strategies may affect fertilization success. Mating behaviors were recorded during the summers of 2005-2008 at three sites with different local population densities within St. Andrew's State Park, Panama City, Florida. Focal individuals were each observed in 15-minute increments and the following were recorded: total number of spawns, number of streak spawns, size of participating spawners and fertilization rate. The occurrence of small sized individuals in the local population predicts a higher frequency of streaking behavior and small fish are most often first year individuals reaching sexual maturity late in the spawning season (August/September). Spawns that included one or more streak spawners had a lower fertilization rate than pair spawns without a streak spawner. Additionally, a field manipulation experiment indicated lower fertilization rates (85-90%) in spawning events that included streakers. Further tests to distinguish the mechanism by which this occurs will be part of future studies.

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89 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Dominique Adriaens[1], Joachim Christiaens[1], Manuel Dierick[2], Luc Van Hoorebeke[2]

[1]Ghent University, Evolutionary Morphology of Vertebrates, Gent, Belgium, [2]Ghent University, Department of Subatomic and Radiation Physics, Gent, Belgium

Speciose and Special: Trichomycterid Catfishes and their Trophic Morphology

Trichomycterid catfishes, comprising more than 200 species, exhibit a wide range of ecological diversity. With that diversity, some distinct anatomical changes have occurred during evolution. Amongst the several phylogenetic lines leading to the trichomycterid phenotypes, evolutionary transformations have involved both changes in the head as well as in the postcranial body (such as body elongation). Morphological changes in the head are quite spectacular, especially when looking at the feeding apparatus. In this presentation, an overview is given of the overall cranial morphology of a basal trichomycterid, along with comparisons of feeding apparatus variation among different clades. Some extensively modified morphologies will be discussed, in relation to innovative mechanisms involved in highly specialised ways of feeding. Putting these observations in a phylogenetic context, this overview may help to better understand the evolutionary morphology of trichomycterid trophic systems, reflecting extensive modifications as a result of adaptive evolution. Special focus will be paid to the tridentines-stegophilines-vandellines clade, reflecting an evolutionary trend towards ectoparasitic feeding behavior.

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90 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Dominique Adriaens[1], Heleen Leysen[1], Manuel Dierick[2], Gert Roos[3], Joachim Christiaens[1], Sam Van Wassenbergh[3], Nora De Clerck[4], Luc Van Hoorebeke[3]

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Stress-related Functional Morphology of the Opercular Bone in Suction Feeding Fishes

Suction feeding is without a doubt one of the most successful feeding strategies in teleostean fishes. Structural specialisations of the oral jaws are considered as one of the most important evolutionary changes and novelties, increasing prey capture success through jaw protrusion. However, frequently neglected is the role of the opercle

functioning as a valve. Higher suction forces will co-occur with high pressure forces, pulling the gill cover inward. As any inward bending of the gill cover would decrease suction performance and may even generate fractures, it can be expected that natural selection would have favoured structural reinforcements of the opercular skeleton. From a mechanical point of view, different answers can be formulated to the same problem in this case (bone thickness, bone structure, mineralisation, curvature, etc.). To test this hypothesis, the histology and 3D-morphology of the opercle in suction feeding teleosts was analyzed. Using micro-CT data of generalised percomorph suction feeders and highly specialised suction feeders (seahorses and pipefishes), 3D-models were generated of the opercles and used for a finite element modelling. Histological sections were also used to analyse bone mineralisation. To test the importance of certain parameters of opercular shape for withstanding inward folding, artificial 3D-models were analysed. To estimate actual inward folding of the opercles during suction feeding in syngnathids, high-speed videos of a seahorse were analyzed.

1017 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER HERPETOLOGY AWARD

Jordan Ahle

California Polytechnic State University, San Luis Obispo. CA, United States

Thermal Biology of Northern Pacific Rattlesnakes (*Crotalus o. oreganus*)

Across all taxa of animals, thermal biology plays an important role in physiology and behavior. Rattlesnakes behaviorally thermoregulate, utilizing various features of the environment that allow them to reach the T_b at which internal mechanisms operate efficiently. In the Carrizo Plain of San Luis Obispo County, California, summer and winter surface temperatures are routinely extreme enough to stress the physiology of *C. o. oreganus*. By recording their T_b throughout the year, we observed how this species utilizes particular refugia to avoid extreme temperatures. T_b of *C. o. oreganus* was collected for one year using surgically implanted iButton temperature data loggers and substrate use was recorded by observation. Throughout the year, *C. o. oreganus* successfully utilizes specific features of the environment, such as rodent burrows, that remain thermally stable throughout the year, to achieve the T_b most suitable for their physiological condition. We are further exploring their thermal biology using snake models that accurately show what T_b a snake would potentially achieve if confined to a particular location. By combining these three parameters (T_b, refugia use, and operative temperature), a complete model of the thermal biology of *Crotalus o. oreganus* can be constructed.

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183 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Shaara Ainsley[1], David Ebert[2], Gregor Cailliet[1]

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Age, Growth and Maturity of the Whitebrow Skate, *Bathyraja minispinosa* (Ishiyama & Ishihara, 1977), from the Eastern Bering Sea

Bathyraja minispinosa (Chondrichthyes: Arhynchobatidae) is an endemic skate species confine mostly to the Aleutian Islands and Bering Sea of which little is known about its life history. The species is taken mostly as by-catch in groundfish fisheries and as such may be especially susceptible to over-exploitation. To fill critical life history gaps a total of 226 vertebrae and caudal thorn samples was collected by during NMFS Alaska Fisheries Science Center (AFSC) trawl surveys along the Eastern Bering continental slope. AFSC observers and fisheries biologists collected additional samples. Observed total lengths for males ranged from 14.7-83.7cm and females from 13.6-89.5cm. Preliminary age estimates established a minimum longevity of 37 years. *B. minispinosa* reached first maturity at 65.7cm TL for males and 66.8cm TL for females. The largest immature male was 79.5cm TL, while the largest immature female was 73.3cmTL. Male *B. minispinosa* reach median size at maturity (TL_{50}) at 70.1cm and females at 67.4cm (Males: $r^2 = 0.9597$, $p < 0.0001$, $n = 27$; Females: $r^2 = 0.9958$, $p < 0.0001$, $n = 28$).

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546 AES Ecology II, Galleria South, Sunday 26 July 2009

Matthew Ajemian, Sean Powers

University of South Alabama & Dauphin Island Sea Lab, Dauphin Island, AL, United States

An Integrative Approach to Evaluating the Ecological Role of Spotted Eagle Rays (*Aetobatus narinari*) in Bermuda

Reported increases in the abundance of Myliobatid rays may pose problems for fisheries management because many of their prey items include exploitable shellfish species. The spotted eagle ray (*Aetobatus narinari*) is the most abundant inshore elasmobranch in subtropical Bermuda, but its predatory role remains unexamined in this region. We utilized a combination of acoustic monitoring, benthic sampling and gut contents analysis (via gastric lavage) to assess the impact of spotted eagle rays to Bermudian shellfish resources. Movement behaviors of adult spotted eagle rays were documented over two summers with ten autonomous wireless hydrophones (Lotek WHS 3050) distributed throughout Harrington Sound and at the mouth of Flatts Inlet. Presence/absence data of rays within Harrington Sound reveal disproportional use of subregions, and significant diel behavior. Individuals fitted with pressure sensors

showed a trend of occupying deeper regions of the sound during the middle of the day, a potential thermoregulatory behavior. In particular, spotted eagle rays appear to exhibit high site-fidelity in a region of southwest Harrington Sound characterized by sandy flats and a wide variety of potential prey organisms. Gut contents from animals experiencing gastric lavage reveal the major prey of adults is the Venerid calico clam (*Macrocallista maculata*), while smaller individuals may prefer thinner-shelled Lucinid clams. Finally, data from two "gate-keeping" hydrophones indicated residency periods beyond several tidal cycles and up to 29 days. High site fidelity and long-term residency combined with the energetic requirements of these large rays imply that these predators may largely impact local prey dynamics.

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118 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Mohammad Ali Akbarian[1], Homayoon Hosseinzadeh[2], Jafar Seyfabadi[1], Jaleh Sarafraz[3]

[1]Tarbiat Modares University, Noor, Iran, Islamic Republic of, [2]Iranian Fisheries Research Organization, Tehran, Iran, [3]Shahid Beheshti University, Tehran, Iran

Effect of Light Intensity and Photoperiod on Growth and Survival of Kutum Roach Early Stages

With the aim to study the effect of light intensity and photoperiod on growth and survival of Kutum roach, *Rutilus frisii kutum*, early stages, in Spring 2007 newly hatched larva were reared for 35 days in an indoor system under different photoperiods (18L:6D or 12L:12D or 6L:18D) and light intensities (80 lux or 400 lux or 2500 lux). Comparing with fish treated under natural light intensity and photoperiod, the results reveal better growth (5.849±0.8) in fish treated under 400 lux light intensity and 18L:6D photoperiod ($p<0.05$); Hence survival was greater (75.3%) in fish treated under 2500 lux light intensity and 18L:6D photoperiod ($p<0.05$). Since no particular light regime is employed in Kutum roach hatchery process, probably mid to high light intensities and approximately long photoperiods can be useful.

1008 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Hugo Alamillo[1], Chad D. Brock[1], Michael E. Alfaro[2]

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Snake Diversification: Was the Miocene the Age of Snakes?

The fossil record reveals three periods in the evolutionary history of snakes with rapid diversification: the rise of snakes in the Cretaceous (65.5–145.5 MYA) ,the diversification of boids in the Eocene (33.9–55.8 MYA) and a third radiation in the Miocene (5.332–23.03 MYA). Given the extent of the colubroid species in the fossil record the Miocene has been called the 'age of snakes'. Here we test the hypothesis that snakes experienced accelerated lineage diversification during the Neogene (1.806–23.03 MYA). First, we report results obtained with MEDUSA, an AIC-based model fitting approach that locates shifts of diversification along branches of a phylogenetic tree with incompletely sampled tip lineages. Secondly, we apply a novel Kendall-Moran estimator to test whether diversification rates in the Miocene across the snake phylogeny are faster than expected given their background rate. Our MEDUSA results return significant likelihood values for elevated diversification rates along the clade subtending the colubroids and elapids, along with slowdowns for pythonids and the monotypic Azemyops. The results from our KM estimator document a higher than expected rate of diversification for the Neogene. We conclude that a long held paleontological hypothesis can be corroborated with results from molecular data. However, more importantly, the radiation that gave rise to the largest clade of extant snakes seems to have been one in the not-too-distant geological past, giving credence to the macroevolutionary idea that a high turnover of species might be the norm throughout the history of some tetrapod lineages.

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793 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

James Albert, Tiago Carvalho

University of Louisiana at Lafayette, LA, United States

Paleogeographic Dating Indicates Paleogene Origins for the Species-rich Amazonian Ichthyofauna

Fossil data indicate origins of many Amazonian fish lineages in the Paleogene or earlier, yet geological data suggest the modern Amazon Basin did not form until the middle Neogene (c. 10 Ma). Therefore many fish lineages from lowland Amazonia are known to be older than the river systems they inhabit. Nevertheless we have little understanding

of the time frame over which the species richness accumulated. Paleogeographic age dating estimates minimum divergence times for allopatrically distributed taxa across geographic barriers with geologically bounded ages, and may also help constrain the time frame over which species richness accumulated on either side of a barrier. We used Brooks Parsimony Analysis (BPA) of 32 published species-level phylogenies with 333 species of freshwater fishes to estimate general area relationships among 46 aquatic ecoregions of tropical South America, and Parsimony Analysis of Endemism (PAE) of 142 of these species distributed over two or more ecoregions to infer instances of range expansion (dispersal). The results suggest the taxonomic composition of the modern hydrogeographic landscapes predate the rise of the Michicola, Fitzcarrald, and Vaupes arches (c. 30 - 5 Ma) that fragmented the Sub-Andean Foreland. The PAE suggests limited dispersal across some low-lying watersheds and portals during the late Neogene. These vicariance and geodispersal events subdivided and mixed pre-existing aquatic faunas leaving a phylogenetic signal on a large portion of the modern fauna. The results also help constrain estimates of the time frame over which the exceptional species richness of modern lowland Amazonia came to be assembled.

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689 Herp Development & Morphology, Galleria North, Sunday 26 July 2009

Michael Alcorn

Auburn University, Auburn, AL, United States

Geometric Morphometrics Role in Phylogenetic Classification and Sexual Dimorphism Dynamics of *Eurycea aquatica* and *Eurycea cirrigera*

Many species of southeastern salamanders exhibit morphological conservatism making species classification a difficult task. Sexual dimorphism can reveal significant information about a species' natural history and is essential to understanding certain physical and behavioral characteristics. The taxonomic status of *Eurycea aquatica* has been a topic of debate since it was first described in 1963. Several studies suggest that *E. aquatica* is a specialized "spring ecotype" resulting from isolation and subsequent divergence from *E. cirrigera*. *Eurycea cirrigera* is found throughout the southeastern United States and the males possess elongate cirri (fleshy downward protuberances from the upper lip). *Eurycea aquatica* is found in stream habitats in Alabama and neighboring states. We propose that previous measurements suggesting conspecificity between *E. aquatica* and *E. cirrigera* were too macroscopic in scale and recent molecular studies have provided evidence that these two groups form separate clades. In this study, we used geometric morphometric analysis to more rigorously compare the morphologies of species and found them to be significantly different. We found head shape to be significantly different between species, between sexes in *E. aquatica* and between males. Head shape was not significantly different between sexes in *E. cirrigera* and between the females of the two species. Results of this work lay the ground work for behavioral studies and novel research on the breeding habits of *E. aquatica*.

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69 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Robert Aldridge, Benjamin Jellen, Dustin Siegel

Saint Louis University, St. Louis, MO, United States

Seasonal Variation in the Relative Mass of the Testis and Sexual Segment of the Kidney in the Ophidia

Two major structures contribute to the ejaculate in squamates, the testis and the kidney. The testis produces sperm and the kidney produces fluids containing carbohydrates and proteins that are released during ejaculation. The majority of North American male snakes have a reproductive cycle that is best described as post-ovulatory spermatogenesis in which sperm are produced in the summer months prior to hibernation and the spring mating season. Sperm are stored in the vas deferens during the winter. Because snakes are polygamous, the sperm of different males compete with one another to fertilize the ova. This intrauterine competition might select for those males who release more sperm during ejaculation to increase the chances of his success. However, because sperm are not being produced during the mating season, an increased ejaculate may limit the number of ejaculations a male can make. In this study we examine the relative importance of the testis and kidney mass by estimating the volume of tissue devoted to sperm production and kidney reproductive secretions in several snake taxa. Preliminary analysis suggests that the sexual portion of the kidney, at the time of mating, equals or exceeds the mass of the testis during peak sperm production. We propose that secretions of the sexual segment, in some snakes, create a viscous barrier to reduce the likelihood of sperm of subsequent matings from reaching the oviduct and may increase the ejaculate volume to facilitate the sperm movement in the oviduct.

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677 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Katherine Allen[1], Mark Roberts[1], James Grady[2], Joseph Quattro[1]

[1]University of South Carolina, Columbia, SC, United States, [2]University of New Orleans, New Orleans, LA, United States

Two Genetically Distinct Lineages of the Shortfin Mako (*Isurus oxyrinchus*)

Despite expectations, highly vagile, cosmopolitan marine fishes often are genetically structured, even in the apparent absence of barriers to gene flow. The Shortfin Mako (*Isurus oxyrinchus*) is a pelagic, globally distributed species that is an important target of commercial and recreational fisheries, and fishing pressure on populations necessitates a

thorough evaluation of population genetic structure. A previous RFLP analysis of genetic variation in *I. oxyrinchus* detected significant mtDNA haplotype heterogeneity that was regionally partitioned, but the data were insufficient to support genetically distinct stocks. Based on this suggestion of geographic structure, a finer scale genetic analysis was conducted by sequencing a 300 bp fragment of the mtDNA control region in 183 individuals from five regions (Northeast Pacific, North Atlantic, Southwest Atlantic, Southwest Pacific, and Africa). Sequencing recovered 30 haplotypes defined by 26 polymorphic nucleotide positions. Mean haplotype diversity (h=0.822) is consistent with RFLP results. Control region gene trees support two clades separated by 2.4% sequence divergence, and haplotype frequencies within and between clades exhibit significant regional partitioning. Evidence of lineage diversification and geographically partitioned genetic variation among mako shark populations should be incorporated in future management plans.

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321 Storm Symposium, Pavilion West, Friday 24 July 2009

Ronald Altig

Mississippi State University, Mississippi State, MS, United States

After Forty Years of Tadpoles: A Career Spent Studying the Verb "To Vary"

In the historical context of this symposium, I will try to reconstruct how I arrived at Oregon State, when and how the concept of "tadpole" came into my mind, and how the study of tadpoles has grown in the last 40 years. In summary, we still lack an immense amount of information on the ecology and morphology of tadpoles, and the range of intra- and interspecific variation seems endless. Intraspecific variations that can be induced add either research intrigue or profound frustrations depending on the day of the week.

1027 Poster Session I, Exhibit Hall, Friday 24 July 2009

Ronald Altig[1], Mary White[2], James Austin[3], Brian Crother[2]

[1]Mississippi State University, Starkville, MS, United States, [2]Southeastern Louisiana University, Hammond, LA, United States, [3]University of Florida IFAS, Gainesville, FL, United States

Unusual Bullfrog (*Lithobates catesbeianus*) Tadpole Phenotypes

A series of tadpoles initially identified as specimens of *Lithobates catesbeianus* were collected from the general geographic vicinity of Alachua County, Florida. One of us (RA) noted that these tadpoles were phenotypically distinct from the expected bullfrog

morphology in pattern, color, and general body form. Phylogenetic comparisons were made with mtDNA sequence data from these specimens and other bullfrogs from a broad sampling of localities. *Lithobates clamitans*, *L. grylio* and *L. heckscheri* were used for outgroup comparisons. The mtDNA did not suggest the tadpoles were from a distinct lineage separate from other bullfrogs. Although part of the sample from the unusual tadpoles formed a monophyletic group, all of these individuals were nested within the larger species tree. Nuclear DNA may indicate otherwise. The morphology and DNA results from these unusual tadpoles will be discussed.

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204 Fish Ecology II, Pavilion East, Sunday 26 July 2009

Cairistiona Anderson[1], John Horne[1], Tracey Sutton[2]

[1]University of Washington, Seattle, WA, United States, [2]Virginia Institute of Marine Science, Gloucester Point, VA, United States

Spatial Distributions of Bathypelagic Fishes along the Mid-Atlantic Ridge

The spatial distribution of organisms plays a key role in facilitating biological processes, such as trophic interactions, which influence pelagic ecosystem structure and function. This study combines discrete trawl net sampling with continuous, full water column, acoustic measurements to investigate the distribution of bathypelagic (1000- 3000 m depth) nekton biomass along the Mid-Atlantic Ridge from Iceland to the Azores in the North Atlantic. Two, previously unknown, distinct bathypelagic acoustic scattering layers (ASLs) were observed using 18 kHz echosounder data. One, extending down on average ~200 m from 2000 m depth, appears ubiquitous wherever bottom depth allows, while the second, found within the 1500-2000 m depth stratum, only occurred south of the Sub-Polar Front. Backscatter from the 2000 m ASL was attributed to fish based on net catches, with species drawn from the suite of bathypelagic species observed throughout the study area, rather than any specific group. No general increase in acoustic backscatter, as a proxy for pelagic nekton biomass (primarily fish), was observed in close proximity to the bottom (≤ 200 m), but localized concentrations of backscatter were observed in areas of steep bottom topography at bathypelagic depths. Together these observations demonstrate a previously unreported degree of complexity in the spatial structuring of bathypelagic ecosystems, which is likely to significantly effect the local functioning of those ecosystems.

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127 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kristie E. Anderson, Daniel G. Blackburn

Trinity College, Hartford, CT, United States

The Placental Interface in Viviparous Snakes, as Revealed by Scanning Electron Microscopy

In viviparous squamates, females sustain their embryos during gestation by placentas that provide oxygen, water, and nutrients. We have used a battery of anatomical techniques in studies of placental morphology, and find scanning electron microscopy particularly useful in revealing surface features at the maternal - fetal interface. SEM was used to examine placentas of various species of viviparous thamnophine snakes. Two major types of placentas are formed -- the chorioallantoic placenta and the yolk sac placenta. In both types, the uterine epithelium consists of an unbroken lining of broad, flattened cells, with no signs of erosion or capillary exposure. The apposed chorionic cells are also broad and flattened over the allantoic capillaries. In contrast, the epithelium lining the yolk sac is enlarged, and in at least some species, includes cells with an absorptive morphology. These observations support the idea that the two placental types are specialized for distinctly different functions.

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618 Fish Systematics II, Pavilion East, Saturday 25 July 2009

M. Eric Anderson[1], Duane Stevenson[2], Gento Shinohara[3]

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A Systematic Review of the Genus *Bothrocara* Bean 1890 (Teleostei: Zoarcidae)

The systematics of the eelpout genus *Bothrocara* Bean 1890 is reviewed on the basis of 941 specimens. Eight mostly eurybathic, demersal species are recognized including *B. nyx*, a species recently described from the continental slope of the eastern Bering Sea. Species of *Bothrocara* are distributed mainly around the rim of the North Pacific and surrounding seas, from Japan to Panama, with two species extending into the South Pacific along the coast of South America and one species entering the South Atlantic. The species are distinguished from one another mainly on the basis of head pore patterns, gill raker morphology, coloration and various meristic and morphometric values. Comparative diet studies and ageing efforts are currently under way for two of the species commonly found in the eastern Bering Sea.

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919 Poster Session I, Exhibit Hall, Friday 24 July 2009

Roger Anderson, Krystal Hazzard, Jamie Ohrt

Western Washington University, Bellingham, WA, United States

The Ecology of Antipredation of the Long-nosed leopard Lizard, *Gambelia wislizenii*, a Mesocarnivore in Desert Scrub

The Long-nosed Leopard Lizard, *Gambelia wislizenii,* as a mesocarnivore is potential prey for coyotes, raptors and snakes. We sought to determine how leopard lizards evade ground and aerial predators so we could elucidate the adaptedness of the lizards' movements and ambush positions that they use throughout their daily activity periods. We expected that anti-predatory responses of *G. wislizenii* would depend on the type of predator, the type and speed of approach, and on which microhabitat it was in at the time of the encounter. Hence, we used humans as the running-pursuit predators and dive-flying predatory bird models as the aerial predators, and we recorded lizard responses to these ersatz predators. We also measured velocities and distances run by *G. wislizenii* when they were chased in unrestricted field conditions and in raceways. Most leopard lizards were encountered in the open or near perimeters of the most common species of shrub, where they were presumably foraging. Lizards usually sought refuge under the nearest shrub when approached by an ersatz aerial "predator." Lizards were relatively unwary when approached by walking humans, and usually did not evade until approached within 1 m. Lizards chased by running humans entered larger and more foliage-laden shrubs and commonly ran along the perimeter of a shrub and out of sight before entering the shrub cover. Field evasion speeds were more typical of quadrupedal running, less than 3m/sec, whereas lizards in raceways could run bipedally at over 4m/sec, as would be expected if pursuing fast-evading lizard prey.

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568 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Kate Andrews[1], William Gazey[1], Scott Raborn[1], Benny Gallaway[1]

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Calculating Shark Bycatch in the Gulf of Mexico Shrimp Trawl Fishery: a Collaborative Approach

The assessment of shark populations in the Gulf of Mexico (GOM) is conducted through the Southeast Data, Assessment, and Review (SEDAR) process. In 2007, the small coastal complex, blacknose (*Carcharhinus acronotus*), Atlantic sharpnose (*Rhizoprionodon terraenovae*), bonnethead (*Sphyrna tiburo*), and finetooth (*Carcharhinus isodon*), was assessed by scientists from the NOAA Fisheries Service. Using the catch data, indices,

and life history parameters recommended by the members of the data workshop working groups, they determined blacknose to be an overfished population with continued overfishing. The largest component of the catches was the yearly estimate of bycatch in the shrimp trawl fishery. The estimation method used was of concern to the shrimp industry due to what they viewed as questionable assumptions and poor data, and their representatives approached NOAA scientists about collaborating to revise the method to use at the following SEDAR. The method had been used in other SEDARs previously, but this was the first application to the data poor shark fishery. Notable adjustments to the method include accounting for a Turtle Excluder Device (TED) effect and matching index data to the fishing behaviors of the commercial shrimpers. The consensus reached is evidence of the SEDAR process at work and illustrates a scientifically sound meeting of the minds, between managers and stakeholders.

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190 Herp Development & Morphology, Galleria North, Sunday 26 July 2009

Robin Andrews[1], Kristopher Karsten[2]

[1]Virginia Tech, Blacksburg, VA, United States, [2]Texas Christian University, Fort Worth, TX, United States

Rates of Development and Embryonic Diapause in Chameleons

We obtained information on the reproductive biology of 104 species of chameleons from eight of the ten currently recognized genera from a literature survey. For the sub-set of 70 species whose evolutionary relationships were known, we determined the evolution of developmental rates by mapping character states on a composite phylogeny. We also conducted field studies in Spain and Madagascar to determine the ecological context of embryonic diapause. Oviparous chameleons in our study were the basal genera *Brookesia*, *Rhampholeon*, and *Rieppeleon* and the derived typical chameleons *Calumma*, *Chamaeleo*, *Trioceros*, and *Furcifer*. Basal chameleons exhibited developmental rates comparable to those of other lizards (normal development). All species were small-bodied residents of lowland tropical forests. Typical chameleons exhibited developmental rates that were slow relative to those of other lizards; character tracing indicated that slow development had a single origin in Madagascar. Several clades of typical chameleons exhibited an additional lengthy period of developmental arrest (embryonic diapause or cold torpor or both) with incubation periods of 6-9 months or more. Embryonic diapause had independent origins in Africa (*Chamaeleo*, and possibly *Trioceros*), and in Madagascar (*Furcifer*, and possibly *Calumma*). Embryonic diapause is associated with large to giant body sizes and with dry climates characterized by strong seasonality and relatively short periods favorable for hatching, mating, and oviposition. Slow development and embryonic diapause are adaptive in these environments as they ensure that hatchlings do not emerge during periods unfavorable for growth and survival.

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38 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Victoria Arch[1], T. Ulmar Grafe[2], Marcos Gridi-Papp[1], Peter Narins[1]

[1]University of California, Los Angeles, CA, United States, [2]University Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam

An Old World Frog Communicates in Pure Ultrasound

Huia cavitympanum, an endemic Bornean frog, is the first amphibian known to emit exclusively ultrasonic (i.e., > 20 kHz) vocal signals. To test the hypothesis that these frogs use purely ultrasonic vocalizations for intraspecific communication, we performed playback experiments with male frogs in their natural calling sites. We found that the frogs respond with increased calling to broadcasts of conspecific calls containing only ultrasound. The field study was complemented by electrophysiological recordings from the auditory midbrain, and laser Doppler vibrometer measurements of the tympanic membrane's response to acoustic stimulation. These measurements revealed that the frog's auditory system is broadly tuned over high frequencies, with peak sensitivity occurring within the ultrasonic frequency range. Our results demonstrate that *H. cavitympanum* is the first non-mammalian vertebrate described to communicate with purely ultrasonic acoustic signals. An unrelated frog species, *Odorrana tormota*, has also been shown to produce and detect ultrasound but does not emit exclusively ultrasonic calls. The species live in similar environments near rushing streams and waterfalls that produce broadband, predominately low-frequency background noise. These noisy environments may have selected for the frogs' convergence on the use of high frequencies/ultrasounds to increase the signal-to-noise ratio of vocalizations. Further comparative studies of the species' communication systems and underlying morphology and physiology should afford new insights into the mechanistic foundations of amphibian high-frequency communication.

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580 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Jonathan Armbruster

Auburn University, Auburn, AL, United States

Loricarioid Catfishes: Species Diversity and Phylogeny

The loricarioid catfishes contain the Nematogenyidae, Trichomycteridae, Callichthyidae, Scoloplacidae, Astroblepidae, and Loricariidae. The Loricarioidea has long been recognized as a distinct clade, and until recently it represented the only suborder of catfishes recognized by nearly everyone. Currently, it is believed that the loricarioids represent the sister clade to all other catfishes. The clade is extremely diverse with six

families, 140 genera, and nearly 1200 species; thus, it represents over one third of catfishes. The range encompasses most of Neotropical South America and extends into Central America to Costa Rica. Modern phylogenetic analyses date to the 1970's, and all families have morphological phylogenies available at the genus level. Molecular phylogenies are also being produced, and at times are extremely incongruent with morphological hypotheses. This incongruency suggests some interesting possibilities such as a great deal of morphological convergence (morphology in error) and very rapid diversification leading to no lineage sorting and convoluted relationships (molecules in error). Either of the previous possibilities or others make understanding the diversity and phylogenetics of loricarioids extremely interesting. Knowledge of the phylogenetics will be further informed by studies being undertaken on the ontogeny and functional morphology of loricarioids. Functional morphology is particularly interesting in these fishes as there are many diverse feeding modes, including lignivory (not seen in any other fishes) and hematophagy. A well-supported phylogeny will be required to understand the complex morphology and ecology of these fishes and how morphology and ecology has permitted the diversification of this large clade of fishes.

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774 Fish Conservation II, Pavilion West, Sunday 26 July 2009; ASIH STOYE AWARD CONSERVATION

Rachel Arnold

University of Washington, Seattle, WA, United States

Phylogenetics and Conservation of Frogfishes (Antennariidae: Lophiiformes)

Frogfishes of the family Antennariidae (order Lophiiformes) are a morphologically diverse group of fishes found in nearly all subtropical and tropical oceans and seas of the world. Some genera have a circumtropical distribution, but most are endemic to relatively small regions within the Indo-Australian archipelago. Relationships within the Antennariidae remain unresolved. No reproductive or population studies have been conducted to explicate the considerable differences in geographic distributions. A phylogeny was inferred using DNA sequences from the nuclear recombination activation gene-2 (RAG2) and the mitochondrial 16S rRNA (16S) and cytochrome oxidase-I (COI) genes. A clade representing genera endemic to regions within the Indo-Australian archipelago (*Echinophryne*, *Histiophryne*, *Kuiterichthys*, *Phyllophryne*, *Rhycherus*, *Lophiocharon*, and *Tathicarpus*) was recovered in addition to a clade representing genera that are more widely distributed in tropical and subtropical zones around the world (*Antennarius*, *Antennatus*, and *Histrio*). Characters of ovarian morphology, reproductive biology, and life history were examined and mapped on to the resultant molecular phylogeny. These characters maintained a strong signal in the context of the molecular phylogeny and supported the discrepancy in the observed geographic distributions. The results from this study can be used to predict taxa that are more susceptible to population decline, and to illustrate the value of phylogenetics in predicting organismal characteristics that have not yet been studied.

628 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Gloria Arratia[1], Jesús Alvarado-Ortega[2]

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Cypriniformes Tree of Life: Ictiobin fishes: Early Diversification and Patterns of Distribution

With more than 3,000 species and about six extant families (e.g., Balitoridae, Catostomidae, Cobitidae, Cyprinidae, Gyrinocheilidae, and Psilorhynchidae) the order Cypriniformes is the largest clade among extant teleosts. Among them, the family Catostomidae is represented today by about 14 genera and 80 species in China, northeastern Siberia, and North America. Two catostomid species occur in Asia (*Myxocyprinus asiaticus* and *Catostomus catostomus rostratus*), whereas all other species occur in North America. These include ictiobins (*Carpiodes* with 5 spp. and *Ictiobus* with 3 spp.), cycleptins (*Cycleptus*), and catostomins (e.g., *Catostomus*, *Moxostoma*). Concerning the catostomid fossil record, ictiobins are known from Eocene-to-Recent, cycleptins from Oligocene-to-Recent, and catostomins from Miocene-to-Recent. The fossil ictiobins have been assigned to the extant genera *Ictiobus* and *Carpiodes*. Important exceptions within the Catostomidae are the Asiatic genus *Vasnetzovia* and the genus *Amyzon* known from 7 extinct species that have been recovered in middle Eocene-early Oligocene localities in both Asia and North America, with one exception, *Amyzon* sp., recovered in the Paleocene (Danian) of North America. New ictiobin material-articulated and disarticulated-recently recovered in the Pliocene of Mexico enlarges the morphological knowledge of the group, its content and also the range of geographical distribution of ictiobins in the past. The present contribution describes the early diversification of the ictiobins in comparison with the modern members of the group, and discuss evolutionary morphological trends of ictiobins. Past and present patterns of geographical distribution are revised and a possible explanation for the major changes is presented.

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626 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Gloria Arratia[1], Miles Coburn[2], Paula Mabee[3]

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Cypriniformes Tree of Life: The Caudal Skeleton of Ostarioclupeomorphs: Issues of Homology

The caudal fin and its endoskeletal supports is a major source of characters for phylogenetic studies of teleosts. Among ostarioclupeomorphs and subgroups, the few known characters from the caudal skeleton are ambiguous. Of the few characters supporting the monophyly of the ostarioclupeomorphs, two are caudal skeletal characters. Ostariophysan phylogenies have been based on 127 characters, only 8 of which are caudal skeletal characters. Two characters support the monophyly of otophysans, and no caudal character support the monophyly of cypriniforms. Is the paucity of caudal skeletal characters at these various phylogenetic levels due to the lack of variation or does it represent incomplete knowledge of development and homology of the caudal skeleton? Among the open questions concerning the caudal skeleton, two can be used as examples: 1) What is the evidence that the compound centrum, pleurostyle and epurals develop in the same way in ostarioclupeomorphs? 2) What is the evidence that hypural 2 fused to ural centrum 1 (of diural terminology) in clupeomorphs is the homologue of hypural 2 fused to a compound centrum in ostariophysans? To address these questions, we have collected new data on the early development, composition, distribution, and homology of these structures. To clarify the problems involved we use the polyural terminology. Our results show that the compound centrum develops differently in ostarioclupeomorphs and also that there are different patterns of development within the ostariophysans (e.g., cypriniform subgroups). In the present contribution we will discuss the problems mentioned above in the broad framework of the ostarioclupeomorphs.

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237 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jairo Arroyave[1], Melanie Stiassny[1]

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Molecular Phylogeny of the African Genus Bryconaethiops and its Systematic Position Within the Family Alestidae (Ostariophysi: Characiformes)

The most comprehensive morphology-based phylogeny of the family Alestidae published to date is partially incongruent with the results of a recent molecular study on the higher-level relationships of the order Characiformes. Additionally, a robust phylogeny of the alestid genus *Bryconaethiops* has yet to be proposed. Therefore, this study presents a phylogeny of *Bryconaethiops* providing a context for evaluating intrageneric relationships of characiform fishes closely related to Alestidae. Phylogenetic relationships within *Bryconaethiops* were inferred using a molecular dataset that included both nuclear (S7 and Rhodopsin) and mitochondrial (COI and Cyt-b) markers. Representatives of more than half of the recognized genera of Alestidae were included in the analyses, which allowed for testing previous hypotheses of relationships between Bryconaethiops and putatively related genera (e.g., *Alestes*, *Brycinus*, *Hydrocynus*). Furthermore, the position of the genus *Chalceus* in the phylogeny of the order Characiformes was also tested. Preliminary results support the monophyly of Bryconaethiops and corroborate the morphology-based hypothesis that *Chalceus* is the sister group of Alestidae.

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144 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Neil C. Aschliman, Gavin J.P. Naylor

Florida State University, Tallahassee, FL, United States

Diversity and Constraint in the Evolution of Skates and Rays (Chondrichthyes: Batoidea)

Skates, rays and their allies (Batoidea) are a prominent but under-studied clade of stem vertebrates that exhibit the majority of chondrichthyan morphological- and species diversity. Understanding the forces affecting the diversification of this group requires a reliable phylogeny. The most taxon-rich batoid phylogenies are morphological and suggest suites of characters that appear constrained and/or convergent. However, discordance with the fossil record and a lack of confidence in any one topology impede the resolution of critical questions posed by morphological trees. Three examples concern: (1) forces shaping the tremendous disparity in number between the derived

skates [~300] and the relatively basal sawfishes [only seven]; (2) the number of convergent derivations of the flattened disc body plan; and (3) the pattern of changes in mode of parition, with skate oviparity a potential reversal from yolk sac viviparity. Most molecular phylogenies have included very few taxa and limited sequence data. We previously described novel but preliminary evidence for a rapid radiation among the extant groups of batoids. We attempted to resolve this basal polytomy using large DNA sequence datasets including the nuclear marker RAG-1 (~100 taxa) and the complete protein-coding complement of the mitochondrial genome (~40 taxa), sampling densely and evenly across Batoidea. Phylogenies were recovered using Maximum Likelihood and Bayesian approaches. We accommodated systematic biases in the data, statistically compared topologies, estimated divergence times and evaluated the prevailing signal against morphology and the fossil record. A number of well-supported clades were recovered. Some are novel, while others are anticipated by morphology.

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516 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Jelle Atema[1], Gabriele Gerlach[2], Vanessa Miller-Sims[3], Jana Deppermann[2], Julia Halverson[1], Michael Kingsford[4]

[1]Boston University, Boston, MA, United States, [2]University of Oldenburg, Oldenburg, Germany, [3]University of Southern California, Los Angeles, CA, United States, [4]James Cook University, Townsville, Australia

Olfactory Imprinting Can Lead To Small Scale Population Structure

We showed small-scale (~10 km) population structure in the brooding pomacentrid (*Acanthochromis polyacanthus*, without larval dispersal) and the apogonid (*Ostorhynchus doederleini*, dispersing larvae), but not in *Pomacentrus coelestis* (dispersing larvae in the same hydrographic regime). Settling larvae of the dispersing species recognize and prefer the odor of their settlement reef. Preference persists over several days regardless of the reef odor in which they are held. This suggests a pre-settlement homing-by-odor mechanism, utilized by *O. doederleini*, but not by *P. coelestis*. In addition, settling juveniles of *O. doederleini* prefer the odor of their own species and their own reef population. Older juveniles are aggressive to foreign newcomers: they visually recognize members of their small local aggregation and associate with them. Social rejection of foreigners would be a powerful post-settlement mechanism for creating population substructure. Similar to Larvae of the cold water lobster (*Homarus americanus*) have pelagic larval duration similar to these reef fishes. After three planktonic stages the fourth stage metamorphoses into a powerful swimming settler. Current studies of adult population structure show genetic and morphometric differences at the 25 km scale. In addition, adults recognize each other by subpopulation: females prefer association with males of their own tribe. We suggest that olfactory imprinting and later olfactory and visual learning can be powerful mechanisms that

generate small-scale population structure in the absence of physical barriers. Both warm and cold water species can use this information to recognize and find preferred habitat, to associate with tribal members and reject foreigners.

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870 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kori K. Ault, R. Steven Wagner, Holly C. Pinkart, James E. Johnson

Central Washington University, WA, United States

Amphibian Saprolegniasis: An Assessment of Pathogen Diversity

Water molds, primarily in the genus *Saprolegnia*, have been implicated in large-scale mortality of amphibian eggs under a variety of environmental conditions. Although a number of water mold species infect amphibian eggs, the pathogens involved in die-offs or utilized in ecological studies often remain unidentified or identified as only one of three species (*S. ferax, S. parasitica or S. diclina*). Lack of adequate identification makes it difficult to assess factors of the host-parasite interaction that contribute to saprolegniasis in amphibians. Furthermore, recent work indicates that the diversity of *Saprolegnia* infecting amphibian embryos may be significantly higher than what was previously known. We used Denaturing Gradient Gel Electrophoresis (DGGE) to assess the diversity of *Saprolegnia* on amphibian eggs from a single pond in central Washington. Unlike traditional morphological methods of identification, which have proven ineffective, and isolation methods, which often recover only the fastest growing taxa, DGGE allows us to quickly identify all the different potentially pathogenic organisms associated with a single embryo using small fragments of DNA. In this study, we found that that most infected eggs contain multiple bands representing different species of water molds. These fragments are subsequently sequenced and identified to species using a DNA barcoding procedure. This method has an advantage over simple DNA barcoding because it assures that we capture all the taxa growing on an individual egg. Based on these results, we strongly recommend that ecological studies of amphibian saprolegniasis take into account the diversity of and potential interactions between these pathogenic water molds.

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48 Poster Session I, Exhibit Hall, Friday 24 July 2009

Toby Auth[1], Richard Brodeur[2], Heather Soulen[3], Lorenzo Ciannelli[4], William Peterson[5]

[1]HMSC/CIMRS/OSU, Newport, OR, United States, [2]HMSC/NOAA, Newport, OR, United States, [3]HMSC/CIMRS/OSU, Newport, OR, United States, [4]COAS/OSU, Corvallis, OR, United States, [5]HMSC/NOAA, Newport, OR, United States

An Investigation of the Response of Fish Larvae to Decadal Changes in Environmental Forcing Factors off the Oregon Coast

We conducted a statistical analysis of the relationships between larval fish concentrations and community structure and both large-scale and local environmental factors in the northern California Current (NCC). Larval fish concentration and taxon composition data were from samples collected at two nearshore stations along the Newport Hydrographic (NH) line off the central Oregon coast. Data from 1996-2005 were compared with historical data from the 1970s and 1980s to evaluate pseudo-decadal, annual, and seasonal variability. Our results indicate that the most abundant taxa from 1996-2005 differ from those of earlier decades. Concentrations of the dominant taxa and total larvae were generally greater in the winter/spring than summer/fall season. Climate indices, such as Pacific Decadal Oscillation (PDO), Northern Oscillation Index (NOI), and the Multivariate ENSO Index (MEI) and local environmental factors, such as upwelling, Ekman transport, and wind stress curl were related to observed changes in ichthyoplankton concentrations (based on generalized additive modeling) with lag periods ranging from zero to seven months for the various environmental variables. We found that the large-scale climate indices explained more of the variance in overall larval fish concentration and diversity, as well as that of the dominant taxa, than did the more local factors. Our results indicate that readily-available oceanographic and climate indices can explain variations in the dominant ichthyoplankton taxa in the NCC.

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513 Fish Biogeography, Pavilion East, Monday 27 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Justin Bagley

Brigham Young University, Provo, UT, United States

Phylogeography of the Knife-Edged Livebearer, *Alfaro cultratus* (Cyprinodontiformes: Poeciliidae), in Costa Rica

Alfaro cultratus are small, livebearing fish endemic to the Atlantic versant of Lower MesoAmerica (LMA) from Nicaragua to western Panama. Given theories that (i) LMA

fishes recently colonized the area following the Pliocene completion of the Isthmus of Panama, (ii) drainage basins limit dispersal of primary and secondary LMA freshwater fishes, and (iii) a regional basis for relationships among LMA fish faunas suggests similar processes have shaped patterns of species with similar distributions, we predicted inferring genetic signatures of colonization events would be possible. We present analyses of mitochondrial DNA phylogeography based on cytochrome b gene variation among *A. cultratus* throughout its range in Costa Rica. Molecular divergence time estimates date the time to the most recent common ancestor (T_{MRCA}) for the ingroup at 2.27 million ybp, suggesting *A. cultratus* colonized LMA around 700,000 years after the closing of the Isthmus of Panama. Phylogenetics and networks indicate two genetic breaks over the sampling area: one near Lake Arenal, a region of historical volcanism, and one along the eastern coastal plain. Mismatch distributions and metrics of population expansion based on coalescent simulations and NCPA results support a view of *A. cultratus* historical population fragmentation coincident with drainage boundaries, as well as the need for expanded sampling to distinguish between local population fragmentation and isolation-by-distance in central and eastern Costa Rican lowlands.

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801 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Justin Bagley, Lacey Nay, Jerald Johnson

Brigham Young University, Provo, UT, United States

Intraspecific life-history variation in the knife-edged livebearer, *Alfaro cultratus* (Cyprinodontiformes: Poeciliidae), from Costa Rica

Alfaro cultratus Regan 1908 is a small livebearing fish mainly distributed along coastal lowlands east of the Continental Divide in Nicaragua and Costa Rica. We examined intraspecific geographical variation in life-history traits among 455 wild-caught female A. cultratus sampled from 11 populations (mean 41 individuals/population) throughout its range in Costa Rica. Our analyses show A. cultratus are non-superfetating, carrying only a single brood at a given time. Overall, 36.70% of individuals possessed offspring, and the interpopulation frequency of gravid females ranged 0-72.72%. Estimated minimum size at sexual maturity was 26-27 mm SL based on 2 mm size classes. Overall number of offspring (mean 13.84, range 0-49) increased linearly with female SL. Reproductive allotment, defined as the percentage of total mass represented by brood mass, averaged 6.48% and ranged 21-fold across individuals, from 0.80% to 17.17% of female dry mass. Mean reproductive allotment showed considerably less interpopulation variation, exhibiting a 2.5-fold range (3.87%-9.87%) among populations with pregnant females. A. cultratus embryos increased approximately 26% in mean dry mass during development, indicating a matrotrophic pattern of maternal provisioning. Lack of organized patterns such as clinal variation among populations is consistent with genetic evidence for historical population fragmentation generated in our lab.

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438 Poster Session I, Exhibit Hall, Friday 24 July 2009

Kevin Bailey, Steven Porter, Susan Picquelle, Annette Dougherty

Alaska Fisheries Science Center, Seattle, WA, United States

Near Real-time Forecasts of Recruitment from Larval Surveys: Application to Walleye Pollock in the Western Gulf of Alaska

Late-larval stage abundances and sizes were measured at-sea and the data were input into a near real-time recruitment forecast model for walleye pollock (*Theragra chalcogramma*) in the western Gulf of Alaska. Larval abundances were weighted for size and temperature-dependent mortality; this weighting reflects the greater value of surviving larger larvae to the population and empirical temperature-mortality relationships. The at-sea method was applied to catches in 2007 and 2008 surveys showing the feasibility of attaining near real-time estimates. The accuracy of the method to forecast recruitment was evaluated from historical data, whereby larval abundances were compared to recruits. Raw unadjusted (without weighting for size) numbers reflected annual estimates of spawning stock biomass. Adjusting larval abundance for size and temperature-dependent mortality improves the trend with recruitment, but the relationship is marginally significant over the entire time series (1979 - 2005). Deconstructing the time series into segments to reflect decadal-scale changes in ecosystem structure improves the relationship. In the early segment (1979-91), size-weighted larval abundance was correlated with recruitment. The later segment (1992-2005), was not significantly correlated with recruitment. These results reflect increasing predation from groundfishes over the last decade and the decoupling of larval survival and recruitment. A forecast model was developed to account for mortality-related factors after the larval period. Based on low larval abundances and high numbers of predators, low to moderate year classes are predicted for 2004-08. Forecasting efforts need to consider changes in the community composition and ecosystem shifts, not just environmental factors during egg and larval life.

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396 Poster Session I, Exhibit Hall, Friday 24 July 2009

Kristin Bakkegard

Samford University, Birmingham, AL, United States

Genetics of Colonization in *Ambystoma gracile* after the 1980 Eruption of Mount St. Helens

With the increasing prevalence of amphibian declines, the ability of amphibians to recover from environmental disturbance is a major concern. I examined the effects of the 1980 eruption of Mount St. Helens on the genetic structure of three populations of *Ambystoma gracile* (Northwestern Salamander). Neotenes and larvae captured in ponds

formed by the eruption's landslide and colonized nine years later were classified as new populations. Recovery populations consisted of survivors and recolonists in lakes of the blowdown zone, impacted by the high heat and strong winds of the lateral blast. Reference populations were found in unimpacted lakes south of the volcano. I measured standard population genetics metrics using 4 microsatellite loci and 81 polymorphic AFLP loci. Based on the life-history characters of this species (low vagility and high philopatry), I predicted new populations would have less genetic diversity than recovering or reference populations. I also expected that all sites would show significant evidence of population structure because rugged topography would hamper movement of animals across the landscape. Both markers showed high levels of gene flow and low levels of genetic structure by collection site and treatment; within population variance by treatment was greater than 90% (AMOVA; P = 0.001). Microsatellites showed no evidence of isolation by distance (Mantel, r = 0.1873, P=0.1559). No loss of genetic variation in new populations and high gene flow across all sites was an unexpected result. The colonization ability of *A. gracile* and perhaps other species of ambystomatid salamanders has been underestimated.

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58 Herp Conservation III , Grand Ballroom II, Monday 27 July 2009

Harold Balbach, Elizabeth Keane

US Army ERDC, Champaign, IL, United States

Why do we Translocate Species-at-Risk, and do we Really Benefit the Species we Move?

Many herp species are officially listed as threatened or endangered at the state or Federal level, and many more are considered at-risk of being so listed, as are numerous fishes, mammals, birds, and plants. In Florida, tens of thousands of gopher tortoises (G*opherus polyphemus*) are proposed for relocation so they will not be killed on construction sites. This is one purpose for relocation. But how can we be assured that they will maintain themselves at their new sites? Frankly, we cannot. Based on those relatively few cases where there are adequate follow-up data, it may be possible in some situations. Should proposed relocations be subjected to closer scrutiny, especially with respect to the new habitat and proposed management and monitoring? The new Florida tortoise management guidelines certainly set a standard for this which has not been seen previously. What about other species? Other states? Does it make a difference if the purpose of the relocation was to re-establish an extirpated population, to extend the range, to create a harvestable population in a new location, or to supplement an existing population? These are all reasons used to justify relocations in one or another case. Are there special concerns relating to the life stage being utilized? Adults? Juveniles? Eggs? Is it of value to "head start" the animals to increase survival? These are some of the many aspects of translocation which are being examined, with special focus on the efficacy of this practice for many species at risk.

265 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Timothy Baldwin, Florence Chan, Yong Wang

Alabama A&M University, Huntsville, AL, United States

Methods for Predicting the Occurrence of Amphibians in Oak Hickory Forests along an Environmental Gradient in the Mid Cumberland Plateau

We investigated the relationship between landscape and habitat features and herpetofaunal species richness and abundance at the James D. Martin Skyline Wildlife Management Area, the Walls of Jericho, and Forever Wild Land Trust in the Cumberland Plateau of northern Alabama between 2005 and 2006. The study area was stratified based on landform and solar exposure. A total of 176 points were randomly selected. Line transect surveys, drift fences with pit-fall traps, pond surveys, and targeted and opportunistic searches were used to quantify the herpetofaunal community. Habitat variables were collected by the collaborators from Auburn University and the Land Division of Alabama Department of Conservation and Natural Resources. Landscape variables at each survey point were generated using remote sensing images, digital elevation models, Alabama Gap Analysis Project, and other spatial reference databases. A total of 2,307 animals were detected during the line transect surveys, including 26 amphibians and 21 reptiles species. The detection probability on the transect line was the highest for stream salamanders (30%) and the lowest for terrestrial and spring amphibians (both 20%). The amount of canopy cover, soil condition, amount of disturbance, and distance to the stream were the significant predictors of herpetofaunal species richness abundance. The land type composition analysis suggested that with the increase in deciduous forests, the herpetofaunal species richness and abundance increased, while developed space and agricultural land had a negative impact on herpetofaunal community. Recommendations for the herpetofaunal monitoring program and conservation at the study site and adjacent areas were provided.

975 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Zachary H. Baldwin[1]

[1]*American Museum of Natural History, New York, NY, United States,* [2]*Richard Gilder Graduate School, New York, NY, United States*

Population Genetics of the Bathypelagic Shining Tube-Shoulder, *Maulisia microlepis*, Along the Northern Mid-Atlantic Ridge (40°N – 60°N)

The studies of biogeography and population genetics of fishes in the meso- and bathypelagic have traditionally been limited by a paucity of both samples, and detailed environmental data. Recent biotic surveys (MAR-ECO project) along the northern portion of the Mid-Atlantic Ridge (MAR), however, have provided the samples necessary to test hypotheses of gene flow and biogeography. Two characteristics of the northern MAR make it particularly well suited to address such hypotheses: first, the Charlie Gibbs Fracture Zone (CGFZ), a major transversal feature where the southern ridge shifts 6°E from the northern ridge, represents a significant vicariant feature by which to test the effects of environment on gene flow; second, preliminary data on the reproductive ecology of a number of species suggest that the MAR may be an important feature for spawning, which has potentially significant implications for dispersal. The object of the present study is twofold: first, to test whether the CGFZ constitutes any sort of barrier to gene flow for populations along the northern MAR, using the shining tube-shoulder, *Maulisia microlepis* (Teleostei: Platytroctidae), as a model organism; second, by coupling these population data with environmental data, to assess what implications, if any, the observed genetic structure has for larval dispersal and pelagic biogeography. 157 fish from five populations along the northern MAR (40°N – 60°N) were sampled, and the mitochondrial DNA control region was sequenced for each. Sequence data is combined with detailed environmental and reproductive data.

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983 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Zachary H. Baldwin[1], John S. Sparks[1]

[1]*American Museum of Natural History, New York, NY, United States,* [2]*Richard Gilder Graduate School, New York, NY, United States*

Evolution of the Gas Bladder–Inner Ear Mechanical Linkage in Malagasy Cichlids

Malagasy and South Asian cichlids exhibit modifications of the ear, skull, and gas bladder, which create a direct mechanical linkage between the gas bladder and the inner ear. Variation in these structures suggests that hearing abilities have evolved and

diversified within this group of fishes. Using MRI scanning technology, we imaged the gas bladder–inner ear connection in 12 Malagasy species of the subfamilies Etroplinae and Ptychochrominae (Teleostei: Cichlidae). We map this morphology onto a well-corroborated phylogeny to reconstruct the evolutionary history of this unique sensory adaptation.

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957 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Trisann Bambico, Jason Turner, Karla McDermid

University of Hawai'i at Hilo, Hilo, HI, United States

Foraging Ecology of the Hawaiian Green Sea Turtle (*Chelonia mydas*) at Punalu'u, Hawai'i

Green sea turtles (*Chelonia mydas*), currently listed as threatened, appear to be in a state of recovery throughout the Hawaiian Archipelago, however, growth rates are decreasing at some localized areas. This project examined feeding ecology of green sea turtles at Punalu'u, Hawai'i to determine how their diet corresponds with algal abundance. Benthic algal surveys conducted bimonthly from March 2008 to January 2009 used the point intercept method. Algal samples were collected during surveys for identification and stable isotope analysis. Turtle tissue biopsies, stomach lavage contents, and turtle length and weight measurements were collected in cooperation with NOAA National Marine Fisheries Service during permitted research operations. Short-term and long-term feeding relationships were investigated. Carbon and nitrogen stable isotope concentrations of turtle tissue were analyzed to determine species composition of long-term diet. Stomach lavage samples were examined to determine what was consumed in recent feeding events. Benthic surveys showed that the red macroalgae, *Pterocladiella capillacea* and *Acanthophora pacifica* were the most abundant algae at Punalu'u. Furthermore, stomach lavage analysis revealed that *P. capillacea* was the most frequently consumed alga. Stable isotope analyses indicated that long-term diets remained consistent with *P. capillacea*, *A. pacifica*, and another red, *Polyopes hakalauensis* as the primary dietary components. Although isotope signatures of *P. capillacea* and *A. pacifica* varied significantly throughout sampling ($p<0.05$), signatures of recaptured green sea turtles changed significantly throughout the study ($p<0.05$), which reflected algal signatures. It appears that although variable, green sea turtle diets at Punalu'u correspond to algal species found in high abundance.

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930 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Barb Banbury[1], Michael Alfaro[2]

[1]Washington State University, Pullman, WA, United States, [2]University of California Los Angeles, Los Angeles, CA, United States

Can Ancestral Morphology Accurately Predict Ancestral Function?

Ancestral state reconstruction is commonly used in comparative studies to estimate both ancestral form and to infer functional or ecological properties based on reconstructed morphology. Often this is done in the absence of a functional model that explains the relationship morphology has to its emergent function. Here, we explore the extent with which we can infer ancestral function from theoretical traits as well as two case studies where the functional model is well understood. We compare two scenarios for reconstructing ancestral function: 1) ancestral morphology is estimated from tip morphology using ancestral state reconstruction and put into an equation to calculate ancestral function, or 2) ancestral function is estimated from known tip function using ancestral state reconstruction. We ask a broad question: does ancestral state reconstruction of the underlying morphology lead to correct inference of ancestral function? The results of both reconstruction methods were linearly regressed to assess accuracy; if ancestral morphology is a precise predictor of ancestral function we will see r2 values equal to one. We find that precision is based on the complexity of the mathematical model, and that the more complex the less likely functional values are to match. Our results urge caution when extrapolating function from ancestral form, and we believe that the same principle should be applied to many differing levels of design.

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559 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Ivy Baremore, Kate Andrews

National Marine Fisheries Service, Panama City, FL, United States

Propagating Measurement Error through the Calculations of Parameter Estimates

Fishery biologists often take several morphometric measurements of fishes to assess growth and other life history characteristics of a stock or population. Published age and growth studies, however, generally restrict the results of a growth model to one measurement, such as total length, with conversion equations included to calculate one length from another. Measurement error can be higher for some measurement techniques, and this error can affect the outcome of growth models, such as the von Bertalanffy growth equation. Furthermore, when life history parameters from these

models are then used as input for stock assessment, the error can be propagated. Length-at-age data from six species of sharks were used to determine if different length measurements (precaudal, fork, natural total, and stretched total) produced differing parameter estimates, specifically the k value, for the von Bertalanffy growth equation. Differences in the k values were detected among lengths for all six species, though the degree of difference varied by length measurement and species. Residual standard error of parameter estimates increased with increasing length measurement. The effect parameter estimate differences on the outcome of stock assessment were determined for two species of sharks: *Rhizoprionodon terraenovae* and *Carcharhinus acronotus*.

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815 Poster Session III, Exhibit Hall, Sunday 26 July 2009

William Barichivich[1], Daniel Calhoun[2], Alan Cressler[2], Melinda Dalton[2], William Hughes[2], Susan Walls[1]

[1]USGS FISC, Gainesville, FL, United States, [2]2USGS Georgia Water Science Center, Atlanta, GA, United States

Batrachochytrium dendrobatidis Surveillance in Great Smoky Mountains National Park: Implications for Environmental Monitoring of a Disease Pathogen

One of the leading hypothesized causes of global amphibian declines is disease, specifically that of chytridiomycosis. Understanding the life cycle of the aetiological agent, *Batrachochytrium dendrobatidis* (*Bd*), is key to developing a complete epidemiology of this disease. Considerable effort has focused on the detection of *Bd* in its amphibian host but until recently little was known about the temporal and spatial distribution of this pathogen in the environment. Herein we report the results of concurrent host and environmental sampling of Bd from Great Smoky Mountains National Park (GSMNP). In July 2008 we swabbed 166 amphibians (137 salamanders and 29 anurans) and filtered water (39 samples) from 13 sites (4 lentic, 3 lotic, and 6 cave systems). Polymerase Chain Reaction (PCR) failed to yield positive results from amphibian swabs but did support the presence of *Bd* (9.6 to 111.1 zoospore equivalents l^{-1}) in water filters from 7 of 12 sites sampled. This research is one of the few examples of simultaneous sampling of *Bd* in its host and the environment: the discordant results between water and biological samples underscore the need for caution in conducting environmental monitoring in the absence of a host context.

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942 Poster Session I, Exhibit Hall, Friday 24 July 2009

Brittany Barker[1], Javier Rodriguez[2], Robert Waide[1], Joseph Cook[1]

[1]University of New Mexico, Albuquerque, NM, United States, [2]University of Nevada Las Vegas, Las Vegas, NV, United States

Tests of Biogeographic Hypotheses for Diversification in the Puerto Rican Frogs, *Eleutherodactylus portoricensis* and *E. antillensis*: Integrating Distribution Models and Phylogeography

Little is known about how historical climatic events have shaped patterns of diversity in tropical islands of the Caribbean Sea. Using ecological niche models (ENMs) of historical climatic conditions and analyses of population genetic data, we tested alternative hypotheses of how two ecologically distinct species of frog in the Puerto Rican Bank responded to Late Pleistocene (21,000 ybp) climate change. *Eleutherodactylus portoricensis* (Mountain Coquí) is restricted to montane rainforest in Puerto Rico. *E. antillensis* (Red-eyed Coquí), a habitat generalist, has a widespread distribution that encompasses the entire Puerto Rican Bank. Paleodistribution models provided estimates of historical distributions and past barriers to gene flow. We tested models of population history with genetic data (555 bp of mtDNA for 140 individuals of each species). The paleodistributional model for *E. portoricensis* predicted increased suitable habitat during the Late Pleistocene, with populations in two disjunct mountain refugia: El Yunque and Cayey. Population genetic analyses and coalescent simulations of *E. portoricensis* data revealed historical population stability, high genetic diversity, and significant differentiation between these two hypothesized refugia. In contrast, the paleodistribution model for *E. antillensis* predicted highest habitat suitability in southern Puerto Rico, with the current ENM showing an increase of suitable habitat in northern regions. While signals of population expansion were recovered in the Cordillera Central and northern Coastal Lowlands, high genetic diversity across all regions provides little support for southern refugia. These findings improve our understanding of factors that promote population divergence and ultimately produce regional patterns of biodiversity in a neotropical island.

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249 Poster Session II, Exhibit Hall, Saturday 25 July 2009

April Barreca, Jason T. Irwin

Central Washington University, Ellensburg, WA, United States

Overwintering of the Cascades Frog in Washington

Cascade Frogs (*Rana cascadae*) are listed as "near threatened" by the World Conservation Union and are classified as a "species of concern" by U. S. fish and wildlife. An

understanding of the basic ecology and biology of this species is urgently needed for preventing their decline in the Pacific Northwest. This study hopes to add insight into the question of whether adequate overwintering habitat dictates the regional abundance of amphibians. Radio tracking methods are being used to monitor overwintering Cascades frogs at a wetland complex at 6000′ (1745m) in the Wenatchee National Forest near Blewett Pass. It is unknown where Cascades frogs spend the winter. Some frog species overwinter on the bottom of ponds that do not freeze completely, but other related species, like the Wood frog (*Rana sylvatica*) hibernate terrestrially. Data indicate that Cascades Frogs are not freeze tolerant and overwinter in a spring from November to April. Air temperatures remained below freezing from December through April while water temperatures remained above freezing at 1-3° C. Dissolved oxygen in the spring was moderate at 6.4-10 mg/L. Our data indicate that Cascades frogs need aquatic overwintering situations for survival.

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382 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Joni Barreda

University of West Florida, Pensacola, FL, United States

A Comparative Study of Thermal Tolerance in Air and Water for Five Species of Indo-Pacific Air-Breathing Fishes

Most fishes are ideal ectotherms incapable of maintaining body temperatures independent of their medium. Amphibious rock skippers (family Blenniidae) and mudskippers (family Gobiidae), however, move freely between air and water, exposing them to a unique set of thermal problems. Both families inhabit mangals of Hoga Island, Sulawesi, Indonesia, but exhibit different emergence patterns and spatial distributions. Mudskippers emerge during day and night low tide events where they encounter extreme shifts in air temperature. In addition, common mudskippers, *Periophthalmus kalolo*, exploit exposed mangal mudflats, whereas barred mudskippers, *P. argentilineatus*, prefer shaded upper mangal zones. Conversely, rock skippers are distributed in all mangal zones, but leave pools only at night when air temperatures cool. We hypothesize that differences in spatial and temporal habitat utilization are supported by divergent aerial and aquatic thermal tolerance patterns. Using Critical Thermal Methodology, high temperature tolerances were determined for three rock skipper and two mudskipper species. Significant interactions between species and media for both critical thermal maximum, and for escape response, confirm rock skippers are more tolerant of high water temperatures and attempt escape at significantly higher temperatures than mudskippers ($p<0.0001$ and $p=0.0147$, respectively). All rock skippers demonstrated significantly higher thermal tolerance values in water than air ($p<0.0001$). Thermal tolerance of common mudskippers did not differ significantly between media ($p=0.0407$); however, barred mudskippers exhibited higher thermal tolerances in air than in water ($p=0.0013$). These data are consistent with observed diel

emergence and distribution patterns and are likely adaptive strategies allowing these syntopic fishes to partition mangal resources.

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520 Lizard Ecology, Pavilion East, Friday 24 July 2009

James Barron

Montana State University - Billings, Billings, Montana, United States

Population Ecology of the Short-horned Lizard, *Phrynosoma hernandesi*: Results from Five Summers of Fieldwork in Southern Montana

Phrynosoma hernandesi, though listed as a Species of Concern by Montana Fish, Wildlife and Parks, has never been studied in detail in Montana. I present the results of five summers of fieldwork on one population in southern Montana. From 2004 through 2008, 555 individuals were marked with PIT tags, including 84 females that gave birth in the lab (9 in two different years). Age structure oscillated among years with juveniles outnumbering adults in even-numbered years, and adults dominating odd-numbered years. Sex ratio was 1:1 at birth, but by adulthood females outnumbered males 2.3 to 1. Concordantly, male mean survival rates across years were less than half that of females, though age and sex-specific survival rates differed among the five years of the study. Location data from recaptures across years indicates that males move significantly greater distances than females, especially during the breeding season (early May). Litters are produced in late July or early August, and neonates immediately begin feeding and grow substantially prior to winter dormancy. In the next summer (the first full summer) juveniles grow quickly, reaching adult size by August. Both sexes mature and breed in their second full summer, with females producing their first litter on about their second birthday. All reproductive traits (litter size, total litter mass, offspring size (length and mass), and relative clutch mass) varied across years, but in a somewhat explainable fashion, related to resource availability in the previous year.

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966 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Henry Bart[1], Richard Mayden[2], Robert Wood[2], Andrew Simon[3], Kenji Saitoh[4], Masaki Miya[5], Mutsumi Nishida[6], Paulette Reneau[1], Wei-Jen Chen[2], Kevin Tang[2], Tetsuya Sado[5], Michael Doosey[1], Lei Yang[2], Vincent Hirt[3], Mary Agnew[2]

[1]Tulane University, New Orleans, LA, United States, [2]St. Louis University, St. Louis, MO, United States, [3]University of Minnesota, Saint Paul, MN, United States, [4]National Research Institute of Fisheries Science, Kanazawa, Yokohama, Japan, [5]Natural History Museum and Institute, Chuo, Chiba, Japan, [6]University of Tokyo, Nakano, Tokyo, Japan

Cypriniformes Tree of Life: Phylogenetic Informativeness of Amino Acid Substitutions and Protein Structure Changes in Four Nuclear Genes for Inferring Relationships of Cypriniform Fishes

A recent phylogenetic analysis of four protein-coding nuclear genes (GH, RAG1, RH and IRBP2), involving both un-weighted and down-weighted 3rd position substitutions, resolved phylogenetic relationships among 49 cypriniform fishes with similar topology, but measurably less homoplasy, than a considerably larger mitogenome dataset. However, topologies were not resolved consistently in the two different character-weighting schemes of the nuclear genes. Here we examine phylogenetic relationships inferred from a dataset of amino acid substitutions in the four nuclear genes for the same group of cypriniform fishes, a more conservative analysis than down weighting substitutions in the 3rd codon position. We use a Maximum Parsimony optimality criterion and show amino acid changes as character support for nodes on the tree. We discuss the phylogenetic informativeness of protein structure changes implied by amino acid substitutions in the nuclear genes and compare this to implied structural changes in mitochondrial NADH dehydrogenase.

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734 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Jonathan Baskin

California State Polytechnic Univeristy Pomona, Pomona, CA, United States

Review of the Psammophilic Trichomycterid Catfishes-Sarcoglanidine/Glanapterygine Clade

The exclusively Neotropical family Trichomycteridae, the "parasitic" catfishes, with more than 200 species, is known for its extremes of habit and habitat. Almost all are substrate oriented species. Two subfamilies, the sister-groups Glanapteryginae and Sarcoglanidinae, show a clear evolutionary trend within each toward a psammophilic habit. This culminates in each with species that appear to live exclusively in the sand substrate of the Orinoco-Amazon and Essequibo systems. These are *Typhlobelus* (4

species), *Pygidianops* (3 species) and perhaps *Glanapteryx* (2 species) comprising a monophyletic group of the Glanapteryginae, and *Sarcoglanis simplex* and *Malacoglanis gelatinosus*, terminal sister taxa of the Sarcoglanidinae. Other more basal species of both subfamilies occur outside the Amazon-Orinoco and Essequibo systems and appear to prefer a leaf litter habitat. These are *Listrura* of the Glanapteryginae (4 species in Southern Brazil) and *Microcambeva* of the Sarcoglanidinae (2 species in Southern Brazil). This may suggest a southern brazilian origin of the glanapteryine-sarcoglanidine clade. The distribution, relationships and habits of these often tiny, blind and pigmentless species is reviewed. Included also is consideration of an undescribed species of *Stenolicmus* from the Essequibo, a basal sarcoglanidine genus previously known only from Bolivia.

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553 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Frederic Bastian, Marc Robinson-Rechavi

Universite de Lausanne, Lausanne, Switzerland

Bgee: Integrating Ontology and Homology for the Study of Gene Expression Evolution

The study of the evolution of developmental processes (evo-devo) has shown that the primary source of change in the evolution of phenotypes is changes in gene expression. Comparing gene expression patterns between animals thus is a major step to understand their evolution. This approach requires dedicated bioinformatics tools to perform high throughput analyses. Thus we have developed Bgee, a database designed to compare expression patterns between animals, by implementing ontologies describing anatomies and developmental stages of species, and then designing homology relationships between anatomies and comparison criteria between developmental stages. To define homology relationships between anatomical features we have developed the software Homolonto, which uses a modified ontology alignment approach to propose homology relationships between ontologies. Bgee then uses these aligned ontologies, onto which heterogeneous expression data types are mapped. These include microarrays, in situ hybridization, and ESTs, from human, mouse, xenopus and zebrafish. Bgee is available at http://bgee.unil.ch/

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726 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Javan Bauder[1], Holly Akenson[2], Charles Peterson[1]

[1]Idaho State University, Pocatello, ID, United States, [2]University of Idaho, Moscow, ID, United States

Movements of Prairie Rattlesnakes in a Mountainous Landscape in Central Idaho

Although Prairie Rattlesnakes (*Crotalus viridis*) are known to make lengthy movements from communal hibernacula to summer foraging habitat, it is largely unknown how these patterns are influenced by mountainous topography. The goal of this study is to characterize rattlesnake movement patterns in a mountainous landscape and determine how these patterns are influenced by topography. We used radio telemetry to monitor the movements of 20 Prairie Rattlesnakes in the Frank Church Wilderness in central Idaho during May - September 2008 and conducted our analyses within a GIS. Mean total distance moved was 4.66 kilometers; mean maximum distance moved from the hibernaculum was 1.45 kilometers. Rattlesnake movement segments (between consecutive telemetry points) could be classified as outbound migration, core area, mate searching, and inbound migration movements. Migration movements were characterized by a small number of rapid, lengthy movements along a relatively fixed bearing. Migration was interrupted by the establishment of one to three core areas, characterized by shorter, low directionality movements related to foraging, digestion, or shedding. Rattlesnakes moved across a wide range of topographic features including ridges, steep slopes, creeks, and rivers. Model selection analysis indicated that rattlesnakes were somewhat restricted by topography within a three kilometer buffer around the hibernacula while this restriction was less evident at the scale of the home range. Although the movement distances observed in this study where generally less than those reported from studies in areas with less topographic relief, rattlesnakes are still capable of making extensive linear movements in mountainous landscapes.

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572 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Aaron Bauer[1], Colin McCarthy[2]

[1]Villanova University, Villanova, PA, United States, [2]The Natural History Museum, London, United Kingdom

Darwin's Amphibians and Reptiles

Charles Darwin collected at least 270 specimens of amphibians and reptiles in the course of the voyage of the *Beagle* (1832-1836). The majority of these were spirit-preserved and

numbered with stamped metal tags. In addition, a small number of dry preparations of Galapagos iguanas and tortoises were also returned to England by Darwin and the officers of the *Beagle*. Information about Darwin's herpetological specimens was recorded in his *Zoology Notes*, in the so-called *Down House Notebooks*, and in an archival manuscript, "Reptiles in Spirits of Wine." Although some identifications were made by Darwin himself, most material was examined and determined by Thomas Bell, who authored the herpetological portions of the Zoology of the Beagle (1842-1843). Bell treated only some of the more interesting species of frogs and lizards in Darwin's collection and sent most of the snake material to Paris for identification by Gabriel Bibron. About 175 specimens from the *Beagle* are listed in the registers of The Natural History Museum, London. Some of these were donated as early as 1837 and others were not received until the 1850s, but most entered the collections in 1845, after Bell had completed his work with them. About 130 of these specimens, including the types of a number of species, have been located in the collections in London. Another ten *Beagle* specimens, presented by Bell, are present in the Muséum National d'Histoire Naturelle in Paris. The whereabouts of the remaining ~130 specimens, including the snakes sent to Bibron, remains unknown.

1010 Herp Systematics, Pavilion West, Thursday 23 July 2009

David Beamer, Trip Lamb

East Carolina University, Greenville, NC, United States

A Comprehensive, Range-wide Molecular Phylogenetic Survey of the Dusky Salamanders (*Desmognathus*)

The most recent phylogenetic treatment of dusky salamanders (*Desmognathus*) identified 35 independent lineages, which suggests the current taxonomy (20 nominal species) greatly underestimates actual species-level diversity. Moreover, the geographic distributions of these lineages are poorly known and, as a result, potential interactions at contact zones-which could help establish taxonomic resolution among lineages-remains obscure. To address this issue, we implemented a comprehensive sampling design that involved surveying all Level IV ecoregions within each independent river drainage across the range extent for the entire genus. To assure correct species assignments, we collected topotypes for all currently recognized species as well as for most synonyms. In total we sampled over 500 populations, and present here the results of a phylogenetic reconstruction based on 2,000 bp's of mtDNA. We describe the distributions for the independent lineages we uncovered, discuss the taxonomic implications of our phylogenetic reconstruction, and identify areas for future systematic research on *Desmognathus*.

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130 Herp Physiology, Galleria North, Monday 27 July 2009

Steve Beaupre[1], Frederic Zaidan, III[2]

[1]University of Arkansas, Fayetteville, AR, United States, [2]University of Texas, Pan American, Edinburg, TX, United States

On Estimating the Cost of Growth in Timber Rattlesnakes (*Crotalus horridus*): Feeding Trials, Field Metabolism, and the Role of SDA

Understanding energy balance requires robust estimates of the metabolic cost of growth (R_G). R_G is defined as the increase in metabolism of a growing animal due to the cost of biosynthesis (new biomass excluded). We utilized data from feeding trials and from field metabolic rate (FMR) studies to estimate R_G in Timber Rattlesnakes. Forty one field metabolic rates from growing snakes were derived from doubly-labeled water studies. Multiple regression analysis using the non-linear model $FMR=aW^b+cG$ (where W= weight, G=growth in g d^{-1} wet mass) yielded non-significant fit and biologically unreasonable estimates of R_G. Timber Rattlesnakes may not fit the assumptions required to estimate R_G using FMR data. Data from feeding trials (where consumption (C), fecal losses (F), uric acid production (U), specific dynamic action (SDA), resting metabolism (M), and growth (G) were known for 79 snake trials) were used in two ways. First, the data set was used to relate available production energy to new tissue, yielding an estimate of R_G=2.9 kJ g^{-1} dry. Second, a subset (n=28) of efficient growers yielded a sample-wise average expenditure per gram dry mass estimated at R_G=10.5 kJ g^{-1} dry. For our data, realistic estimations of R_G required inclusion of SDA as cost of growth, which is consistent with recent discussions of SDA as a major component of R_G. Our estimates of R_G bracket the range of values reported for animals.

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146 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Christine Bedore, Stephen Kajiura

Florida Atlantic University, Boca Raton, FL, United States

Electrosensitivity and Pore Distribution in the Cownose Ray (*Rhinoptera bonasus*)

Among elasmobranch fishes, the cownose ray, *Rhinoptera bonasus*, possesses a unique bilobed head morphology with paired extendable cephalic lobes on the ventral surface of the head. These cephalic lobes are extended to closely contact the substratum as a ray searches for benthic prey, which may confer an electrosensory advantage during prey detection and localization. We tested this hypothesis by quantifying the pore distribution and sensitivity of *R. bonasus* to prey-simulating electric stimuli. Results were compared to a more conventionally shaped ray, the Atlantic stingray (*Dasyatis sabina*).

The cownose ray had an average of 689.6 ± 19.8 pores combined on the dorsal and ventral surfaces, while the Atlantic stingray had an average of 570.6 ± 40.8 pores combined, both with a high proportion of these pores on the anterior ventral surface. A large number of these pores occurred on the cephalic lobes in *R. bonasus*, while the distribution was more widespread in *D. sabina*. To select an appropriate bio-electric stimulus to simulate in the lab, the electric fields of the Eastern oyster (*Crassostrea virginica*) were measured. *R. bonasus* demonstrated a sensitivity of 7.5 nv cm-1 to simulated bioelectric fields, similar to reported values for the Atlantic stingray. Despite a lack of differences in electrosensory sensitivity, differing pore quantities and distribution patterns may provide the cownose ray with an enhanced sensory mechanism for benthic prey detection and localization by placing electroreceptors in direct contact with the substratum where potential prey items are located.

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488 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Mark Belk, Jerald Johnson, Bruce Schaalje

Brigham Young University, Provo, UT, United States

Life History Variation Within Poeciliid Species Does Not Predict Variation Among Closely Related Species

Characterizing patterns of variation in life history at multiple taxonomic scales provides a mechanism for understanding changes in life history over the course of speciation. Poeciliids provide a model system for exploring life history variation at multiple taxonomic scales because there are many closely related species with abundant populations that occur in a variety of environments. We use four species of the genus *Brachyrhaphis* to ask the question does variation observed among individuals and populations within a species predict the major axis of variation among species? Among individuals and among populations within a species the major axis of life history variation coincides with that expected from a gradient of resource availability - i.e., positive relationships among body size, egg size, clutch size and reproductive allocation. However, among species the major axis of variation coincides with that expected from variation in mortality rate (i.e., predator regime). Classic trade-offs between life history traits (e.g., egg size and number, and female body size and reproductive allocation) are evident mainly at the among species level. We suggest that this difference in life history variation among scales is a response to the relatively consistent variation in predator regime compared to the spatially and temporally variable nature of resource availability.

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526 Poster Session I, Exhibit Hall, Friday 24 July 2009

Martin Benavides[1], Phaedra Doukakis[1], Ellen Pikitch[1], Cecilia Bartholomew[2], George Amato[2], Demian Chapman[1]

[1]Stony Brook University, Stony Brook, NY, United States, [2]American Museum of Natural History, New York, NY, United States

Shark Diversity, Population Demographics and Fisheries at Turneffe Atoll (Belize) Assessed with Field Surveys and DNA Barcoding of Fishery Products

Turneffe atoll (Belize) is the largest and most productive of the three atolls of the Mesoamerican Barrier Reef, the world's second largest barrier reef ecosystem, yet it is the only one without a marine protected area (MPA). Because of this lack of protection and it's close proximity to Belize's major population center, most of Turneffe's commercially exploited marine species, including sharks, are exposed to significant fishing pressure. Managing these shark fisheries will be impossible without a better understanding of which species and life stages occur at the atoll and in the fishery. Our goal was to characterize shark biodiversity, demographics and fisheries for the first time at Turneffe atoll. We first employed a fishery-independent longline survey to assess shark species diversity, relative abundance and demographic composition. We then convinced local gillnet shark fishermen to provide us with whole, dried anal fins from every shark they captured over two years, for genetic species-identification and regression of approximate body size of each shark captured. More than 300 sharks were sampled as part of these two initiatives, revealing that at least 9 shark species utilize Turneffe atoll, especially nurse sharks(*Ginglymostoma cirratum*) and Caribbean reef sharks (*Carcharhinus perezi*). These and at least three other sharks species breed at this location, including the scalloped hammerhead shark (*Sphyrna lewini*) a species listed as "Endangered" by the International Union for the Conservation of Nature. These findings reveal that Turneffe atoll provides critical, yet unprotected, habitat for several exploited shark species.

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585 Snake Ecology, Pavilion East, Monday 27 July 2009

David Bender[1], William Stark[1], Raymond Lee[2]

[1]Fort Hays State University, Hays, Kansas, United States, [2]Washington State University, Pullman, Washington, United States

Population Characteristics and Diet of Western Massasauga in Central Kansas with Inferences from Stomach Contents and Stable Isotopes

Western Massasaugas (*Sistrurus catenatus tergeminus*) occur in both wetland and grassland macrohabitats in Kansas. We compared size structure, diet, and stable isotope

ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in a grassland (n = 36) and a wetland (n = 105) in central Kansas. In the wetland, Western Massasaugas were larger than in the grassland (MANOVA: wetland, n = 82; grassland, n = 32; Wilk's $\lambda > 0.00$, SVL: $F_{1, 113} = 9.488$, $P = 0.003$; M: $F_{1, 113} = 15.993$, $P < 0.001$). Stomach contents revealed that wetland snakes fed on small mammals (n = 15) (75%) and snakes (n = 5) (25%); whereas grassland prey items included mammals (n = 2) (16%), snakes (n = 4) (33%), lizards (n = 5) (42%), and a centipede (n = 1). Stable isotope signatures of Western Massasaugas in the wetland (n = 47) were enriched in $\delta^{15}N$ (x = 11.5) and depleted in $\delta^{13}C$ (x = -21.2) relative to the grassland snakes (n = 15) $\delta^{15}N$ (x = 6.9) and $\delta^{13}C$ (x = -19.1) (MANOVA: Wilk's $\lambda > 0.01$, $\delta^{13}C$: $F_{1, 56} = 9.228$, $p = 0.004$; $\delta^{15}N$: $F_{1, 56} = 103.28$, $p < 0.001$). In addition, stable isotope analysis in R revealed an ontogenetic shift in diet from a diverse or generalized diet in young animals to a specialization or reliance on *Microtus ochrogaster* in the wetland. In the grassland, no diet shift or specialization was detected with age or size class. These results suggest that wetlands might support higher quality populations in Kansas.

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464 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Amanda Bennett, Matthew Keevil, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

The Effects of Habitat Fragmentation on Demography and Gene Flow in Northern Map Turtles (*Graptemys geographica*) on the Trent-Severn Waterway, Ontario, Canada

Habitat fragmentation is one of the leading causes of reptile declines worldwide. The Trent-Severn Waterway (TSW) is a 386 km navigational route linking Lake Ontario to Georgian Bay via a series of 44 locks and over 100 dams. Northern Map Turtles (*Graptemys geographica*) are highly aquatic, freshwater turtles, listed as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada. We hypothesized that the locks and dams on the TSW are fragmenting Northern Map Turtle habitat, and predicted that populations would have lower densities and altered sex ratios in fragmented sites (areas bounded by locks and dams) compared to contiguous control sites. Population density and sex ratios were determined using mark-recapture data from two field seasons (May - August 2007 and 2008). Population density varied between sites, and sex ratios were significantly female biased (1 male : 1.81 females) in the fragmented habitats. We also found that turtles in fragmented habitats were significantly smaller and had reduced growth rates compared to control populations. We predicted that Map Turtles would have reduced genetic diversity in the fragmented sites. Tissue samples were collected from turtles (N=146) in reaches separated by locks and dams along the waterway. Mean heterozygosity, gene flow, and population structure are being estimated using five polymorphic microsatellite loci. It is evident that Northern Map Turtle populations are affected by fragmentation from the locks and

dams, although further research is necessary to determine what these effects mean for the long-term persistence of these populations.

1030 Fish Behavior, Parlor ABC, Monday 27 July 2009

Zehev Benzaken[1], Kevin Warburton[2], Bronwen Cribb[2]

[1]Amazonas State University, Manaus AM/Brasil, Brazil, [2]University of Queensland, Brisbane Australia, Australia

The Tale of the Two Shoals: How Individual Experience Influences Shoal Behavior

This project examined how the spatial behaviour and cohesion of rainbow fish (*Melanotaenia duboulayi*) shoals are affected by the contrasting previous experience of individual shoal members. The main variables considered were: overall group size, the time since group members were exposed to a positive (food) or negative (threat) experience, and the proportions of shoal members having the two types of experience. The food and threat stimuli were introduced close to a habitat patch, to which fish were normally attracted. Shoals of two fish were exposed to food or threat for thirty minutes. Their behaviour was then recorded in twenty- minute trials after different lengths of time had elapsed since exposure (0, 1, 24 and 48 hrs). Shoals made up of different combinations of food-exposed and threat-exposed fish were used (0+2, 1+1, 2+0). Two fish shoals continued to use the patch, possibly because of a protection trade-off where for a small group the refuge benefits of the patch outweighed the perceived risks associated with open water, or because of lower efficiencies in terms of learning and mutual reinforcement in small shoals. I will propose several experiments to answer these questions that remained unanswered such as the protection trade-off by remaining at the patch and the learning deficiency of small shoal. With this talk I hope to promote discussion of how to answer these unresolved questions.

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751 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Peter Berendzen[1], Alexandra DeWitt[1], Brian Barber[2]

[1]University of Northern Iowa, Cedar Falls, IA, United States, [2]American Museum of Natural History, New York, NY, United States

Test of Simultaneous Diversification of Central Highlands Fishes East and West of the Mississippi River

The Mississippi River is the primary center of diversity and distribution of freshwater fishes in eastern North America. Most of this diversity exists in the Central Highlands,

which are a series of isolated highland areas formed by climatic oscillations during the Pleistocene. There is a replicated pattern of distribution of fishes inhabiting these areas. One distinct pattern is the divergence between populations of widespread species and closely related species groups distributed east and west of the Mississippi River. The Mississippi River is recognized as a long-term stable refuge during glaciation and dispersal route during following glacial retreat. This study examines the temporal nature of diversification of fishes across the Mississippi River to test the hypothesis that vicariant events associated with glacial cycles and fluctuating sea levels lead to this pattern. Sequence data from the cytochrome b mtDNA gene from nine Central Highlands fish taxa were analyzed using Approximate Bayesian Computation implemented in MSBAYES to test hypotheses of diversification across the Mississippi River in eastern North America. Preliminary results will be presented.

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884 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Diego Bernal[1], Scott Aalbers[2], Chugey Sepulveda[2]

[1]University of Massachusetts Darmouth, Dartmouth, MA, United States, [2]Pfleger Institute of Environmental Research, Oceanside, CA, United States

The Role of the Caudal Fin in the Common Thresher Shark, It's Not Just for Swimming

Threshers are a monophyletic group of pelagic sharks most commonly recognized by an elongate upper lobe of the caudal fin, which reaches a length equal to that of the trunk of the body. It has been hypothesized that threshers utilize the elongate fin to stun small-schooling prey while feeding. The bi-functional role of the caudal fin for both thrust production and predation represents a unique adaptation among elasmobranchs. Despite the commercial and recreational importance of the threshers, there are no published accounts on how the caudal fin is used during feeding. The objectives of this study were to 1) acquire video footage of feeding threshers, 2) examine the caudal fin morphology, and 3) to investigate the ocular morphology and potential range of eye movement. Of the 140 specimens captured and released, only 3% were hooked in the mouth and the remainder in the caudal fin. Video of free-swimming threshers yielded footage from 20 sharks showing the use of the tail during the feeding event. Morphological examination of the caudal fin revealed that the upper lobe is predominantly comprised of tendinous and cartilaginous support tissues and has both aerobic and anaerobic muscle fibers throughout its entire length. In general, the structural architecture of the thresher caudal fin is similar to that of lamnid sharks, but with much larger dorso-ventral cartilaginous support elements. Preliminary findings show that the eye has the capacity to rotate along the longitudinal within the orbit which may enhance vision in the posterior field.

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874 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Diego Bernal[1], Douglas Syme[2], Jeanine Donley[3], Scott Aalbers[4], Chugey Sepulveda[4]

[1]University of Massachusetts Dartmouth, Dartmouth, MA, United States, [2]University of Calgary, Calgary, Alberta, Canada, [3]Miracosta College, Oceanside, CA, United States, [4]Pfleger Institute of Environmental Research, Oceanside, CA, United States

Adaptations for Continuous Swimming: Functional Morphology of the Locomotor Muscles in Thresher Sharks

Threshers are a group of large, pelagic sharks easily recognized by their elongate upper caudal lobe and are the only genus with species having either a subcutaneous (lateral) or medial (internal) position of the red aerobic locomotor muscle (RM). This provides an ideal system in which to test the hypothesis that the medial RM position in the common thresher (*Alopias vulpinus*) provides the basis for a propulsion mechanism similar to that found in the lamnid sharks and different from that of sharks with a more lateral position of the RM such as the other two threshers (*A. superciliosus* and *A. pelagicus*). This study quantified the in-vivo muscle dynamics during sustained swimming in the RM and white muscle (WM) of 12 common threshers swimming in the wild. At a tailbeat frequency of 0.5Hz, RM strain (at first dorsal fin) was consistently greater than that of the WM and decreased significantly during simulated swimming movements (RM not activate; passive swimming). By contrast WM strain did not differ between active and passive swimming. A comparison of RM and WM shortening phase during swimming showed instances in which RM shortening both led and trailed that of the surrounding WM, with no phase difference observed during the passive swimming experiments. This finding suggests that, similar to lamnid sharks, the common thresher RM sheers relative to the WM. Therefore, these results suggest that the common thresher may exhibit a similar uncoupling of RM shortening and local body bending as seen in the thunniform lamnids.

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10 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Tim Berra

The Ohio State University, Mansfield, OH, United States

Charles Darwin: The Man and his Accomplishments

Charles Darwin is often considered the most influential scientist who ever lived because the theory of evolution is one of the most powerful ideas in science and may well be the greatest idea ever had by the human mind. His message of descent with modification

through natural selection presented in 1859 precipitated a paradigm shift. Darwin changed the way humans view their place in nature. Darwin drew the first evolutionary tree showing the relatedness of all animal life (1837). He explained how coral reefs form (1842) and contributed to geological observations on earth movements (1844) and the deformation theory of metamorphic rock (1846). He described all known barnacle species, fossil and living (1851-1854). Darwin explained how orchids are fertilized by insects (1862) and how plants climb (1865). He introduced the "control" in "controlled experiment" and he catalogued the variation in domestic plants and animals (1868). He explained human origins and sexual selection in ways never before articulated (1870-71), and discussed human and animal emotions (1872). The latter work was one of the first books to use photographs. Darwin showed how insectivorous plants growing on impoverished soils utilize nitrogen-rich insects (1875), and he demonstrated that the offspring of cross-fertilized plants were more numerous and vigorous than self-fertilized ones (1876, 1877). His observations of climbing plants laid the foundation for the field of plant growth hormones (1880), and his work on earthworms (1881) is a classic study in ecology. Any one of these achievements could constitute a life's work for most scientists.

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159 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Michael Berumen[1], Serge Planes[2], Geoff Jones[3], Glenn Almany[3], Simon Thorrold[1]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA, United States, [2]University of Perpignan, Perpignan, France, [3]James Cook University, Townsivlle, QLD, Australia

Connectivity and Self-recruitment of Coral Reef Fishes in a Marine Reserve Network in Kimbe Bay, Papua New Guinea

The scale of larval dispersal of marine organisms is important for the design of networks of marine protected areas. We examined the fate of coral reef fish larvae produced at several small island reserves in a network of reserves throughout Kimbe Bay, Papua New Guinea. We assessed larval dispersal and self-recruitment using several methods, including mass-marking larvae via maternal transmission of stable isotopes to offspring, parentage analysis using microsatellite markers, and natural markers in the elemental composition of otoliths in known-origin larvae. Using both a pelagic spawning fish with a long (>1month) pelagic larval duration and a benthic spawning fish with a short (<2 weeks) PLD, we found that local retention ("self-recruitment") appears to be relatively high at our study sites, with typically 50-60% of newly settled larvae having natal origins at the same site. However, we are also able to document dispersal events among the marine reserves in the Kimbe Bay network. Empirical measurements of dispersal and connectivity will be critical to inform and test the coupled-biophysical models of larval dispersal dynamics necessary for effective marine reserve designs.

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349 Poster Session I, Exhibit Hall, Friday 24 July 2009

Dana Bethea[1], Alicia LaPorte[1], Mark Grace[2]

[1]NOAA Fisheries SEFSC Panama City Laboratory, Panama City, FL, United States, [2]NOAA Fisheries SEFSC Mississippi Labs, Pascagoula, MS, United States

NOAA Southeast Fisheries Science Center Elasmobranch Tagging Management System

The Panama City Laboratory and Mississippi Laboratories of the NOAA Southeast Fisheries Science Center (SEFSC) and our Gulf of Mexico State Shark Pupping and Nursery survey (GULFSPAN) collaborators have tagged over eleven-thousand elasmobranchs in the Gulf of Mexico and southeast Atlantic Ocean since 1996. Elasmobranchs are tagged with dart-like or loop tags inshore through the GULFSPAN survey, offshore via fishery-independent surveys on NOAA research vessels, and commercial vessels carrying an observer. Elasmobranches are also being tagged with satellite pop-off tags and acoustic tags. Recognizing the need to standardized data collection, we developed an elasmobranch tagging management system for the SEFSC. The ultimate goal of the database is to provide managers, researchers, and the public involved in elasmobranch tag and recapture in the Gulf of Mexico and southeast Atlantic Ocean with a system to enter and process elasmobranch tag and recapture data. Capture and recapture data include: date, time, and location (latitude and longitude) of capture, gear and bait type used as well as specific abiotic conditions such as temperature, salinity, dissolved oxygen, and turbidity. We plan to have the database fully searchable for NOAA researchers and collaborators by April 2009 and online for public use January 2010.

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879 Fish Ecology I, Pavilion East, Friday 24 July 2009

Maria Elina Bichuette[1], Eleonora Trajano[2]

[1]Universidade Federal de Sao Carlos, Sao Carlos, Sao Paulo State, Brazil, [2]Universidade de Sao Paulo, Sao Paulo, Sao Paulo State, Brazil

Ecological Data for Brazilian Subterranean catfishes, the Case of *Glaphyropoma spinosum* (Siluriformes: Trichomycteridae: Copinonodontinae)

Copionodontine occur exclusively in the Chapada Diamantina, a vast plateau composed of Proterozoic terrain in Bahia State, northeastern Brazil. We present herein population data for *Glaphyropoma spinosum*, from subterranean waters in the Diamantina Plateau (Torras Cave). This is the first subterranean species of Copionodontinae catfish registered for Brazil, which presents a high diversity of cave fishes (24 species). Population data based on visual censuses were obtained in January and July of 2007 and

in July of 2008 corresponding respectively to one rainy (January) and two dry seasons (July). In a 150 m of long stream reach and 1 m of width, 61 individuals were registered in January; 59 in July of 2007 and 64 in July 2008. Population densities were, respectively, 0.41 ind.m^{-2} (January 2007); 0.39 ind.m^{-2} (July 2007) and 0.43 ind.m^{-2} , indicating little if any seasonal oscillations in population data. Population densities are considered medium for cave fish standards. These catfishes are relatively sedentary, with most individuals concentrated in quiet isolated pools. The estimated mean densities are close to that observed for other subterranean tricomycterids from Brazil, genus *Ituglanis*. Therefore, the notion of low population densities as characteristics of subterranean organisms does not apply to *G. spinosum*, possibly because their food is not as limiting as usual for subterranean populations. The subterranean course extends for another 2,000 meters downstream, where the population is distributed. This cave was heavily impacted by diamond mining in the past, starting in the middles of 1,800's and extended to the early 1990s.

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949 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Eric Billman

Brigham Young University, Provo, UT, United States

Life History and Population Dynamics of an Introduced Population of *Gambusia affinis* in Utah

Seasonality in environmental conditions has significant effects on the life history of *Gambusia affinis* within its native range. As a result of the ability to adjust its life history, *G. affinis* is able to successfully establish populations in different and often harsh environments in which it has been introduced. We quantified population dynamics and life histories of female *G. affinis* in Utah Lake, Utah, in 2008 to determine the effects of a highly seasonal environment on this introduced population. Reproduction occurred over a shorter period (May until September) compared to populations in its native range. In early summer, the population was represented by females that had over-wintered and may or may not have reproduced in the previous summer. By mid-August, these females had died. By mid-July early-reproducing young-of-year (YOY) were found abundantly in the population. Based on a 28-day gestation period, we predict that over-wintered females could have 2 - 4 clutches, while YOY could have 0 - 3 clutches depending on when they were born. Females that overwintered had high fecundity consistent with the life history theory prediction that females should allocate more to reproduction when probability of survival is low (late in adulthood). Young-of-year females followed a pattern of high fecundity at first reproduction followed by decreased fecundity later in summer. This pattern may be the result of high initial allocation due to the uncertainty of survival through winter, and decreased late allocation to increase probability of survival through winter or due to low probability of offspring survival.

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435 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jose Birindelli, Leandro Sousa

MZUSP, São Paulo, SP, Brazil

New Species of *Leptodoras* (Siluriformes: Doradidae) from Rio Fresco, Xingu Basin, Brazil

A new species of thorny catfish genus *Leptodoras* Boulenger (Siluriformes: Doradidae) is presented. As congeners, the new species have a modified oral hood and first gill arch with enlarged accessory lamellae extending well onto medial face of gill filaments. The new species is distinguished from all congeners, except *L. oyakawai*, by having gas bladder moderately sized (not reduzed) with simple walls (diverticula absent), and paired bony capsules on anteriormost vertebrae reduced to paired cup-like laminar ossifications separated by triangular septum. The new species differs from *L. oyawakai* and remaining species of *Leptodoras*, except *L. hasemani*, by having a dark blotch in the distal half of the anterior dorsal-fin rays and membranes. The new species is known from the rio Fresco drainage, a tributary of the middle Xingu basin. The species was discovered from material deposited at MZUSP and collected more than 20 years ago in the territory of the Kayapo indians, in Pará State, Brazil. Additional material were recently collected during the Expedição AquaRios.

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858 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Katherine Birkett[1]

[1]The University of Michigan School of Natural Resources & Environment, Ann Arbor, MI, United States, [2]The University of Michigan Museum of Zoology, Ann Arbor, MI, United States

Spatial and Temporal Variation in Fish Communities in the Huron River of Southeastern Michigan

The Huron River is a slow-moving, low-gradient warmwater system located in southeastern Michigan. Records on its fish communities have been collected by over the course of decades, providing an excellent historical record. Fish surveys conducted in the Huron River over the summer of 2008 indicate significant changes in fish community composition, which may be attributed to the introduction of the zebra mussel (*Dreissena polymorpha*) in the mid-1990's. The 2008 surveys also indicate a spatial pattern, in which fish community composition changes with distance throughout the river's main stem. A marked increase in fish species richness and diversity was also detected with increasing

distance downstream from a zebra mussel-infested lake located within the watershed. This study of the Huron River system can provide valuable insights regarding how riverine fishes react to environmental changes over longer time scales.

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340 Poster Session I, Exhibit Hall, Friday 24 July 2009

Noëlle K.J. Bittner[1], Stephen G. Tilley[1], Joseph Bernardo[2]

[1]Smith College, Northampton, MA, United States, [2]Cornell University, Ithaca, NY, United States

Allozyme Analysis of a Contact Zone Between Two mtDNA Haplotypes in *Desmognathus ocoee* (Amphibia: Plethodontidae)

Recent phylogenetic analyses of mitochondrial DNA (mtDNA) sequences have revealed five distinct well supported clades within the salamander species traditionally called *Desmongnathus ocoee* Nicholls. This information suggests that the organisms currently recognized as *D. ocoee* may belong to more than one species. In the Blue Ridge Mountains of northeastern Georgia, a contact zone between two mtDNA haplotypes has been identified. Using starch gel electrophoresis, this study sought to augment the mtDNA data with information from nuclear genes by comparing allele frequencies at six polymorphic allozyme loci among populations of *D. ocoee* at and around the contact zone. Previous studies have found allozyme frequencies tend to corroborate mitochondrial sequence data, indicating similar patterns of geographic differentiation among populations. However, the allele frequencies determined by this study do not correlate with the mtDNA data. They show little differentiation between populations in excess of that expected from isolation by distance, suggesting that they belong to the same biological species.

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125 AES Ecology II, Galleria South, Sunday 26 July 2009

Joseph J. Bizzarro[1], Leonard J.V. Compagno[2], Robin Leslie[3], David A. Ebert[1]

[1]Pacific Shark Research Center, Moss Landing, CA, United States, [2]Save our Seas Foundation, Capetown, South Africa, [3]Marine and Coastal Management, Capetown, South Africa

Biology and Distribution of the Sixgill Sawshark, *Pliotrema warreni* Regan 1906, off Southern Africa

The sixgill sawshark, *Pliotrema warreni*, is one of six described sawshark species (Pristiophoridae) and the only member of its genus. Endemic to waters off southern

Africa, this species has been reported from Cape Agulhas to Durban, South Africa, and from Madagascar, at depths of 26-455 m. Seventy-four individuals (42 females, 32 males) were collected primarily from fishery independent trawl surveys conducted between 1985 and 2007, facilitating a general biological assessment of this poorly known species. The occurrence of *P. warreni* was extremely localized and its captured was infrequent in survey trawls. Size at birth was estimated at > 35 cm total length (TL). The largest immature female was 118.5 cm TL, whereas the largest immature male measured 82.0 cm TL. Size at first maturity ranged from 109.1 cm TL for females to 91.1 cm TL for males Median size at maturity was 113.2 cm TL for females. Maximum size of females and males was 136.4 cm TL and 112.0 cm TL, respectively. *Pliotrema warreni* was a third-level consumer (trophic level = 4.13), with a diet comprised primarily of small, demersal fishes and, to a lesser extent, shrimps. This species is probably extremely vulnerable to fishing pressure, because it is endemic to the waters of southern africa, rare within its distribution, and easy to capture because of its toothed rostrum. Further study and monitoring should be conducted to determine the population status of the species.

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458 Poster Session I, Exhibit Hall, Friday 24 July 2009

Hillary Black, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

The Effects of Body Mass and Temperature on the Standard Metabolic Rate of Three Species of Colubrid Snakes

Ectotherm behaviour, as well as physiological and developmental processes, are greatly influenced by environmental temperature, and the combination of these factors may limit species distributions. We tested the effects of temperature, body mass, and species on the standard metabolic rate (SMR) in three species of snakes: the Eastern Garter Snake (*Thamnophis sirtalis sirtalis*), the Northern Red Belly Snake (*Storeria occipitomaculata*), and the Smooth Green Snake (*Liochlorophis* vernalis). CO_2 production was measured in the lab at 15°C, 20°C, and 25°C using a flow-through respirometer. We predicted that as temperature and body mass increased, SMR would increase for all three species. We hypothesized that SMR would differ among snake species when controlling for body size because different species have different feeding ecologies which in turn affect digestion and therefore metabolic rate. As expected, SMR increased with temperature and body mass, but did not differ among species. The lack of species differences may be because of a phylogenetic effect as all species examined were from one family, the Colubridae. Q_{10} values were similar among all three species (~5), and were slightly higher than those reported for other vertebrate ectotherms. Our findings generally agree with other examinations of reptile metabolism, although no previous studies have tested SMR in frequently-feeding small-bodied snake species. Future studies should concentrate on comparisons of SMR between infrequently feeding colubrids and frequently feeding colubrids.

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128 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Daniel Blackburn

Trinity College, Hartford, CT, United States

Evolution of Vertebrate Viviparity and Matrotrophy: An Overview

Viviparity (living - bearing reproduction) has evolved among chondrichthyans, actinistians, sarcopterygians, and teleosts, as well as various amphibians, reptiles, and mammals. Phylogenetic analysis reveals that vertebrate viviparity has arisen convergently in more than 145 separate clades, with >24 of these origins having occurred among fishes. Substantial matrotrophy has evolved in at least 27 of the viviparous clades, commonly through modification of structures specialized for respiration. Studies on individual lineages reveals that viviparous matrotrophy has evolved by entirely different sequences and mechanisms in mammals vs. fishes and squamates, and most likely, by different selective pressures. Consequently, studies on each of these groups have limited utility as models for the others. Studies of piscine viviparity provide their own justification, and give insight into aspects of reproductive diversity that have important implications for anatomy, physiology, ecology, and evolution.

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95 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Daniel G. Blackburn[1], James R. Stewart[1]

[1]Trinity College, Hartford CT, United States, [2]East Tennessee State University, Johnson City TN, United States

Evolution of Placentation in Viviparous Thamnophine Snakes

We have been involved in a long term investigation of placental structure and function in viviparous thamnophine colubrids, as part of a research program aimed at understanding the diversity and evolution of reptilian placentation. Investigated taxa include species of *Thamnophis, Storeria, Virginia, Tropidoclonion, Regina,* and *Nerodia*. Our techniques have included light and electron microscopy (TEM and SEM), immunochemistry, and quantitative analyses of placental transport. The chorioallantoic placenta shows marked specializations for gas exchange, including well vascularized membranes and a minimal fetal - maternal diffusion distance. In contrast, the yolk sac placenta (omphalallantoic placenta) shows unusual specializations for absorption by the fetus, and may function in sodium and water uptake. Although placental transport of calcium occurs, the site and mechanism of such transfer is unknown. We postulate that

viviparous thamnophines are derived from a common ancestor with two distinct placentas, respectively specialized for gas exchange and water provision. These functions appear to be retained from ancestral functions of fetal membranes in distantly - related oviparous snakes. An emerging body of phylogenetic information offers a framework for interpreting species differences in placental development and composition.

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165 Herp Systematics, Pavilion West, Thursday 23 July 2009

David Blackburn[1], Cameron Siler[1], Arvin Diesmos[2], Rafe Brown[1]

[1]University of Kansas Natural History Museum, Lawrence, KS, United States, [2]National Museum of the Phillippines, Manila, Philippines

A Quantitative Analysis of Ecomorphological Evolution in the Frog Genus *Kaloula* (Anura: Microhylidae)

Rapid diversification of a clade accompanied by an increase in ecological and morphological diversity is the hallmark of adaptive radiation. Despite many suggestions of a close relationship between morphology and ecology, there have been few, if any, analyses of ecomorphological evolution, and thus little rigorous evidence for adaptive radiation, within extant frogs. We estimated the phylogeny of the genus *Kaloula* based on analyses of mitochondrial genes; this dataset includes 11 of 15 currently recognized species, representatives of several subspecies, and several undescribed species. We then collected continuously varying morphological data for 13 of 15 currently recognized species as well as for the other taxa. To characterize ecomorphs, we chose linear measurements of ecologically relevant anatomical features (e.g., body size, limb lengths, digit tip widths, and interdigital webbing). We summarized variation by conducting a principal components analysis of these data. Mean scores for principal components were calculated for each species and these were used to analyze patterns of ecomorphological evolution in the context of our phylogenetic estimate. We utilized phylogenetic comparative methods to examine the relative timing and order of ecomorph evolution as well as to reconstruct ancestral states. We contrast our approach of quantitatively describing ecomorphology with an approach based on reconstructing ecomorphological evolution using discrete multi-state characters. This research was supported by NSF grant EF-0334939 (AmphibiaTree).

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929 Poster Session I, Exhibit Hall, Friday 24 July 2009

Mary Ellen Blasius[1], John O'Sullivan[2], Christopher Lowe[1]

[1]California State University Long Beach, Long Beach, CA, United States, [2]Monterey Bay Aquarium, Monterey, CA, United States

Evaluation of Organochlorine Contaminants in Young-Of-Year White Sharks (*Carcharodon carcharias*) from the Southern California Bight

As a top predator, white sharks (*Carcharodon carcharias*) occupy one of the highest levels in the oceanic food web giving this species great potential for biomagnification of organochlorines (OCs). We measured chlorinated pesticides and polychlorinated biphenyls (PCBs) in young-of-year (YOY) white sharks incidentally caught by fishers in the Southern California Bight. Chlorinated pesticides and PCBs were measured in dorsal muscle and liver and identified and quantified using gas chromatography mass spectrometry. Concentrations ranged from 22-187 μg/g and 7-22 μg/g in liver of chlorinated pesticides and total PCBs (tPCB), relatively. p,p DDE was the predominant isomer observed in all tissue samples possessing concentrations as high as 180 μg/g in liver, the highest level reported in sharks. Other compounds detected in liver were heptachlor, heptachlor epoxide, and hexachlorohexanes. YOYs feed heavily on benthic fishes, and thus are unlikely to obtain these high levels of contaminants from their food source in such a short period. Pinnipeds in the Southern California Bight have also been found to have high contaminant loads in their blubber. Therefore, these high levels of contaminant found in YOYs are more likely due to maternal offloading of contaminants from their mammal-eating mothers via the yolk. These results indicate significant concentrations of OCs within tissues of white sharks warranting further study on the potential effects of DDT and PCB on the population of sharks in the SCB.

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502 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Erin Blevins, George Lauder

Harvard University, Cambridge, MA, United States

Understanding Undulation: The Biomechanics of Stingray Swimming

The characteristic undulatory swimming mode of benthic batoids has inspired a variety of theoretical and physical models, but the current understanding of biological batoid fins lags behind. Our research combines several techniques to give insights into the kinematics and hydrodynamics of stingray locomotion, and reveal how the remarkable flexibility and deformation of these fins is employed during swimming. We present the results of three integrated experiments on pectoral fin locomotion in freshwater stingray *Potamotrygon hystrix*: a detailed three-dimensional kinematic study, a hydrodynamic analysis using particle image velocimetry (PIV), and a PIV analysis of flow around a

self-propelling robotic model animated using simplified *P. hystrix* kinematics. In the kinematic study, three synchronized one-megapixel cameras (250 frames/s) were used to film rays swimming at two steady speeds (1.5 and 2.5 disc lengths/s). The x, y, and z excursions of approximately 30 points were used to describe fin deformations during multiple finbeats per individual, per speed. The hydrodynamic implications of these kinematics were further explored using PIV, with a vertical light sheet capturing fluid motion perpendicular to the fin. To assist in interpretation of these results, a simple model ray fin (30 Shore A Neoprene) was attached to a two-actuator robotic flapper, with heave and pitch values corresponding to known stingray kinematics; PIV data from the model were compared to flows observed around live rays. By combining three-dimensional kinematics, hydrodynamics, and simple robotic models, we are able to draw conclusions about both the principles and practice of undulatory locmotion by benthic rays.

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500 Poster Session I, Exhibit Hall, Friday 24 July 2009

Deborah Blood[1], Janet Duffy-Anderson[1], Ann Matarese[1], Dongwha Sohn[2], Phyllis Stabeno[3], Wei Cheng[4]

[1]NOAA/Alaska Fisheries Science Center, Seattle, WA, United States, [2]Oregon State University, Corvallis, OR, United States, [3]NOAA/Pacific Marine Environmental Laboratory, Seattle, WA, United States, [4]JISAO/University of Washington, Seattle, WA, United States

Early Life History Of Greenland Halibut (*Reinhardtius hippoglossoides*) in the Eastern Bering Sea based on Recent Field Studies (2007-2009): Spawning, Distribution, and Physical Processes Affecting Drift and Dispersal

Researchers at the National Oceanic and Atmospheric Administration and Oregon State University have been examining transport of Greenland halibut (GH) eggs and larvae from spawning to potential nursery locations in the eastern Bering Sea (EBS). We are evaluating the influence of hydrography and circulation on transport, dispersal and survival of the early life history stages. Ichthyoplankton surveys were conducted in the EBS in February (2008-2009) and May (2007-2009) to better evaluate GH life history ecology and connectivity between spawning and nursery habitats. Results from these cruises indicate that Greenland halibut spawn in deep (600+m) water off the continental slope January-early February, with eggs and early-stage larvae initially occurring in deep water (500+m). Historical data indicate that larvae later rise to above 45 m depth. Model output from a 3D hydrographic circulation model, and empirical data from subsurface moorings and satellite-tracked drifters, indicate eggs and larvae are entrained in depth-discrete currents that advect planktonic stages north and east over the continental shelf. Vertical position in the water column of eggs and early-stage larvae appears to be modulated by physiological changes during development, while larval behavior likely influences vertical distribution in later stages. Preliminary results

suggest that the degree of connectivity between slope and shelf habitats may be influenced by sea ice cover, speed and direction of the Bering Slope Current, and mixing processes in submarine canyons and over the continental shelf.

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841 Fish Biogeography, Pavilion East, Monday 27 July 2009

Devin Bloom, Nathan Lovejoy

University of Toronto, Toronto, ON, Canada

Testing the Miocene Marine Incursion Hypothesis Using Anchovies (Engraulidae)

South America hosts a considerable number of marine derived lineages (MDLs) of freshwater fishes. The origin of MDLs in continental freshwaters may have been facilitated by Miocene marine incursions. The marine incursion hypothesis predicts that (1) the distribution of the sister group to South American MDLs should include the Caribbean (the source of marine inundation) and (2) the age of freshwater taxa should coincide with geological dates for marine sediments in South America. Here, we use anchovies (Engraulidae) as a model for testing these biogeographic predictions. Anchovies are ideal for investigating the biogeography of transitions from marine to freshwater habitats because the family is predominately marine, yet includes at least 12 freshwater endemics in South America. We use phylogeny estimation and molecular dating methods, along with ancestral character reconstruction of habitat type, to determine the number and timing of marine to freshwater events. We compare patterns in anchovies to those of other hypothesized MDLs.

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908 Fish Systematics, Pavilion East, Monday 27 July 2009

Flávio Bockmann[1], Vitor Masson[1], Marcelo Rocha[2]

[1]*Laboratório de Ictiologia de Ribeirão Preto (LIRP), Universidade de Sao Paulo, FFCLRP, PPG Biologia Comparada, NSF/ACSI project, CNPq, Ribeirão Preto, SP, Brazil,*
[2]*Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, AM, Brazil*

A New Catfish Genus from Northern Brazil (Siluriformes: Heptapteridae) Provides New Insights on the Relationships of the Enigmatic Genus *Phreatobius* Goeldi

Morphological evidence indicates that *Gladioglanis* is the sister group of *Phreatobius*, one of the most intriguing taxonomic riddles in catfish systematics. These genera belong to a more inclusive group, also comprising *Brachyglanis*, *Leptorhamdi*a, and *Myoglanis*. This

clade is diagnosed by, among other synapomorphies, the hypertrophied *adductor mandibulae* muscle, reaching dorsally to the cranial midline, a feature thought to be reversed in *Gladioglanis*. However, the highly modified morphology of *Phreatobius* casts doubts on the homology of several of these synapomorphies, rendering doubtful even its inclusion in Heptapteridae. Furthermore, recent molecular investigation has concluded that *Phreatobius* is the sistergroup of Pimelodidae. In the present work we report on two new heptapterids with hypertrophied jaw musculature, occurring sympatrically in the Rio Negro basin, Brazil. These species belong to a new genus, based on a phylogenetic analysis of the genera cited above and 45 morphological characters. The new genus is supported by three homoplasy-free synapomorphies, and it is hypothesized to be closely related to the clade formed by *Gladioglanis* and *Phreatobius*, whose sister group relationship was corroborated. The group containing all these three genera is nested among other heptapterids with jaw musculature invading the roof of cranium, corroborating the absence of this characteristic in *Gladioglanis* as a reversal. The discovery of the new taxon helps to understand the relationships of *Phreatobius* by providing intermediate character states which substantiate homology propositions.

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914 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Erin Bohaboy, Alison Cleary, Juleen Dickson, Brooke Longval, Jack Szczepanski

University of Rhode Island, RI, United States

Functional Diversity in Temperate Coastal Fish Communities

As more emphasis is placed on ecosystem based management, understanding the functional roles of species within a community is becoming more important. Biodiversity provides a large range of ecosystem services, thus it is important to understand how the addition or loss of species affects the dynamics among community members. Functional diversity has been studied in a number of tropical communities, but has not been investigated on a wide scale in temperate communities. The purpose of this study was to explore the relationship between fish species richness and functional diversity in temperate coastal ecosystems. Fish species from 12 different temperate communities were identified from trawl surveys conducted over 25 years. Richness, Shannon's H, and evenness were calculated using functional groups based on size, primary feeding preference, and resilience (productivity) and then recalculated for functional groups based on a combination of two or three of these variables. The functional diversity, richness and evenness of single variable functional groups remained constant regardless of the number of species within the community, but increased with the number of species in two variable functional groups. Combining all three variables produced a positive logarithmic relationship between species and functional group richness, but functional diversity and evenness did not increase with species richness. The effect of more variables and incorporating more species, such as invertebrates, needs to be investigated further. In the future, functional diversity maybe an important tool for understanding the roles that species have in an ecosystem.

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109 General Herpetology, Galleria South, Sunday 26 July 2009

Luis A. Bonachea, Michael J. Ryan

University of Texas, Austin, TX, United States

Predation Risk Influences the Expression of Mate Choice in Túngara frogs, *Physalaemus pustulosus*: Implications for Sexual Selection

Mate choice drives several important evolutionary processes, including speciation, sexual conflict, and the evolution of elaborate male traits. The pace of these processes should then be greatly influenced by the strength of selection, so understanding factors that create variation in the strength of female preferences is necessary to understand these processes. While predation risk is recognized as a significant cost of mate choice, we have a very limited understanding for how females themselves respond to variation in levels of risk. Túngara frogs, *Physalaemus pustulosus*, have been a model system in studying female choice for nearly 25 years. These females show well documented and robust preferences for particular aspects of the male advertisement calls. For the past 5 years, we have been using this rich background to explore the effects of predation risk on the expression of female choice. Simulating risk using the advertisement calls of predatory frogs, light levels, and all too natural models of predators in both the lab and field, we have shown that females assess predation risk during mate choice and it can influence various aspects of assessment, including choices among males, sampling time and strategy, and permissiveness. The results of this work demonstrate that predation risk can strongly influence and even eliminate the expression of female choice, having significant implications for sexual selection.

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212 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Xavier Bonnet

CNRS, Villiers en Bois, France

The Evolution of Semelparity

Mathematical modelling does not allow us to understand why some zoological groups are oriented towards semelparity. In effect, the putative links between allelic combinations and the reproductive strategies (semelparity versus iteroparity) rely on the personal choice and convenience of the modeller. A long-term ecophysiological study on a viviparous snake (*Vipera aspis*) helped to identify the proximal forces that favour semelparity. Reproductive females (more than 500 individuals monitored in the field +

laboratory studies) exhibited a low survival rate and consequently tended to breed only once during lifespan. Strong elevation of plasma levels of oestradiol-17β provoked the mobilisation of maternal body reserves required for yolk formation, associated with a marked exposure to predators to meet the temperature (metabolic) requirements for vitellogenesis. Similarly gestation imposed strong metabolic and predatory costs trough important sun basking behaviours. Importantly, a substantial proportion of the costs were independent from fecundity. Indeed, the optimal body temperatures (close to 30°C) for vitellogenesis and embryogenesis are not influenced by offspring number; hence maternal metabolism and the risk of being killed by a predator are determined by reproductive status rather than fecundity. To minimise such costs, selection favours fecundity per reproductive bout instead of iteroparity. Capital breeding offers a solution to increase offspring number. Under constraining climatic conditions this strategy can involve towards semelparity. Further demographic investigations and modelling provide strong support to this ecophysiological scenario.

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527 ELHS/LFC Ecology I, Galleria South, Broadway 1&2 25 July 2009

Rita Borges[1], João V. Medeiros[1], Ester A. Serrão[1], Emanuel J. Gonçalves[2]

[1]Centre Marine Sciences of the Algarve University (CCMAR), Faro, Portugal, [2]Eco-Ethology Research Unit, ISPA, Lisbon, Portugal

Tidal and Vertical Distribution of Nearshore Fish Larval Assemblages at a Temperate Rocky Shore

Previous studies have shown that, at the Arrábida Marine Park (Portugal), fish larvae can exhibit vertical patterns of distribution at very small spatial scales, with patterns being variable between species. This vertical distribution can modulate the horizontal displacement of larvae and thus change the dispersal patterns expected by currents, and potentially contribute for local retention during the pelagic phase. The mechanisms underlying this distribution are not known, but must depend on distinct larval behavioral capabilities in relation to the physical environment. In this work we investigate the possible tidal influence on the vertical distribution of fish larvae at the extreme nearshore. During June and July 2008, fish larvae were collected using a plankton net attached to an underwater scooter at two distinct depths, close to the bottom and 1 m below the surface, and during all tidal phases. Overall, PERMANOVA results did not reveal any interaction between tide and depth to explain the structure of the assemblages. However, a vertical structure could be found, with larvae of some species clearly associated to the bottom (e.g., gobies) while others (e.g., tripterygiids) were more abundant at the surface. Although diversity did not differ between tides, there was a significant tidal effect on the structure of the assemblage, with the highest abundance of larvae clearly associated with distinct tidal phases depending on the species. For some species, tide seems to be linked to the regulation of their vertical positioning.

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587 Poster Session I, Exhibit Hall, Friday, 24 July 2009

Keith Bosley[1], Todd Miller[2], Richard Brodeur[1], Ahna Van Gaest[1]

[1]NOAA Fisheries, Northwest Fisheries Science Center, Newport, Oregon, United States, [2]Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

Feeding Ecology of Juvenile Rockfish off Oregon and Washington as Indicated by Diet and Stable Isotope Analysis

There have been few studies that have looked at the feeding habits of co-occurring pelagic young-of-the-year rockfish off the west coast—information crucial to understanding how these fish may be influenced by bottom-up processes. We undertook a study of the feeding habits of juvenile rockfish (genus *Sebastes*) collected off Oregon and Washington during GLOBEC (2002) and NOAA Predator (2006) surveys. The predominant species collected in both years were darkblotched (*S. crameri*), canary (*S. pinniger*), yellowtail (*S. flavidus*), and widow (*S. entomelas*) rockfishes. Analysis of gut contents by % number revealed that darkblotched rockfish had a high degree of variability in their diets, consisting of gelatinous zooplankton (2002), several life-history stages of euphausiids (2006), as well as hyperiid amphipods and copepods (2002, 2006). Canary, yellowtail, and widow rockfishes had a high degree of dietary overlap, because of common utilization of copepods and euphausiids. There was less overlap in diets between species when % wet weight was examined, with only canary and widow rockfish showing significant similarities (2006). Additionally, nitrogen stable isotope analyses confirmed that there was a 1.5 ‰ difference between years, and all fish from the same year were feeding at nearly the same trophic level. In both years, carbon signatures were of an off-shore origin, and darkblotched were enriched relative to all other species. Non-metric multidimensional scaling revealed significant differences in diet with increasing distance from shore. Taken together, these results advance our understanding of some of the important environmental factors that affect young-of-the-year rockfish during their pelagic phase.

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172 Poster Session I, Exhibit Hall, Friday 24 July 2009

Mariah Boyle, David Ebert, Gregor Cailliet

Moss Landing Marine Laboratories, Moss Landing, CA, United States

Trophic Relationships of the Roughtail Skate, *Bathyraja trachura*, and Sympatric Groundfishes

The carbon and nitrogen stable isotope (SI) composition of roughtail skate, *Bathyraja trachura*, was investigated using individuals collected during National Marine Fisheries

Service trawl surveys. Trawls were conducted at depths of 200-1,200 m along the Pacific Coast of the contiguous United States. Skates were identified, measured, and white muscle tissue was excised from sampled individuals. Muscle tissue was prepared with 0.5N HCl and petroleum ether to remove inorganic carbon and lipids, respectively. Stable isotope analysis (SIA) was performed at the University of California, Santa Cruz. Although many skate diet studies have demonstrated that larger skates feed at higher trophic levels, regression analysis found that there was not a linear relationship between $\delta^{15}N$ and total length (r^2= 0.012, p=0.458). To understand the relative position of B. trachura in the food web, carbon and nitrogen SI values of co-occurring invertebrates and teleosts were used to construct a dual isotope plot. The sampled organisms exhibited changes in $\delta^{15}N$ values according to previously reported trophic levels, suggesting nitrogen SIA may be a viable method for determining the trophic levels of deep-sea fishes. The organisms exhibited a range of $\delta^{13}C$ values, the extremes of which represented benthic and pelagic habitats. This grouping suggests it may be possible to infer general habitat associations from carbon SI data. From these results, it appears that SIA of nitrogen and carbon may prove a useful technique for determining the trophic relationships of deep-sea invertebrates, and both bony and cartilaginous fishes.

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661 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Ian Bradbury[1], Sophie Hubert[3], Brent Higgins[3], Sharen Bowman[3], Ian Paterson[1], Paul Snelgrove[2], David Hardie[1], Jeffery Hutchings[1], Paul Bentzen[1]

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Ocean Temperature Determines Dispersal Potential and Adaptive Connectivity in a North Temperate Marine Fish

Ocean climate may influence connectivity of marine organisms directly through physiological responses such as temperature-dependent development and indirectly through temperature-driven local adaptation. We examine the hypothesis that direct and indirect process both contribute to the scale of spatial connectivity in a north temperate marine fish, Atlantic cod (*Gadus morhua*). Direct influences of temperature on early life history dispersal were examined using seasonal ichthyoplankton surveys in coastal Newfoundland conducted from April (<0°C) to August (~8°C). Dispersal during the pelagic egg stage declined by 40-68% as surface waters warmed seasonally, declining from >100 km to ~40 kms. We examined indirect influences of temperature on selection and local adaption using a transcriptome wide survey (~1600 single nucleotide polymorphisms) and range-wide sampling. We identify a subset (~1.5%) of independent polymorphisms for which allele frequencies show parallel temperature-associated clines

on either side of the Atlantic, test positive for signatures of selection, and cluster predominantly in two linkage groups. The results are consistent with parallel adaptive co-evolution of multiple genes in response to gradients in ocean temperature and the presence of local adaptation despite high dispersal potential. Taken together, direct and indirect mechanisms suggest the potential for large variation in realized connectivity associated with variability in ocean climate across a range of habitats.

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203 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

David Bradford[1], Nita Tallent-Halsell[1], Kerri Stanley[2], Laura McConnell[3], Maliha Nash[1], Staci Simonich[2], Roland Knapp[4]

[1]US EPA, Landscape Ecology Branch, Las Vegas, NV, United States, [2]Oregon State Univ., Dept. Environ. & Molecular Toxicology, Corvallis, OR, United States, [3]USDA, Agricultural Research Service, Beltsville, MD, United States, [4]Univ. of Calif., Sierra Nevada Aquatic Research Laboratory, Mammoth Lakes, CA, United States

Airborne Pesticides as an Unlikely Cause for Population Declines of Alpine Frogs in the Sierra Nevada, California

Airborne pesticides from the Central Valley of California have been implicated as a cause for population declines of several amphibian species, with the strongest evidence for the mountain yellow-legged frog complex (*Rana muscosa* and *R. sierrae*) in the Sierra Nevada. We measured pesticide concentrations in multiple media at multiple times at 28 sites in the southern Sierra and evaluated the pesticide-decline hypothesis in three ways: (1) we described the temporal variation in concentrations in lake water and compared these values to established critical levels; (2) we tested the hypothesis that pesticide concentrations decrease with distance from the Valley, a pattern that could explain the east-west pattern in population declines; and (3) we tested the hypothesis that pesticide concentrations are correlated with frog population status (i.e., fraction of suitable sites occupied within 2 km of a site). Media represented were air, lake water, sediment, and tadpoles of a surrogate species (*Pseudacris regilla*). Results do not support the hypothesis for a pesticide effect on frog populations. Concentrations of up to nine pesticides (both currently and historically used forms) were extremely low, on the order of 1 part per trillion in lake water, and well below critical levels established for other taxa. Evidence for a distance effect in concentrations was very limited. Virtually no association was found between frog population status and any chemical metric. In contrast, two well documented causes for the dramatic and continuing population declines of these frogs are chytridiomycosis and introduced trout.

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976 Fish Ecology I, Pavilion East, Friday 24 July 2009

Marissa Brady, Dewayne Fox, Qiquan Wang, Colette Cairns

Delaware State University, Dover, DE, United States

Impact of a Non-native Parasitic Nematode on American Eels (*Anguilla rostrata*) in Delaware Waters

American eel (*Anguilla rostrata*) support an important commercial fishery in Delaware; however recent landing declines in portions of their range have raised concerns of managers. Although its impact on American eel is unknown, *Anguillicola crassus* (Dracunculidae) is an invasive swim bladder nematode that causes swim bladder malfunction and can hinder swimming ability in European eel (*A. anguilla*). We documented infestation rates of *A. crassus* and quantified triglyceride levels in infested and non-infested American eel from Delaware waters. A broad size range (226-630mm) of yellow phase American eel (n=1553) collected from mesohaline habitats in Delaware yielded A. crassus infestation rates infestation rates ranging from 34-39% from 2005-2007. Similar to previous studies we failed to document differences in condition indices (p-value=0.84) as a result of *A. crassus* infestation in American eel. Additionally, all size classes of American eel were infested during all sampling periods indicating overwintering by *A. crassus* in Delaware waters. Our examination of triglyceride levels suggests an interaction between American eel length and infestation by *A. crassus*. We documented significant differences in triglyceride levels related to eel length (p-value=0.0025); with triglyceride levels increasing with eel size. Although triglyceride levels did not vary significantly as a result of infestation (p-value=0.08), we plan to continue assessing the biochemical impacts of *A. crassus* on American eel. We recommend further study to better understand the physiological impact of *A. crassus* on American eel; however non-traditional methods may prove more efficient in assessing these impacts of infestation rather than standard condition indices.

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664 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Susan Brady, John Arlt, Lana Carolan, Ian Quitidamo, Jim Johnson

Central Washington University, Ellensburg, WA, United States

Yakima WATERS: Students Investigating Amphibian Decline

Yakima WATERS is a National Science Foundation sponsored, regional program designed to promote integration of interdisciplinary science research into K-12 public school classrooms. Each WATERS team includes a Central Washington University graduate student fellow, a faculty mentor, and a local K-12 teacher. The goal of this collaboration is to encourage the incorporation of watershed-based research into the science classroom. The WATERS team at Ellensburg High School has implemented

immersive, research-focused field trips and inquiry-based classroom activities and labs that emphasize topics related to amphibian decline and disease research. Students learned and assessed potential causes of amphibian declines such as habitat degradation, pollution, and disease. Students discussed the importance of wetlands and wetland restoration for declining amphibian populations and a wetland restoration project on the high school grounds was developed that will provide future students an opportunity be involved in a long-term interdisciplinary monitoring project. Tenth grade biology students also designed and conducted their own research. A number of fungi and fungus-like organisms including the water molds, particularly in the genus, *Saprolegnia*, have been implicated in causing amphibian disease and mass mortality events. Students investigated a variety of topics including: the effects of different isolation conditions on the recovery of water mold biodiversity; growth rates with respect to different environmental conditions such as nutrient type and concentration, temperatures, and pH; and factors influencing chemotaxis and electrotaxis of zoospores. Students collected and analyzed data, drew appropriate conclusions based on their data, and evaluated their findings in the broader context of amphibian decline.

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705 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Adrianne Brand, Matthew Gallagher, Joel Snodgrass

Towson University, Towson, MD, United States

Salt in Aquatic Ecosystems: Effects of Water Hardness on Toxicity

Salinization of aquatic habitats is an emerging concern, particularly with the widespread application of road salts and their subsequent accumulation in nearby streams and wetlands. Aquatic-breeding amphibians that depend on freshwater habitats throughout embryonic and larval development may be particularly vulnerable to changes in ion concentrations; however, it is unclear how the presence of other common ions affects salt toxicity. We exposed embryonic and larval wood frogs (*Rana sylvatica*) to eight different levels of NaCl with five levels of background water hardness. Embryonic and larval survival were influenced by NaCl concentrations, but the effects of NaCl were dependent on hardness. For embryos, survival was reduced at the highest conductivity (2000 μS/cm) across all hardness levels, but was reduced more when water was very soft (27.5 mg/L total dissolved ions) or very hard (880 mg/L total dissolved ions). The effects of salt and hardness were most severe when water was very hard and conductivity was highest, where survival was only 5%. For larvae, the effects of NaCl increased from very soft water, where survival was 79%, through very hard water where survival was 0%. There were no sublethal effects of NaCl or hardness on size at metamorphosis or days to metamorphosis among larvae that survived, although there was a negative correlation between days to metamorphosis and size. From our results, it appears that water hardness influences the toxicity of salt in aquatic ecosystems and that salt may be particularly detrimental to survival in very hard or very soft water environments.

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26 Lizard Ecology, Pavilion East, Friday 24 July 2009

Bayard Brattstrom

Horned Lizard Ranch, Wikieup, AZ, United States

Seasonal and Microhabitat Partitioning in an Australian Skink Community

A skink community was studied on a 32.4ha plot, 60 km north of Townsville, Queensland, Australia from September 30 to December 1993 in a Coastal dry, sclerophyl, Eucalyptus woodland. The area was explored and microhabitats searched for skinks about every two weeks. On nine occasions 100 x 5m transits were done. Nine species of skinks occurred on the site, and each species was in a different microhabitat. Some species were only seen in the cooler trips. while others, often large sized species, were only seen in the warmer trips. Skinks were most abundant in late Octobrer (160-440/ha), rare in cooler September and in hot, humid December (0-140/ha). October transit data suggest that there may be as many as 14,256 skinks on the 32.4ha plot. A 2ha study plot, just across a major highway, was seasonally burned to stimulate the growth of an exotic grass for use by cattle. Six 100 x 5m transits on this plot resulted in only one lizard during the study.

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623 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Forrest Brem, Matthew Venesky

University of Memphis, Memphis, TN, United States

Variation in *Batrachochytrium dendrobatidis* Zoospore Production Rate and Thalli Morphology Between a United States and Panamanian Isolate

Pathogens evolve rapidly through natural interactions with their host(s) and environment, and changes in a pathogen can alter host-pathogen dynamics. There are few data suggesting that *Batrachochytrium dendrobatidis* (*Bd*) has undergone genetic differentiation in the various environments in which it now exists, natural and artificial. However, it is unreasonable to assume that Bd has been unaffected by local selection pressures exerted by different species, communities, and environments. During routine passages of *Bd* in culture, we noted differences in thalli morphology between a United States (284) and a Panamanian (423) isolate where thalli of 423 appeared solely spherical and thalli of 284 appeared to have both spherical and irregular forms. To test for variation in thalli morphology, we recorded the absolute value (width - height) of every observable thalli on plates and analyzed those data using ANOVA. We also tested for variation in zoospore production at both 24°C and 5°C by creating equal zoospore

density inoculates of each isolate, plating them out, and incubating them at 24°C and 5°C. We found that 423 thalli were consistently more spherical than 284 ($p<0.05$), and that 423 produced more zoospores at 24°C ($p<0.05$) but fewer at 5°C ($p<0.05$) than 284. Our results suggest that variation among these isolates exists, however, its origin is unclear. If it is a result of natural selection our data suggest that *Bd* is differentiating among regions. If artificial, our data suggest *Bd* changes rapidly in culture which could affect transmissibility and pathogenicity (and their underlying genes), and the results of many lab experiments using *Bd* isolates.

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301 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jillian Brinser, Dominique Dagit

Millersville University, Millersville, PA, United States

Comparative Pectoral Fin Anatomy of Batoid Fishes

Among Chondrichthyan fishes, batoid fishes have unique dorsal-ventrally compressed bodies and expanded wing-like pectoral fins that are attached to the head. This unique body design is adapted for a pelagic as well as a benthic existence. The external shape of the wings differs between species and also within families which allows for different modes of swimming (undulation, oscillation, or a combination of the two). The skeletal anatomy of 11 different species of batoid fishes, including both skates and rays was analyzed. This investigation describes the skeletal anatomy of the pectoral girdle and fins, as well as the arrangement of radial elements that make up the pectoral fins. These different anatomical patterns are related to the mode of swimming and external wing shape. Additionally the basal elements of the pectoral fin are highly variable within and between families, as well as the attachment and arrangement of radial elements relative to the basal elements. It is likely that these arrangements and attachments are phlyogenetically important.

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342 Lizard Ecology, Pavilion East, Friday 24 July 2009

Eric Britt, Alessandro Catenazzi, Henry Mushinsky, Earl McCoy

University of South Florida, Tampa, FL, United States

Fire History and Florida Sand Skink (*Plestiodon reynoldsi*) Population Abundance

The sand skink (*Plestiodon reynoldsi*) is a small fossorial lizard with reduced limbs and slender body. Because they are entirely restricted to isolated patches of Florida scrub, Florida sand skinks are listed as threatened under the Endangered Species Act. The

Florida scrub is a fire maintained ecosystem, but the effect of prescribed fire on sand skink population abundance is not understood. The goal of our study was to establish the relationship between fire history in Scrubby Flatwoods and sand skink population biology. In March of 2007 at Archbold Biological Station in Highlands County Florida, we installed 36 enclosures fitted with pitfall traps to estimate the absolute number of sand skinks per enclosure in three categories of time since last fire: less than 5 years, 6 to 17 years, and 17 to 40 years since last fire. We present the results from three years (Spring 2007, Fall 2007, Spring 2008, Fall 2008 and Spring 2009) of surveying population densities. We observed higher Florida sand skink densities in areas that have not been burned for 17 years or longer, and found some environmental variables to vary with time since fire and sand skink population abundance. We also tested the direct response of sand skinks to fire in 5 enclosures by conducting controlled burns in the fall of 2008. The relationship between fire history and sand skink population abundance should provide land managers with additional information helpful to the conservation of this species.

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186 Poster Session I, Exhibit Hall, Friday 24 July 2009

Tristan Britt[1], Marisa Litz[1], Mattias Johansson[2], Richard Brodeur[3]

[1]OSU/NOAA Cooperative Institute for Marine Resources Studies (CIMRS), Newport, OR, United States, [2]Coastal Oregon Marine Experiment Station (COMES), Newport, OR, United States, [3]National Marine Fisheries Service, Northwest Fisheries Science Center, Newport, OR, United States

Genetic Identification of Northeastern Pacific Late Larval-Juvenile Rockfishes (*Sebastes* spp.) Captured off Oregon and Washington

The National Marine Fisheries Service has taken action to improve stock assessments of commercial marine groundfish species off the U.S. West coast by conducting annual juvenile surveys to track short-term fluctuations in abundance. These surveys provide early indications of shifts in abundance caused by shifts in average recruitment levels. However, visual identification based on morphometrics, meristics, and pigmentation of the 65 commercially important rockfish species of the northeast Pacific is problematic due to substantial overlap among the species. Therefore, we employed genetic methods, based on mitochondrial cytochrome B sequences, to accurately identify post-larval and juvenile rockfishes (*Sebastes* spp.) captured in Stock Assessment Improvement Program (SAIP) surveys. We identified a total of ten species in a sample of 229 individuals collected from the summers of 2005 to 2007. The majority were identified as sharpchin rockfish (*S. zacentrus*; 56%) with the next largest proportion identified as pygmy rockfish (*S. wilsoni*; 28%). Other species identified were Puget Sound rockfish (*S. emphaeus*), redstriped rockfish (*S. proriger*), Pacific ocean perch (*S. alutus*), greenstriped rockfish (*S. elongatus*), silvergray rockfish (*S. brevispinis*), rosethorn rockfish (*S. helvomaculatus*), blue rockfish (*S. mystinus*), and splitnose rockfish (*S. diploproa*). We are currently focusing on a collection in 2008, a year with anomalously high numbers of post-larval rockfishes in

our surveys, which will allow us to correlate rockfish species with environmental variables in the future.

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381 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Richard Brodeur[1], Cassandra Benkwitt[2], Elizabeth Daly[3], Marisa Litz[3]

[1]Northwest Fisheries Science Center, National Oceanic and Atmospheric Administration, Newport, OR, United States, [2]Aquatic Farms, Newport, OR, United States, [3]CIMRS, Oregon State University, Newport, OR, United States

Lipids and Fatty Acids of Juvenile Salmon and their Prey in Coastal Waters

We measured the lipid content and fatty acid composition of yearling Chinook and coho salmon from Washington coastal waters during May and June 2008 shortly after ocean entrance, as well as those of 16 species of juvenile fish and larval invertebrates classified as either common juvenile salmon prey items (prey) or organisms found in relatively high abundance in the field, but not commonly found in juvenile salmon diets (non-prey). Lipid content of prey and non-prey varied both within and between species during our sampling period, although there were no significant differences in lipid content between juvenile fish and invertebrates or between prey and non-prey fish species. There was a significant decrease in lipid content for coho salmon from May (2.6%) to June (1.1%), but not for juvenile Chinook salmon. Juvenile fish prey had significantly higher levels of the essential fatty acids docosahexaeonic acid (DHA) and arachidonic acid (ARA) while invertebrates showed significantly higher levels of eicosapentaenoic acid (EPA). Coho salmon had significant increases in all three EFAs between May and June, while Chinook salmon, which is typically more piscivorous, had significant increases only in the two EFAs indicative of juvenile fish. Lipid content does not seem to be an accurate indicator of prey quality nor of juvenile salmonid condition. However, juvenile salmon may be choosing prey with higher EFA content, specifically DHA and ARA, to adequately meet their physiological requirements and improve survival, making fatty acid signatures a useful tool in food web studies.

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93 Storm Symposium, Pavilion West, Friday 24 July 2009

Edmund Brodie

Utah State University, Logan, UT, United States

Introduction: Robert M. Storm Symposium

An overview to the career of Robert M. Storm and overview to the symposium.

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55 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Bob Brodman

Saint Joseph's College, Rensselaer, IN, United States

Amphibians and Reptiles as Predictors of the Paleoenvironment of the Late Tertiary Pipe Creek Sinkhole

The Pipe Creek Sinkhole (PCS) is a 5 million year old fossil site in Grant County, IN that was the first deposit of its age ever discovered in the interior of the eastern half of North America. Seventeen extant taxa and 4 extinct taxa of amphibians and reptiles have been recovered from PCS. To reconstruct the paleoenvironment I compared the fossil herp assemblage from PCS to the modern assemblage across the Midwest. The extant taxa found in the PCS assemblage are typical of species found in a mosaic of open canopy habitats including oak savanna, prairie, wet meadows, and forest edges. Many of these species prefer habitats with loose sandy soils. The aquatic and semi-aquatic herp taxa suggest that the site had a permanent body of water with ample shallow areas. The presence of *Regina* sp. also suggests that a rocky stream was in the area. A biogeographical approach using GIS indicates that all 17 extant taxa are currently found together only in southeastern Michigan (near Ann Arbor), whereas only 5 extant taxa are currently found in Grant County, IN. The 30-year meteorological norms of southeastern Michigan are significantly cooler (0.6 C) and drier (10.6 cm) than Grant County. The climate differences are most pronounced for temperature from Feb through September and precipitation from March through July. Together these data suggest that PCS had cooler and drier springs and summers than today, with an open-canopy upland community surrounding a permanent pond and associated wetlands.

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822 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Anne Bronikowski, Kylie Robert

Iowa State University, Ames, IA, United States

The Evolution and Ecology of Aging Phenotypes in the Garter Snake

Evolutionary theories of aging are linked to the mortality environment in which the life history evolves. Safe habitats are a priori expected to exhibit stronger selection against deleterious mutations with late-age expression than experienced by individuals in hazardous habitats. This is predicted to manifest at the organismal level in the evolution of energy allocation strategies that spend more energy on somatic maintenance and

robust stress responses in less hazardous environments in exchange for energy spent on growth and reproduction. Here we report on experiments from long-studied populations of western terrestrial garter snake (*Thamnophis elegans*) that reside in safe and hazardous environments. Laboratory common-environment colonies of two ecomorphs with short- and long-lifespan were tested for a suite of physiological characteristics. We measured: mass-independent metabolism (oxygenconsumption, VO2); mitochondrial oxygen consumption, ATP production rate and free radical production; and erythrocyte DNA damage and repair-efficiency. We evaluated whether this suite of parameters mirrored the evolution of life history and concomitant lifespan in this species. Neonates from the long-lived ecotype (less hazardous habitat): (1) were smaller, (2) consumed equal amounts ofoxygen when corrected for body mass, (3) had DNA that damaged more readily but repaired more efficiently, and (4) had more efficient mitochondria and more efficient cellular anti-oxidant defenses than short-lived snakes.

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820 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Anne Bronikowski[1], Amanda Sparkman[1], Dawn Byars[2], Neil Ford[2]

[1]Iowa State University, Ames, IA, United States, [2]University of Texas, Tyler, TX, United States

The Role of Insulin/IGF1 Signaling (IIS) in Snake Reproduction

The insulin/insulin-like growth factor(IGF) /relaxin family is composed of a single insulin, two IGFs, and varying numbers of insulin-like factors and relaxin genes across the vertebrate phylogeny. Insulin-like growth factor-1 (IGF-1) is a hormone that modulates the action of growth hormone; it promotes growth and reproduction, and has been implicated in the reduction of lifespan. IGF-1 is also capable of responding plastically to environmental stimuli and temperature. We determined whether IGF-1 modulates growth, maturation, and reproduction in two species: the house snake (*Lamprophis fuliginosis*), which matures within the first year of life, and the garter snake (*Thamnophis elegans*), which does not mature until at least three years of age. In the house snake we found: (1) IGF-1 is correlated with growth rate at 6 months, (2) IGF-1 peaks after first mating and declines to baseline levels after egg-laying, and (3) IGF1 patterns vary among families. In the garter snake we found: (1) IGF-1 covaries with feeding rate during the first two years of development in the laboratory, (2) IGF-1 was elevated during abundant feeding, during pregnancy in the field. And (3) IGF-1 shows a plastic relationship to adult body size that varies with annual food availability. Unlike mammals and birds, no gradual increase in IGF1 was observed during development. Similar to mammals and birds (also turtles and alligators), however, IGF-1 is elevated during egg-retention (house snake) or pregnancy (garter snake). We discuss the implications of elevated IGF1 signaling for maturation, reproduction and possibly lifespan in snakes.

444 Poster Session I, Exhibit Hall, Friday 24 July 2009

Edward Brooks, Christopher Berry, Annabelle Oronti, Jasmine Wilchcombe, Alannah Vellacott, LeBrocq Maxey, Andy Danylchuk

Cape Eleuthera Institute, Eleuthera, Bahamas

Diversity and Abundance of Sharks in the North East Exuma Sound, The Bahamas: A Comparison between Baited Longline and Baited Underwater Video Survey Techniques

Knowledge of the diversity and abundance of sharks is fundamentally important when attempting to protect these important apex predators. Currently, the standard assessment method for sharks involves the use of baited long-lines, however this approach does have some drawbacks in that it is invasive and sometimes results in mortality. A less invasive and novel alternative is the use of baited remote underwater video surveys (BRUVS) which 'captures' sharks on video rather than physically hooking them. To compare the effectiveness of BRUVS to baited longline surveys, we employed both methods in the Exuma Sound to measure the diversity and abundance of sharks. Surveys were conducted across the four seasons and in three coastal zones differentiated by coarse habitat type and distance from pelagic waters. Soak time and bait type were standardized across methods. Across all seasons combined , diversity of sharks was similar with nine species being caught during long-line surveys and seven during BRUVS. Within seasons, however, concordance of diversity between methods was consistent only during the winter. When comparing species specific CPUE data between survey methods and across seasons, the relative abundance of Caribbean reef sharks (*Carcharhinus perezi*) showed similar increases for both methods in the summer when compared to autumn and winter. Spatial comparisons of CPUE data showed significantly more Caribbean reef sharks were caught in the wall zone than other habitat zones during the longline surveys ($p<0.0001$ $F=29.6639$) yet the same trend was only marginally significant using BRUVS surveys ($p=0.0569$ $F=2.9118$). Other species-specific comparisons will be discussed.

65 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Edward Brooks[1], Katherine Sloman[3], David Sims[2], Andy Danylchuk[1]

[1]Cape Eleuthera Institute, Eleuthera, Bahamas, [2]Marine Biological Association of the United Kingdom, Plymouth, Devon, United Kingdom, [3]University of Plymouth, Plymouth, Devon, United Kingdom

Seasonal Abundance, Demographics and Habitat Use of the Caribbean Reef Shark (*Carcharhinus perezi*) in the North East Exuma Sound, The Bahamas

The Caribbean reef shark (*Carcharhinus perezi*) is a large, reef-associated apex predator common throughout the tropical western Atlantic and Caribbean. Despite the ecological and economic importance of *C. perezi*, relatively little is known about its basic ecology and life history throughout its range, including the Bahamian archipelago. To examine the abundance and habitat use of *C. perezi* in the northeast Exuma Sound, longline surveys were conducted across the four seasons and in three coastal zones differentiated by coarse habitat type and distance from pelagic waters. Soak time for longlines was 90 minutes and each shark landed was sexed, measured, and tagged. In addition, a subset of sharks were implanted with acoustic transmitters and tracked using a fixed receiver array spanning approximately 50 km2. To date, 142 sharks (male n=45 female n=93 unknown n=4) have been captured during 192 sets across three seasons of sampling. Results show distinct variation in relative abundance with a greater number of sharks occurring in the summer when compared with autumn and winter (mean CPUE Summer=1.656, Winter=0.818, Fall=0.352 sharks 100 hooks^{-1} hour^{-1}; $p<0.0001$, $F=13.0180$). Significant differences also occurred between habitat zones with a greater abundance of sharks being caught in the deep reef area immediately adjacent to the Exuma Sound ($p<0.0001$, $F=29.6639$). During the summer months sharks exhibit highly developed philopatry as illustrated by 9.5% recapture rate and a mean linear dispersal between capture and recapture of 1.1 km. Strong philopatry was also evident from the acoustic telemetry data.

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507 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Meriel Brooks

Green Mountain College, Poultney, VT, United States

Larval Fish Drift in a Northeastern River

Drift of freshwater larval fishes (passive downstream movement at certain stages) has been studied since the middle of the 20th century, though not to the same extent as invertebrate drift. The latter are hypothesized to drift for many different reasons: biotic (dispersal, avoidance of predation and competition), abiotic (spates, droughts,

temperature change, or pollution) and accidental (simple dislodgement). Studies of fish and invertebrates most often describe the drift pattern for taxa, but have not shed much light on causes. It is the more recent invertebrate experimental studies that have begun to link drift to its causes for those organisms. Data presented here, from 4 years of night drift collections and 24 hour samples, support the hypothesis of accidental drift for minnow communities in the northeastern river, though other hypotheses are not ruled out. These data are part of an ongoing set of studies intended to rule out hypotheses for larval drift.

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999 Poster Session I, Exhibit Hall, Friday 24 July 2009

Lori Brown[1], Jimmy Kroon[2], Dewayne Fox[1], Bradley Wetherbee[3], Johnny Moore[1]

[1]Delaware State University, Dover, DE, United States, [2]Pennsylvania State University, University Park, PA, United States, [3]University of Rhode Island, Kingston, RI, United States

Shark Tracker: Utilizing Web-based GIS to Educate the Masses

Delaware State University has been using biotelemetry to record and examine the movement patterns of several important Delaware Bay species, including sand tiger sharks (*Carcharias taurus*). Managing these data through GIS provides a powerful means for both spatial and temporal analyses. Although desktop GIS software facilitates management, analysis, and conversion of these data into valuable information for fisheries professionals, traditional reporting methods often fail regarding outreach to the public sector. We are developing Shark Tracker, a web-based interactive GIS that allows users to explore sand tiger shark movement patterns and visualize spatial relationships between shark movements, environmental conditions, and habitat features. Web-based mapping tools allow resource managers to explore research information and receive more timely updates with ongoing projects, aiding in species management and planning. Shark Tracker can also be used as an outreach and educational tool to expand public understanding for sand tigers which are common in large aquaria exhibits. The Shark Tracker site uses a geospatial data server, GeoServer, which communicates with a mapping client, OpenLayers, running in a web browser. Customized OpenLayers functionality allows users to choose how sand tiger movement information is displayed according to several variables. GeoServer and OpenLayers are free, open-source software providing low-cost alternatives to commercial GIS servers. Whether through open-source or commercial software, Web-GIS provides multiple user groups information access without costly software, increasing feasibility of large-scale outreach, education, and resource management projects.

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300 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Nancy J. Brown-Peterson[1], David C. Heins[2]

[1]University of Southern Mississippi, Ocean Springs, MS, United States, [2]Tulane University, New Orleans, LA, United States

Effects of a Cestode Macroparasite on Oocyte Recruitment and Spawning of Alaskan Threespine Stickleback

Threespine stickleback (*Gasterosteus aculeatus*) from Walby Lake, Alaska, show varied reproductive responses to infection by the cestode macroparasite *Schistocephalus solidus*. Three collections of stickleback taken during the first half of the reproductive season in 2000 - 2001 were analyzed to examine the potential impact of *S. solidus* on clutch production. Histological analysis showed that the ratio of primary growth/late vitellogenic oocytes was always largest in infected fish; this difference was significant ($p<0.01$) in late May 2000 and 2001 and marginally significant ($p=0.087$) in June 2001. These results suggest a decrease in recruitment of oocytes from the standing stock of primary growth oocytes into vitellogenesis in infected fish, resulting in fecundity reduction. Histological estimations of interspawning interval using postovulatory follicles (POFs) show no significant differences between infected and uninfected fish for any collections, suggesting that the frequency of ovulation and spawning of mature oocytes is unaffected by *S. solidus*. Furthermore, there is no difference in the percentage of vitellogenic oocytes undergoing atresia in the ovaries of infected and uninfected fish for any collection, suggesting that once an oocyte enters vitellogenesis it successfully undergoes maturation and ovulation. Thus, it appears that sequential processes in the reproduction of *G. aculeatus* are differentially affected by the presence of the macroparasite. The reduction in recruitment of oocytes into vitellogenesis may represent a response of parasitized sticklebacks to the nutrient theft imposed by *S. solidus*, such that the fish only recruits the number of oocytes she can support for growth, maturation and spawning.

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178 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD I, Galleria North, Sunday 26 July 2009

Elizabeth Broyles[1], David Owens[1], Bill Roumillat[2], Erin Levesque[2]

[1]College of Charleston, Charleston, SC, United States, [2]Department of Natural Resources, Charleston, SC, United States

Diamondback Terrapins (*Malaclemys terrapin*) Of The Ashley River: Estimated Population Size, Sex Ratio, and Distribution

We examined the structure of the diamondback terrapin (*Malaclemys terrapin centrata*) populations in the Ashley River near Charleston, South Carolina. This is an area of high boat use including the trapping of blue crabs, sport fishing, recreational boating, and industrial shipping. Little is known about current terrapin population status or distribution in this heavily used estuarine area. In conjunction with an extensive trammel netting study of estuarine fishes, mark and recapture methods were used to estimate terrapin population parameters. Terrapins were marked using passive integrated transponder (PIT) tags during 12 sampling days over 12 months that resulted in 428 terrapins tagged and 29 recaptures. Mark and recapture data were statistically analyzed using the program MARK to determine population estimates, and sex ratios were determined to be significantly male biased at 1:1.46 ($p<.01$). The distribution of terrapins over a thirteen year period (1995-2008) was analyzed using the SCDNR trammel netting data in which terrapins were counted as a bycatch species. Catch per unit effort of terrapins at each of the 26 sampling sites along the Ashley have been recorded since 1995. Movements of localized terrapin densities were evaluated using ArcGIS. This information on population size, sex ratios, and distributional changes will be used to determine if regulation on habitat degradation, as well as possible protection, is needed for this species.

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981 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

John Bruner

University of Alberta, Edmonton, Alberta, Canada

Spreitzer vertebrae, a new unreported character for *Esox* (Esocidae, Esociformes)

Bruner (2004), in an osteological study of the Percidae, defined Spreitzer vertebrae as anterior caudal vertebrae in which the haemal canal arches are not closed ventrally, and the right and left arches lend support to the anterior proximal pterygiophores of the anal fin. The open haemal arches allow an extension of the abdominal cavity into the anterior caudal region. Of the nine percid genera and 44 species examined, Bruner found

Spreitzer vertebrae only in Ammocrypta and concluded this to be a unique character of the crystal and sand darters. Examining YOY specimens of *Esox lucius*, *E. masquinongy*, *E. niger*, and *E. americanus*, Spreitzer vertebrae were found supporting the proximal pterygiophores of the anal fin. However, Spreitzer vertebrae were not found in adult skeletons of *E. lucius*. Specimens examined of *Dallia pectoralis*, *Novumbra hubbsi*, and *Umbra limi* (Umbridae, Eosciformes) did not possess this type of vertebrae.

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419 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Walter Bubley[1], James Sulikowski[2], Paul Tsang[1], David Koester[2]

[1]University of New Hampshire, Durham, NH, United States, [2]University of New England, Biddeford, ME, United States

Histological Staining of Vertebral Centra Increases Precision of Age Estimates Compared to Dorsal Fin Spines in Spiny Dogfish, *Squalus acanthias*

Spiny dogfish (*Squalus acanthias*) are considered to be the most abundant shark species in the Western North Atlantic, but recent concerns regarding a decline in their numbers argue for an update of previous life history parameters. However, wear and breakage of the spine, as well as variablility in interpretation of growth increments has resulted in conflicting age estimates in the literature. The uncertainty in estimating age in turn affects other parameters that are dependent on it, such as growth rate and age at maturity. Our hypothesis was that the growth increments of vertebral centra provided more consistent and reliable estimates of age than the dorsal fin spine method for spiny dogfish in the Western North Atlantic. Vertebrae and second dorsal fin spines were collected monthly from spiny dogfish from July 2006 - December 2008. The spines were examined whole while the vertebrae were sectioned and prepared using histological techniques to enhance the visualization of the growth increments. Using these two structures, two readers provided age estimates that were compared with coefficient of variation and average percent error. The vertebral centra produced more precise age estimates between and within readers compared to the dorsal spine method. Ultimately, the vertebral centrum provided a structure that produced a more reliable correlation between age and total length, a parameter critical to improving population models and successful management of spiny dogfish in the Western North Atlantic.

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739 Fish Ecology III, Pavilion West, Monday 27 July 2009

Michele Buckhorn

University of California, Davis, Davis, CA, United States

The Influence of Habitat and Exploitation on Reef Fish Assemblages

Human-induced, top-down predation of marine species has resulted in huge reductions or loss of target species. Direct effects of predator removal are reduced size classes and abundances of predators. Indirect effects can result in density or behaviorally-mediated effects such as trophic cascades, where prey species abundances increase, food web dynamics change, and species diversity is reduced. Released from predation pressure, prey items increase causing a subsequent decline in reef invertebrates. This study was conducted in Loreto Marine Park, Baja California Sur, Mexico from 2004-2007. Subtidal surveys were conducted to assess reef organism densities and substrate factors. There were clear patterns of different assemblage types being associated with benthic fish predator densities. Unfortunately, many benthic predator densities were so low that they were excluded from multi-dimensional scaling analysis because their abundances were less than 1% total fish abundances. Some species were even less than 0.1% of total densities. The very low abundances of these species might partly explain the limited evidence for strong trophic cascades. The one benthic predator species sufficiently abundant to be included in the analysis was the leopard grouper (*Mycteroperca rosacea*). Site differences were correlated with the presence of other piscivorous predators, including leopard grouper, and there were spatial similarities in fish assemblages among reefs.

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746 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Michele Buckhorn, Peter Klimley

University of California, Davis, Davis, CA, United States

Movements of Sevengill Sharks in San Francisco Bay

The sevengill shark, *Notorhynchus cepedianus*, is a member of the family Hexanchidae. Adult sevengills are common inhabitants of estuaries and bays from southeastern Alaska to the southern end of the Baja Peninsula, and a population exists within the northern Gulf of California (Ebert, 2003). Although adults are commonly captured in Humboldt and San Francisco Bays at certain times of the year, it is not known whether sevengill sharks are resident year round or whether they leave the bays and migrate along the coastal shelf. In order to determine the movement patterns of sevengill sharks, sharks were caught within San Francisco Bay on hook and line and implanted with either a coded (n=20) or continuous (n=4) VEMCO transmitter between July and October, 2008. Lengths of sharks caught ranged from 89.0 to 246.0 cm with a mean

length of 162.21 ± 43.77 cm. The four continuous transmitters were individually tracked for up to 72 hours each. Preliminary observations are as follows: sharks maintained their positions in the water column between 4 and 30 meters depth and tidal currents influenced their movements heavily; their movements in and out of San Francisco Bay were synched with the ebb and flood tides. While the actively-tracked sharks stayed within the Bay or within a 10-kilometer distance just outside the Golden Gate Bridge, one sevengill shark with a coded tag was recently detected at the monitors placed in Bodega Bay, approximately 65 miles north of San Francisco Bay.

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521 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009

Vivian Buehler, Vera Maria Almeida-Val, Adalberto Val

INPA- National Institute of Amazonian Research, Manaus, Brazil

Hypoxia in a Changing World - What Can We Learn from Amazon Fishes?

Due to global warming and anthropogenic influences, the concern regarding oxygen availability in aquatic systems is increasing. In tropical areas, this worry is even larger, since organisms are already compelled to live at their physiological limits. In the Amazon basin, where the amount of dissolved oxygen undergoes huge daily and seasonal oscillations, many fish species developed different strategies to cope with such environments. Among them, Oscars (*Astronotus ocellatus*) present incredible ability to survive under hypoxic and even anoxic conditions. At moderate hypoxia, metabolism is suppressed while under severe hypoxia or anoxia; anaerobic metabolism is activated to supply energy demands. Nevertheless, under laboratory conditions, reduction of aerobic metabolism seems to be related to decreasing in growth, gonadal development and spawning, and therefore, it fails to explain how the species thrive in those daring environments. Recent developments in post-genomic science offer now broad, open screening approaches to understanding mechanisms underpinning hypoxia tolerance, and identifying candidate genes. In the present study 10 couples of wild *Astronutus* were submitted to either long-term moderate hypoxia or normoxia until reproduction. Right after spawning, blood, brain, liver, gonads, and gills tissue were sampled. A small sample of eggs from each couple was frozen while the remaining amount was subdivided and immediately resubmitted to hypoxia or normoxia until larval hatching. Larvae from each treatment were sampled and remaining individuals pursued growth till juvenile stage. A cDNA library has been generated; available data will be presented and discussed.

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989 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Kurt Buhlmann[1], Tracey Tuberville[1], Stephanie Koch[2], Brian Butler[3], Veronica Palermo[3], Jason St. Sauver[2], Eileen McGourty[2]

[1]University of Georgia, Savannnah River Ecology Laboratory, Aiken, SC, United States, [2]U.S. Fish and Wildlife Service, Eastern Massachusetts National Wildlife Refuge Complex, Sudbury, MA, United States, [3]Oxbow Associates, Inc., Boxborough, MA, United States

Reintroduction as a Conservation Tool for Blanding's Turtles

The validity of reintroduction as a conservation tool for declining amphibian and reptile species has been debated in the literature and among scientists and conservation biologists. We developed a structured decision-making tree to assist managers and biologists faced with evaluating the appropriateness of reintroduction or population augmentation as a conservation measure for a target species or focal population. Important facets of the decision-making tree include, but are not limited to, landscape needs of the species, genetic concerns, and evaluation and remediation of threats that may have initially caused the species' local extirpation. We next implemented the decision-making tree at a specific site and determined that reintroduction is a valid conservation tool for Blanding's turtles in Massachusetts. Using this decision tree, we developed a comprehensive, science-based and model-informed reintroduction proposal. The proposal identified a candidate donor population and evaluated the appropriateness of relocating various life stages (hatchlings, head-started hatchlings, juveniles, and adults) with emphasis on minimizing overall impact to the donor population while successfully establishing a new population. We developed population models based on known life history traits of Blanding's turtles to predict the number of animals of each selected life stage that need to be introduced annually in order to achieve a viable, self-sustaining population at the new site. We began implementing this project in 2007 and preliminary results will be presented.

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887 Fish Genetics II, Parlor ABC, Monday 27 July 2009

Vincent Buonaccorsi

Juniata College, Huntingdon,PA, United States

Molecular Signals of Natural Selection in *Sebastes chrysomelas* and *S. carnatus*

Little is known regarding specific genetic mechanisms that lead to adaptive divergence in marine fishes. Identifying regions of the genome that have experienced or are currently experiencing adaptive divergent selection in recently separated species may also provide insight into factors leading to their speciation. *Sebastes chrysomelas* and *S.*

carnatus are the two most closely related species members of the speciose genus *Sebastes*. Prior microsatellite DNA studies established that the two are distinct taxa. However, inter-specific divergence levels were exceedingly low, with exception of a single highly divergent locus, *Sra*.7-2. We expanded genome coverage to 33 microsatellite loci and the *Sra*. 7-2 locus remained a divergence outlier when accounting for single locus variance in F_{ST} expected at mutation-drift equilibrium. Using genome walking we characterized 20,000bp of surrounding DNA sequence. Two linked microsatellite loci were identified in the surrounding region, and both were also exceptionally divergent when scored in each species, strongly suggesting that the area has been impacted by directional selection. Unexpectedly, all three loci were in Hardy-Weinberg disequilibria within *S. chrysomelas* alone, suggesting that selection is still acting on the region in this species. Three genes were also identified in the area. Preliminary analyses of non-synonymous to synonymous amino acid substitution rates will be presented to identify the target of selection.

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266 Herp Ecology, Galleria North, Monday 27 July 2009

Nick Burgmeier, Rod Williams

Purdue University, West Lafayette, IN, United States

Movement Patterns, Habitat Use, and Home Range Size in Eastern Hellbenders

Eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) are large aquatic salamanders that have suffered substantial population declines throughout their range. Many aspects of their biology have been studied, but little is known regarding habitat use, dispersal, and home range size within small isolated populations. We sampled for adult hellbenders at 40 locations along the Ohio River drainage during 2008. We surgically implanted radio transmitters in 17 hellbenders throughout a 112-km stretch of river. Individuals were tracked 2-3 times per week for up to 10 months. We discuss seasonal movement patterns, habitat use, and home range size in light of the physical characteristics associated with both macrohabitat and microhabitat types. Radio-tracking is expected to continue for an additional 12 months and will provide valuable insight into the breeding biology and movement patterns of eastern hellbenders within an agriculturally-dominated landscape.

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407 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Derek Burkholder[1], Michael Heithaus[1], Jordan Thomson[2], Aaron Wirsing[3]

[1]Florida International University, Miami, FL, United States, [2]Simon Frasier University, Vancouver, British Columbia, Canada, [3]University of Washington, Seattle, WA, United States

Does Tiger Shark (*Galeocerdo cuvier*) Predation Risk Influence Habitat Use of Green Sea Turtles (*Chelonia mydas*) at Multiple Spatial Scales?

Trade-offs between predation risk and food availability shape habitat use decisions of many species. However, these factors can vary significantly at differing spatial and temporal scales. Because foraging by large-bodied herbivores can alter the dynamics of plant communities it is important to understand the factors driving their habitat use. From 1999-2009, we assessed habitat (deep waters vs shallow seagrass banks) and microhabitat (bank edges and interior portions of banks) use of green sea turtles (*Chelonia mydas*) in relation to the availability of food and perceived risk from tiger sharks (*Galeocerdo cuvier*) in Shark Bay, Western Australia. Habitat use was assessed using belt transects and predation risk was determined using catch rates on drumlines (temporal variation) and acoustic tracking from previous studies (spatial variation). At the level of habitats, green turtles selected shallow banks where food availability was high and, surprisingly, did not show a significant shift into safer, deeper waters when tiger shark abundance increased. Similarly, we did not detect population-level shifts in microhabitat use; the distribution of turtles between more dangerous interiors and safer edges did not shift seasonally. This may be due to the year-round presence of sharks during years when we assessed microhabitat use (i.e. shark abundance changed but they never abandoned the bay) or the possibility that green turtles manage predation risk primarily at the microhabitat level and based on their individual body condition whereby low-condition animals are willing to take risks to forage in high-risk but high-gain interior habitats when sharks are abundant.

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367 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Kelly Burnett[1], Dede Olson[1], Daniel Miller[2]

[1]Pacific Northwest Research Station, Corvallis, OR, United States, [2]Earth Systems Institute, Seattle, WA, United States

Evaluating Linkage Areas on Headwater Streams for Conserving Amphibians and Salmon

Headwater stream channels in forested, montane ecosystems provide habitat for numerous species and can influence conditions and processes downstream. Efforts to quantify differences among headwater channels as a potential framework for prioritizing freshwater conservation actions have generally targeted a single resource or species. In this study, we synthesize understanding about the characteristics of headwater channels that may control their relative value both as amphibian habitat and as a source of materials to downstream salmon habitats. In this context, the potential effects were evaluated of streamside management zones aimed at different proportions and spatial configurations of the headwater channel network. Headwater channels were ranked across western Oregon, USA, based on estimated probabilities of being affected by debris flows that deliver to salmon-bearing channels downstream. The ranks were used to delineate alternative streamside management zones encompassing 25%, 50%, and 75% of these debris-flow susceptible headwater channels. The highest debris-flow probabilities were contained in a relatively small area. Thus, focusing streamside management zones along these most debris-flow susceptible headwater channels may be sufficient to provide essential functions for salmon-bearing channels. But, the resulting area and spatial configuration in streamside management zones may be insufficient to meet the habitat needs of headwater-dependent amphibians.

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537 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Gwendolynn Bury[1]

[1]Western Washington University, Bellingham, WA, United States, [2]Oregon State University, Corvallis, OR, United States

Physiological Response of Larval Tailed Frogs, *Ascaphus truei*, to an Ecologically Relevant Thermal Stress

Human alterations, such as timber harvest, have affected many forested streams of the Pacific Northwest as well as the unique and important species which inhabit them. I

sought to determine if the maximum summer temperatures in small streams cause physiological stress to tadpoles of the Tailed frog, *Ascaphus truei*. I obtained 40 Ascaphus tadpoles in northern Washington State for laboratory testing in 4 replicates of 10 animals each. Half of the tadpoles in each replicate were exposed to 3 days of a daily temperature cycle similar to that experienced in sunlit, disturbed canopy, streams (low 10° , high 23°C), and the other half to 3 days of a daily cycle similar to that of shaded streams (8-13°C). On the third night, the water temperatures was decreased to the low of the warm stream (10°C) and I then determined the resting rate of oxygen consumption as an estimate of physiological stress. The entire experiment was repeated 4 times. The tadpoles that experienced warmer temperatures consumed significantly more oxygen (61%) than the cool treatment tadpoles. These findings show a physiological response in an endemic headwater amphibian to a realistic human-caused stream temperate change, indicate that *Ascaphus* may be a good indicator species, and should have impacts on future research and management in the Pacific Northwest.

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534 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

R. Bruce Bury[1], David J. Germano[1]

[1]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR, United States, [2]California State University, Bakersfield, CA, United States

Ecology and Conservation of Tortoises and Freshwater Turtles: What Are the Challenges Ahead?

We have many unanswered questions and scant support to address the biology and conservation of chelonians. Most of our knowledge is based on studies of a few species or ones limited to one geographic area. We seldom design comparative studies or sample at multiple study areas across a region. We need to ask more theoretical questions as well as conduct applied studies on populations and their environments. There is little available on how turtles use aquatic and terrestrial environs on daily or seasonal bases, and increased use of radio-telemetry would assist in gathering this data. Better understanding of population features requires more studies on growth rates, fecundity, longevity, and survivorship. The ecology of small-sized individuals remains almost unknown and this biological information is critical for conservation and wise management of chelonians. We should establish a global network of permanent sampling sites to track changes in turtle and tortoise numbers over time, including an effort to locate and archive existing data sets before more are lost. Because habitat loss and alteration remain the principal threats to the long-term survival of chelonians, we need to identify what specific areas should be afforded protection. Today, most standing waters near urban areas are occupied by introduced turtles and we do not understand their impacts. Turtles and tortoises receive widespread public support and this assists efforts to protect them. We urge biologists to merge their skills with educational efforts to help improve management of wild populations of chelonians.

1044 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Thaddaeus Buser, Isadora Jimenez-Hidalgo, Nancy Davis, Lorenz Hauser

University of Washington, Seattle, WA, United States

Genetic Techniques Provide Evidence of Chinook Salmon Feeding on Walleye Pollock Offal

Declining runs of Chinook salmon in western Alaska have focused interest on the ocean condition and food habits of Chinook salmon in the Bering Sea. Observer sampling by the U.S. North Pacific Groundfish Observer Program (NOAA Fisheries) provided stomach samples of Chinook salmon caught during winter. Examination of the stomach contents revealed isolated pieces of skin, bones, and fins belonging to large bodied fish, suggesting that Chinook salmon were feeding on fish offal. These pieces were determined to be either Pacific cod (*Gadus macrocephalus*) or walleye pollock (*Theragra chalcogramma*), but differentiation between the two species was impossible by physical means alone. To confirm the species identification of the fish parts, we designed novel mitochondrial DNA (mtDNA) primers to amplify a 174 base pair (bp) long section of the Cytochrome oxidase subunit I (COI) to match DNA sequences of the samples to known sequences of walleye pollock and Pacific cod downloaded from the GenBank database. The specific design of our primers allowed us to make positive identification and differentiation of walleye pollock and Pacific cod. Of the 15 offal samples, 9 yielded usable sequences, all of which were positively identified as walleye pollock. Our results clearly demonstrate the utility of a short COI sequence for species identification of Chinook salmon stomach contents that might otherwise be unidentifiable due to the state of digestion, or because the salmon consumed isolated body parts rather than the whole fish. These results suggest that walleye pollock offal supplements the diet of Chinook salmon during winter.

1003 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Donald Buth

UCLA, Los Angeles, CA, United States

Should Mitochondrial DNA Sequences be Used in Phylogenetic Studies of Fishes, Amphibians, and Reptiles?

Despite the concerns of many systematists, DNA sequence data have become the paradigm in current phylogenetic studies of fishes, amphibians, and reptiles. However, mitochondrial DNA and nuclear DNA have quite different properties, and some of the former violate prerequisites for phylogenetic application. As a symbiont, mtDNA is

extrinsic to its host's genome and is inappropriately used as a proxy for the latter. mtDNA is inherited as a unit and can be subject to intact lateral transfer via hybridization, yielding a conflicting signal in regard to the phylogeny of the hosts. mtDNA is useful in determining the direction of hybridization and perhaps at the population level (gamma). However, at the interspecific level (beta), mtDNA should be used only as a one-way test of hypotheses that are based on characters of the host, e.g. as applications of Hennig's Parasitological Method. mtDNA should not be used as a primary database in phylogenetic studies. All previous phylogenetic applications of mtDNA should be checked with nuclear DNA sequences and/or other intrinsic data.

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603 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Elaine Caldarone[1], Sharon MacLean[1], Beth Sharack[2], Shayla Williams[2], John McCarthy[2], Vincent Guida[2], Brian Beckman[3]

[1]DOC/NOAA/NMFS/NEFSC, Narragansett, RI, United States, [2]DOC/NOAA/NMFS/NEFSC, Highlands, NJ, United States, [3]DOC/NOAA/NMFS/NWFSC, Seattle, WA, United States

Potential Non-lethal Methods for Estimating Condition and Growth Rates in Juvenile Fish

We conducted laboratory studies using juvenile Atlantic salmon (*Salmo salar*) (18 - 22 cm FL) and juvenile Atlantic cod (*Gadus morhua*) (16 - 24 cm TL) to evaluate the response time and efficacy of three potential non-lethal methods for estimating growth rate and condition. The methods tested were: bioelectrical impedance analysis (BIA), use of a growth hormone (insulin-like growth factor, IGF-I), and the ratio of RNA to DNA (R/D). To obtain a range of condition and growth rates, we subdivided individually tagged fish into two groups: one group was fed to satiation, while the other group was food deprived. On day 0, blood was withdrawn from the caudal vein for IGF-I analysis, muscle tissue was removed with a 2 mm biopsy punch for R/D analysis, and bio-impedance measurements were determined. Every 4 days thereafter over the next 23 days, 4 fish from each treatment again were sampled using the three methods and then immediately sacrificed. Each carcass and liver was analyzed for total lipid, protein, and water content. Initial sampling for BIA, IGF-I and RNA/DNA appeared to be non-lethal as no mortalities or infections occurred during the experiment due to these protocols. For each approach, preliminary results are presented with respect to the response time to food deprivation, and the utility of the approach to estimate growth rates and fish condition.

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965 Snake Conservation, Pavilion West, Monday 27 July 2009

Earl Campbell

U.S. Fish and Wildife Service, Honolulu, HI, United States

Brown Treesnake Management: A Programmatic Update

The introduced brown treesnake (*Boiga irregularis*) on the island of Guam has been the focus of significant effort since the mid-1980's. This snake introduction is the cause of well documented, negative biodiversity, economic and human health impacts. The potential introduction and establishment of this snake to other sites within and beyond the Pacific region is an on-going concern. Brown tree snake interdiction, control and research have been the subject of long-term cooperative efforts that include agencies and entities on a local, regional, national and international scale. On a national level, brown treesnake control is coordinated by the U.S. Fish and Wildlife Service through the federally-mandated Brown Tree Snake Technical Working Group. This talk will summarize successes and challenges faced by the community working on brown treesnake management from a broad-scale perspective. A critical success is the reduction of brown tree snakes detected in the State of Hawaii in association with the movement of civilian and military vehicles or cargo from Guam. This success is directly linked to the implementation of dedicated snake interdiction program operated by USDA-Wildlife Services. Significant progress has been made in the areas of snake capture and control techniques. These efforts have primarily been the product of USGS - Biological Resources Division and USDA - Wildlife Services - National Wildlife Research Center efforts. A challenge is Department of Defense (DOD) growth on Guam, which will create a substantial increase in air and sea traffic to other sites in the Pacific and the Continental United States.

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864 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Matthew Campbell[1], J. Andres Lopez[2]

[1]University of Alaska Fairbanks, Fairbanks, AK, United States, [2]University of Alaska Museum of the North, Fairbanks, AK, United States

Genetic Diversity of *Dallia pectoralis* (Alaska Blackfish) in Central and Western Alaska

The genus *Dallia* is confined to Beringia, a unique distribution among primary freshwater fishes and one that must reflect the history of glaciation and sea level fluctuations across the present and historical range of that lineage. *Dallia pectoralis* (Alaska blackfish) occurs to the East and West of the Bering Strait, with the largest proportion of its range contained in the state of Alaska. In Asia, D. pectoralis is restricted to a narrow band on the eastern edge of the Chukchi Peninsula. In Siberia, two species of

Dallia are recognized to the west of the range of *D. pectoralis*. In contrast, other Beringian freshwater fishes such as *Esox lucius* (Northern pike) and *Lota lota* (burbot) have large ranges, with themselves or congeners distributed from Western Europe through northern North America. The dispersal ability of *D. pectoralis* is predicted to be very low compared to other Beringian freshwater fishes, and as a result a more structured phylogeographic signal should be evident in its genetic variability. Within Alaska, karyotypic differences between Colville River and Yukon River populations point to complete genetic isolation between Arctic and Bering drainages. We examine the extent and spatial distribution of mitochondrial DNA diversity (control region and cytochrome oxidase I) within and among populations in the Yukon-Kuskokwim system to estimate the extent of movement and connectedness across drainages in this region. These observations provide a baseline measurement of genetic variability to inform tests of different phylogeographic hypotheses for the species, the genus, and the freshwaters of Beringia.

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221 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

John Carlson[1], Cami McCandless[2], Enric Cortes[1], Dean Grubbs[4], Kate Andrews[1], Aaron MacNeil[1], Jack Musick[3]

[1]NOAA Fisheries Service, Panama City, FL, United States, [2]NOAA Fisheries Service, Narragansett, RI, United States, [3]Virginia Institute of Marine Science, Gloucester Point, VA, United States, [4]Florida State University, Tallahassee, FL, United States

An Update on the Status of the Sand Tiger Shark, *Carcharias taurus* for the U.S. Atlantic Ocean

The sand tiger, *Carcharias taurus*, is a coastal shark inhabiting waters in the U.S. Atlantic Ocean. Sand tiger relative abundance has been reported to have declined by 75% since the mid 1970s. NMFS identified the sand tiger as a Species of Concern in 1997 due to its low productivity and purported decline in abundance. We evaluated several new sources of data to provide an update as to whether sand tigers should be retained or removed from the species of concern list. We found little evidence to support the conclusion that sand tigers are endemic to any discrete location in U.S. Atlantic waters. Sand tigers have very low productivity—or low rebound potential—and are among those sharks on the "slower" section along the "fast-slow" continuum of life history traits and population parameters. Average size for all long term series has remained relatively stable suggesting that growth overfishing has not been occurring. An analysis of trends in abundance from multiple data sources indicated the lack of a considerable decline in abundance for any series examined. Most series showed low to moderate declines in abundance, from 0.2% to 6.2%. However, owing to the exceptionally low productivity of sand tigers and the relatively low sample sizes on which we based our trend analyses that led to very high levels of uncertainty in our parameter estimates, we

are hesitant to remove this species from the NMFS species of concern list and thus recommend that it be retained as a precautionary approach.

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903 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Rose Carlson, George Lauder

Harvard University, Cambridge, MA, United States

Kinematics and Performance Limits of Four Species of *Etheostoma* Darters (Percidae: Etheostomatinae) During Benthic Station-Holding

Etheostoma darters represent a substantial radiation of freshwater fishes that live in close association with the substrate in North American streams and rivers. A key feature of any *Etheostoma* darter is therefore its ability to stay in place or to "hold station" in flowing water. Here, we describe the primary kinematic responses of four station-holding darter species to a range of imposed flow velocities. We also find the performance limits of the species by determining the lowest flow speed at which each loses contact with the substrate and slips downstream. We measured body and fin positions from individual frames of high-speed video obtained from four morphologically divergent darter species, the rainbow darter *Etheostoma caeruleum*, the fantail darter *E. flabellare*, the Missouri saddled darter *E. tetrazonum*, and the banded darter *E. zonale* holding station over speeds ranging from 4 to 67 cm/s in a flow tank on small rock substrate. We found broad similarities in station-holding posture among species across flow speeds. Changes in body posture and paired fin position associated with increases in flow speed are consistent with those predicted to increase negative lift forces and other substrate contact forces in order to reduce the likelihood of a downstream slip. Despite overall similarity in posture, we found significant differences in station-holding performance among species. These differences may be linked to variation in pectoral fin or body morphology. In general, species having pointed or wing-like pectoral fins performed better than species having round pectoral fins.

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433 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Evan Carson[1], Sten Karlsson[2], Eric Saillant[3], John Gold[1]

[1]Texas A&M University, College Station, TX, United States, [2]Nofima, Ås, Norway, [3]Gulf Coast Research Laboratory, Ocean Springs, MS, United States

Genetic Studies of Hatchery-Supplemented Populations of Red Drum, *Sciaenops ocellatus*, in Four Texas Bays

Genetic diversity, population structure, and average, long-term genetic migration and effective size of red drum, *Sciaenops ocellatus*, in each of four Texas bays were assessed using variation in 13 nuclear-encoded microsatellites among samples from the 2004 and 2005 cohorts. Each of the four bays is supplemented annually by the Texas Parks and Wildlife Department (TPWD) with from 1.8 to 5.3 million hatchery-produced, red drum fingerlings. No significant differences in genetic diversity, measured as number of alleles, allelic richness and gene diversity (expected heterozygosity), were detected among bays. Tests of homogeneity of allele and genotype distributions among bays, including analysis of molecular variance (AMOVA), were non-significant. Estimates of the average, long-term (mutation-scaled) migration rate (M) between adjacent bays were low, but fairly symmetric. Estimates of average, long-term effective size in the four bays ranged from 1,602 to 2,587, sufficient to offset concerns regarding population fitness and long-term persistence. Adjustment of long-term effective sizes (Ne) in each of the four bays relative to the estimated surface area and the shoreline distance in each bay revealed a positive relationship between both Ne/km^2 (surface area) and Ne/km (shore-line distance) and red drum abundance as measured by catch-per-unit effort statistics compiled between 1982 and 2005 by TPWD biologists. The observed high levels of genetic diversity and homogeneity and the estimates of average, long-term effective size indicate that the TPWD stock-enhancement program likely has not genetically compromised the 'wild' red drum subpopulations in the four bays.

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649 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Felipe Carvalho[1], Debra Murie[1], Fabio Hazin[2], Humberto Hazin[2], George Burgess[1]

[1]University of Florida, Gainesville, Florida, FL, United States, [2]Universidade Federal Rural de Pernambuco, Recife, Brazil

Blue Shark (*Prionace glauca*) Spatial Distribution and Catch Probabilities in the Southwest Atlantic Ocean

Generalized Regression Analysis and Spatial Prediction (GRASP) was applied to the catch per unit of effort (CPUE) data of blue shark from the Brazilian tuna longline fleet

between 1997 - 2007 (44,633 longline sets), and size class data (11,932 individuals) from the Brazilian observer program between 2006 and 2008, in order to better understand the relationship between catch distribution and environmental factors (sea surface temperature, depth of mixed layer, chlorophyll concentration, and distance from coast). Results indicated that spatial catch probabilities for blue sharks were closely related to sea surface temperature. CPUE spatial prediction map indicated higher catch probabilities of blue sharks between 30^0 - 45^0S of latitude and 48^0 - 23^0W of longitude. Size class spatial prediction maps indicating higher probabilities of juveniles concentrating in latitudes below 41°S, adults and sub-adults in middle latitudes between 16^o - 30^oS, and large-adults in latitudes between 5N°-10°S. These results suggest that the spatial distribution in length class of blue sharks included the entire Southwest Atlantic, between 5°N and 45°S, and might be influenced by oceanographic events in the area.

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648 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Felipe Carvalho[1], Debra Murie[1], Fabio Hazin[2], Humberto Hazin[2], George Burgess[1]

[1]University of Florida, Gainesville,Florida, FL, United States, [2]Universidade Federal Rural de Pernambuco, Recife, Brazil

Catch Trends, Distribution, and Length-frequency Composition of Blue Sharks (*Prionace glauca*) Caught by Brazilian Tuna Longline Fleet in the Southwest Atlantic Ocean

Catch-per-unit-effort (CPUE) of blue sharks (*Prionace glauca*) caught by the Brazilian tuna longline fleet (national and chartered) from 1978 to 2007 (60,645 sets) and size class data (11,932 individuals) from the Brazilian observer program between 2006 and 2008 were analyzed. CPUE, as a measure of relative abundance, was standardized by a general linear model (GLM) using three different approaches: i) a negative binomial error structure (log link); ii) the traditional delta-lognormal model, assuming a binomial error distribution for the proportion of positive sets, and a Gaussian error distribution for the positive blue shark catches; and iii) the Tweedie distribution, recently proposed to adjust models with a high proportion of zeros. A cluster analysis was used to identify target species and was incorporated as a factor into the GLM. Blue shark standardized CPUE showed a relatively stable trend from 1978 to 1995. From 1995 on, however, there was an increasing trend in standardized CPUE, with a sharp rise between 2000 and 2002, reaching a maximum in 2007. The overall results of blue shark size data showed a clear spatial and seasonal distribution for male and female blue sharks in the Southwest Atlantic Ocean.

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922 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Marcelo Carvalho

Universidade de Sao Paulo, Sao Paulo, SP, Brazil

Morphology and Phylogenetic Relationships of the Giant Electric Ray from the Eocene of Monte Bolca, Italy (Chondrichthyes: Torpediniformes)

The giant electric ray, *Narcine molini* Jaekel, 1894, from the Middle Eocene (Lutetian) Monte Bolca deposits of northeastern Italy, is redescribed on the basis of three holomorphic specimens, two of which are reported for the first time. *Narcine molini* is placed in a new genus, which is compared to all living and fossil electric ray genera. It is characterized by its derived, extremely elongated tail (at least one-half of total length), absence of dorsal fins, great size, and by other features still of uncertain polarity within torpediniforms, such as absence of posterior processes at midlength of antorbital cartilages, presence of rostral fontanelle, and absence of basonasal rostral fenestrae. Morphological features of the new genus with systematic significance include anterolaterally projecting and branched antorbital cartilages, broad rostrum, stout jaws with teeth arranged in tooth-bands, triangular labial cartilages, elongated and tapering hyomandibulae, and greatly elongated prepelvic processes with spatulate extremities. The new genus is unequivocally demonstrated to be a member of the Narcinoidea (Narcinidae + Narkidae), and of the Narcinidae, and is conservatively placed in a basal position within this family; it may eventually prove to be more closely related to the clade *Narcine* + *Discopyge* + *Diplobatis*, but a strict parsimony analysis is necessary to resolve this conflict. Based on the design of its mandibular and hyoid arches, the new genus was a benthic, suctorial feeder, similar to living narcinoids.

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934 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Marcelo Carvalho, Joao Paulo Capretz, Thiago Loboda, Fernanda Silveira, Paula Lemos

Universidade de Sao Paulo, Sao Paulo, SP, Brazil

A Systematic Overview of the Taxonomically Diverse, and Evolutionarily Complex, Neotropical Freshwater Stingrays (Chondrichthyes: Myliobatiformes: Potamotrygonidae)

The morphology and taxonomy of the Neotropical freshwater stingrays of the family Potamotrygonidae has been the subject of an ongoing review that has revealed an elevated diversity with many new species discovered. Complex and highly variable chromatic patters, associated with a conservative overall morphology, are some of the reasons why taxonomic progress has been slow -- high levels of intraspecific variation

require careful, long-term study in order to properly comprehend species-level diversity. The family contains three valid genera (with one to describe), and at least 30 species of which at least 10 are presently in description as new species. The evolution of this group, the only living supraspecific chondrichthyan taxon that has diversified in freshwaters, has been the subject of both molecular and morphological investigations (these in my lab) that have, to date, revealed conflcit as molecular results point to independent evolution of color patterns in different basins. Recent research and progress concerning the taxonomy and morphology of purported species-complexes are summarized. Our efforts to properly revise the systematics of the family are hampered by clouded conservation legislation, "amateurism", and the general lack of appreciation that good systematics requires significant collection efforts and healthy collaboration.

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423 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Tatiane Casagrande Mariguela[1], Ricardo Macedo Corrêa Castro[2], Guillermo Ortí[3], Claudio Oliveira[1]

[1]Instituto de Biociências de Botucatu - UNESP, Botucatu, São Paulo, Brazil, [2]Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo - USP, Ribeirão Preto, São Paulo, Brazil, [3]University of Nebraska, Lincoln, NE, United States

Phylogenetic Relationships of Cheirodontinae (Ostariophysi: Characiformes: Characidae) Based on Mitochondrial and Nuclear DNA Sequences

Among fishes of the suborder Ostariophysi, Characiformes are exclusively freshwater fishes distributed in the Americas and Africa with largest diversity in neotropics. Characidae is the most specious group inside the Characiformes but the relationships among this family and other families still remain unclear. Approximately 1000 species of Characidae are known and one third is distributed on 13 subfamilies and the others do not have a clear phylogenetic position and are included in a big group named incertae sedis. The subfamily Cheirodontinae comprises about 50 valid species, being a group of characids widely distributed in South and Central America, occurring in the major hydrographic basins including trans-Andean species. Among 15 genera recognized of Cheirodontinae there are two tribes: Cheirodontini (*Cheirodon*, *Nanocheirodon*, *Heterocheirodon*, *Spintherobolus*, and *Serrapinnus*), Compsurini (*Saccoderma*, *Compsura*, *Macropsobrycon*) and some genera without phylogenetic position recognized (*Odontostilbe* with *Holoshesthes* as synonym, *Aphyocheirodon*, *Pseudocheirodon*, *Prodontocharax*, and *Cheirodontops*). In this study, the main goal was investigate the relationships among genera and species of Cheirodontinae through DNA sequencing of mitochondrial (16S) and nuclear genes (RAG1, RAG2, and Myh6). The results of Bayesian analysis showed that this is a monophyletic group. However, Cheirodontinae cannot be grouped in tribes as previously described. *Spintherobolus* is the sister group of the remained cheirodontines. The trans-Andean species are close related except the genus *Cheirodon* that is sister group of *Heterocheirodon*, *Kolpotocheirodon*, and

Macropsobrycon. *Holoshesthes* does not appear as synonym of *Odontostilbe*. *Compsura*, *Serrapinnus* and *Odontostilbe* are not monophyletic groups.

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132 ELHS/LFC Connectivity Symposium II, Galleria South, Friday 24 July 2009

Jennifer Caselle, Robert Warner

Marine Science Institute, UCSB, Santa Barbara, CA, United States

Tropical vs. Temperate Differences in Dispersal: An MPA Perspective

Marine reserves (no take areas) have been established worldwide, and the responses of local ecosystems to protection can lend insight into many processes in marine ecology. Recent reviews of marine reserve function suggest that there are no differences in response between temperate and tropical regions in terms of increases in population density, size of organisms, or species diversity after protection. When the differences in abundance inside vs. outside reserves are extreme, such that most or all production is occurring inside protected areas, then studies of the spatial distribution of recruitment can be used to estimate dispersal distances of larvae or propagules. A recent review of existing studies of larval export from reserves suggests that the service area of a reserve can be surprisingly limited in extent, with dispersal distances in the tens of kilometers and a considerable amount of self-recruitment. While sample sizes are small and taxonomically limited (all mollusks), at this point there is no evidence of differences in larval dispersal distances out of tropical vs. temperate reserves.

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478 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Mollie Cashner

Tulane University, New Orleans, LA, United States

Dispersal of Nuclear and Mitochondrial Genes Within a Hybrid Zone Between *Notropis chlorocephalus* and *N. chiliticus* in the Catawba River System

Notropis chlorocephalus occurs in the Catawba River system (North Carolina) and is in limited sympatry with an aberrant (likely anthropogenically introduced) population of *N. chiliticus*. It has been previously noted that *N. chiliticus* and *N. chlorocephalus* hybridize where they co-occur, and my observations during the spawning season further support this. Using both mitochondrial (ND2) and nuclear (ITS1) DNA, I characterize the extent of hybridization between these two species, primarily within streams in the Lake

Norman area of the Catawba River system. In this hybrid zone, there is mtDNA admixture and evidence of F1 hybrids as well as back-crossed individuals. There is no evidence of *N. chiliticus* mtDNA haplotypes or ITS1 alleles dispersing beyond the focal streams within the lower Catawba system, however, ITS1 alleles are present in a population in the upper Catawba system, suggesting other areas of *N. chiliticus* introduction and genetic dispersal.

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799 Herp Genetics, Galleria North, Saturday 25 July 2009

Todd Castoe[1], A.P. Jason de Koning[1], Hyun-Min Kim[1], Wanjun Gu[1], Brice Noonan[2], Gavin Naylor[3], Zhi Jiang[4], Christopher Parkinson[5], David Pollock[1]

[1]University of Colorado School of Medicine, Aurora, CO, United States, [2]University of Mississippi, University, MS, United States, [3]Florida State University, Tallahassee, FL, United States, [4]University of Miami, Miami, FL, United States, [5]University of Central Florida, Orlando, FL, United States

Ancient Convergent Molecular Evolution Between Snakes and Agamid Lizards: A Dream for Molecular Evolution and a Nightmare for Phylogenetics

Documented cases of convergent molecular evolution due to selection are fairly unusual, and examples to date have involved only a few amino acid positions. This has led to the view that such convergent evolution is rare, and in many ways insignificant at the molecular level. Because convergence mimics shared ancestry and is not accommodated by current phylogenetic methods, it can strongly mislead phylogenetic inference when it does occur. Here, we present a case of extensive convergent molecular evolution between snake and agamid lizard mitochondrial genes that overwhelmingly misleads strong phylogenetic signal. Evidence from morphology, nuclear genes, and most sites in the mitochondrial genome supports one phylogenetic tree, but a subset of non-synonymous amino acid-altering substitutions (1st and 2nd codon positions primarily) across multiple mitochondrial genes strongly supports a radically different topology. The relevant sites generally involve known functional convergence between ancient lineages of snakes and agamids. At least 4 out of 13 required convergent changes distributed across all 13 mitochondrial protein-coding genes are expected to have arisen from non-neutral causes, suggesting remarkably strong non-neutral convergent evolution has occurred. Consistent with strong previous evidence for adaptive evolution in snake mitochondrial proteins, it is likely that much of this convergent evolution was driven by adaptation. These results indicate that convergent molecular evolution in mitochondria can occur at a scale and intensity far beyond what has been previously documented, and highlight the vulnerability of standard phylogenetic methods to the presence of convergent sequence evolution.

CANCELED

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108 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Ted Cavender

The Ohio State University, Columbus, Ohio, United States

A New Fossil Centrarchid Species of the Genus *Pomoxis* from the Miocene of Nebraska

Pomoxis is one of the most distinctive of the centrarchid genera in both its skeletal and soft anatomy. The generic assignment of the fossil based on relatively complete material is well established but some of the meristic characters suggest a more primitive form, possibly ancestral to the evolutionary line leading to the extant *P. annularis* and *P. nigromaculatus*. The fossil species is separated from the latter taxa by its lower number of supraneural bones, precaudal vertebrae and soft dorsal rays as well as showing a more anterior insertion of the dorsal fin. Specimens range in size from small juveniles to "adults" up to 130mm standard length. The fossils were preserved in mud deposited in a quiet water (lentic) environment under anoxic conditions. Total evidence suggests a shallow, ice covered flood plain pond.

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907 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Chris Chabot[1], Donald Buth[1], Camm Swift[2], Jonathan Sim[1], Thomas Dowling[3], Larry Allen[4]

[1]*University of California, Los Angeles, Los Angeles, CA, United States,* [2]*Entrix, Inc., Ventura, CA, United States,* [3]*Arizona State University, Tempe, AZ, United States,* [4]*California State University, Northridge, Northridge, CA, United States*

Introgression of Mitochondrial DNA Between *Catostomus fumeiventris* and *Catostomus santaanae* (Cypriniformes: Catostomidae) in the Santa Clara Drainage

Our previous allozyme study confirmed the presence of "pure" parentals, and both F_1 and F_2 hybrids between *Catostomus fumeiventris* and *C. santaanae* in the Santa Clara drainage in southern California where both species were introduced many decades ago. To obtain further information, sequences were obtained from a mitochondrial gene (subunit 2 of the NADH dehyrdrogenase [ND2]) for 156 of the 160 specimens used in the allozymic identification. We found ND2 sequences of both *C. fumeiventris* and *C. santaanae* present among both of the F_1 and F_2 groups as well as in both of the "pure" parental species. Introgression is bidirectional but biased as 6% of "pure" *C. santaanae* and 50% of "pure" *C. fumeiventris* express mtDNA of opposite species. The Santa Clara populations are genetically compromised and caution should be exercised if one uses

these introduced populations as a source of research specimens in place of those from their native (protected) ranges.

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56 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Prosanta Chakrabarty[1], Philip Willink[2], John Sparks[3]

[1]Louisiana State University Museum of Natural Science, Baton Rouge, LA, United States, [2]The Field Museum, Chicago, IL, United States, [3]The American Museum of Natural History, New York, NY, United States

Blind Cave Fishes from Opposite Ends of the Indian Ocean Reveal an Ancient Gondwanan Connection

Two genera of troglodytic (blind, cave dwelling) gobies, separated by the Indian Ocean, are found to be sister taxa. These sister genera, *Milyeringa* of Northwestern Australia and *Typhleotris* of Southwestern Madagascar, are members of the diverse Gobioidei family Eleotridae. Their relationship is tied to the break-up of Eastern Gondwana more than 100 million years ago. This period was the last time Australia and Madagascar were part of the same landmass. In addition, a novel species from this lineage has been discovered that is known only from a single sinkhole in Madagascar. This new species is unique among blind fishes in being uniformly darkly pigmented. Strangely, this species is blind despite surviving in an area exposed to direct sunlight. Phylogenetic analysis reveals that this species is derived from cave dwelling forms that survive in perpetual darkness and that it has regained body pigmentation. Notably both the karst formations in Australia and Madagascar where these species are found are identified as Eocene in age, a time period far younger than the Cretaceous age necessary under a vicariance scenario. However, given the extremely limited dispersal ability of these fishes and their karst habitat, vicariance appears to be the only viable hypotheses for explaining their distribution.

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20 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Christopher Chambers

NOAA Fisheries Service, Northeast Fisheries Science Center, Highlands NJ, United States

A Method for Comparing Alternative Measures of Fish Condition and Other Qualitative Indices

The well being of fish in a population is important information about the population status and possible environmental effects on it. The capability of estimating fish condition provides a means of determining this well being. The concept of fish condition is widely viewed as useful and worthy of the resources directed towards various methods for its quantification (e.g., body size, robustness, recent growth, energy reserves, nucleic acid ratios, cell-cycle rate). A problem arises in the measurement of fish condition which is fundamental to quantifying any qualitative index: Which measure of condition is best? We introduce a statistical method that is designed to answer this question. The method computes a relative 'utility value' of two or more alternative measures that are promoted as proxies for the property of interest, e.g., condition. The utility value is based on a ratio of the differential of the two proxies (dP_1/dP_2) to the quotient of their respective standard deviations (sd_{P1}/sd_{P2}). We show that this value 1) depends only on the alternative proxies of the property of interest (and not the property itself), 2) is independent of units used for each proxy and is invariant to changes of their respective scales, and 3) when combined with the cost of obtaining estimates of each proxy, provides a basis for choosing among alternative measures based on their technical and economic merits. Examples are given using common measures of fish condition.

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524 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Demian Chapman[1], Kevin Feldheim[2], Andrea Bernard[3], Sabine Wintner[4], Geremey Cliff[4], Mahmood Shivji[3]

[1]Stony Brook University, Stony Brook, NY, United States, [2]The Field Museum, Chicago, IL, United States, [3]Nova Southeastern University, Fort Lauderdale, FL, United States, [4]Natal Sharks Board, Durban, South Africa

Mating System and Paternity in an Intrauterine Cannibal: The Sand Tiger Shark

The sand tiger shark (*Carcharias taurus*) is the subject of heightened conservation concern worldwide because it is extremely vulnerable to even modest levels of fishing pressure. This vulnerability stems from the exceptionally low litter sizes (two) of this

species, which occurs because the largest/eldest embryo in each uterus kills and consumes all of the other embryos ("intrauterine cannibalism" or "embryophagy"). This remarkable reproductive strategy suggests that competition between male sand tigers for paternity is likely to be especially intense when compared to species that produce larger litter sizes. In this context it is not surprising that male sand tigers have been observed guarding females, which may serve to prevent these females from mating with and being fertilized by additional males ("multiple paternity"). We therefore genetically-tested nine sand tiger litters (24 embryos) from Richards Bay, South Africa, to see if single paternity of litters was more typical in this species. This analysis revealed that the two surviving offspring in a sand tiger litter are more commonly half- rather than full-siblings, demonstrating multiple paternity. Competition for paternity therefore continues after copulation has taken place in this species (i.e. sperm competition). We also provide evidence that some males that successfully fertilize a female are still reproductively unsuccessful because their offspring are cannibalized prior to birth by embryos sired by a rival male. Competition between males for paternity therefore extends beyond fertilization in this species. We discuss these findings in the context of sand tiger mating system evolution and conservation.

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485 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Taylor Chapple[1], Salvador Jorgensen[2], Scot Anderson[3], A. Peter Klimley[1], Louis Botsford[1], Barbara Block[2]

[1]University of California, Davis, Davis, CA, United States, [2]Hopkins Marine Station, Stanford University, Pacific Grove, CA, United States, [3]Inverness, CA, United States

A Mark-Recapture Population Estimate of Great White Sharks, *Carcharodon carcharias*, off California

Great white sharks, *Carcharodon carcharias*, occur circumglobally and are currently protected internationally under the Convention on International Trade in Endangered Species and the World Conservation Union (IUCN, Category VU A1cd+2cd). Recently, three large genetically distinct populations have been described (Australia/New Zealand, South Africa, north eastern Pacific [NEP]). To date, there is no estimate of abundance in the NEP. Within the NEP, sub-adult and adult white sharks show consistent yearly site fidelity at known aggregation sites off California or Guadalupe Island in Mexico, which supports use of mark-recapture frameworks to quantify their population. We used photo identification of dorsal fins to individually "mark" white sharks at aggregation sites off California over a three-year period. We collected 321 photo IDs representing 133 unique individuals over 1,141 hours of effort. Yearly recapture rates ranged from 23-27%. We analyzed these data in a sequential Bayesian algorithm incorporating informative priors. Results show the adult white shark population in central California is 261 ([200,365] lower and upper quantile, respectively) individuals. This estimate can function as a baseline for future studies concerning the health of the white shark population and support efforts to quantify their status,

population trends and protection requirements. We also discuss the pitfalls and assumptions of this framework and how it can be expanded to include the white shark aggregation site in Mexico, approximating an abundance estimate for the entire NEP.

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770 Poster Session I, Exhibit Hall, Friday 24 July 2009

Sharon Charter, William Watson, Jason Stannard, John Hyde

NOAA Southwest Fisheries Science Center, La Jolla, CA, United States

Molecular Identification of Larval *Sebastes moseri* and *S. rufinanus* in the California Current region

Many rockfishes, *Sebastes*, are important in fisheries and are well known, but some small, deep-water, non-fishery species are poorly known. Two of these, *Sebastes moseri* and *S. rufinanus*, were first recognized relatively recently. A distinctive, but unidentifiable, *Sebastes* larval type has been recognized in California Cooperative Oceanic Fisheries Investigations plankton collections from the California Current region since 1951. Sequencing a portion of its cytochrome-b gene demonstrated that it includes both *Sebastes moseri* and *S. rufinanus*. Preflexion stage larvae of both species are moderately elongate, slender, and somewhat compressed, with a short preanal length. The head is moderately large, with a short snout and large eyes. All these dimensions gradually increase as the larvae grow, except pectoral-fin length remains 7-8% BL through mid-flexion stage. There are no spines on the head or pectoral girdle until late preflexion stage when the parietal and first preopercular spine form. During flexion more preopercular spines are added and a supraocular and pterotic spine form. Fin-rays begin to form during the flexion stage. Both species are lightly pigmented, with melanophores on the dorsum of the head, gas bladder, gut, and posteriorly on the tail. A melanophore may be present at the anteroventral margin of the liver. The nape is commonly pigmented (~60% of the larvae), and tail pigmentation is limited to two prominent patches posteriorly on the dorsal and ventral margins. Pectoral-fin pigmentation is present or absent; it is on the distal margin when present.

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987 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Yongjiu Chen[1], Steve Parmenter[2], Bernie May[3]

[1]Texas A & M University - Corpus Christi, Corpus Christi, TX, United States, [2]California Department of Fish and Game, Bishop, CA, United States, [3]The University of California - Davis, Davis, CA, United States

Genetic Relationships of Tui Chubs in Southwestern Great Basin and Management Plans for the Mohave Tui Chub

Genetic relationships of tui chubs (*Siphateles bicolor ssp*) are by and large unknown despite their diversity and the uncertain taxonomic and population status of some groups. We characterized genetic variation among and within tui chub populations in the southwestern Great Basin using microsatellite DNA loci. Our results support the genetic integrity of each of the previously recognized forms, i.e., Lahontan, Owens, toikona, Fish Lake Valley and Mohave tui chubs. The levels of genetic diversity found in these tui chubs, in particular toikona and Mohave, are substantially lower than in the more widespread Lahontan tui chub. Of the four Mohave tui chub populations, the MC Spring population is most divergent, possessing the fewest alleles and lowest heterozygosity. These data suggest that genetic drift resulting from a persistent low effective size at MC Spring and/or an initial founder effect has reduced genetic variation since apparent isolation in 1934. A bottleneck of 10 individuals during the founding of the Camp Cady population is reflected in significantly lower genetic diversity of that population compared with the source population at Lake Tuendae, while a robust founding population at China Lake better replicated the source population's diversity. We recommend instituting artificial gene flow to rebuild genetic diversity in Camp Cady from both Lake Tuendae and China Lake, reciprocal exchange of individuals between China Lake and Lake Tuendae, and establishment of new populations with founders from both Lake Tuendae and China Lake.

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299 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Huang Yong Cheng, Lue Guang Yang

National Taiwan Normal University, Taipei, Taiwan

Resource Partition and Habitat Preference of *Japalura luei* in Taiwan

Japalura luei is a rare and endemic agamidae lizard in Taiwan. The distribution range, population size and information about its ecological requirements of this lizard are limited. In this study, we tried to investigate morphological difference between sexes, habitat preference, distribution range, population age structure and resource partition of them in Taiwan. Our survey indicated that *J. luei* was mainly found near the mixed

forest in Northern Taiwan with red false-cypress and Japanese Cedar in Nanao. The estimated population size by mark-recapture method was about 485 individuals. The SVL of males is 65.95 mm, females is 62.71 mm. The male lizards mainly were found on the conifers (73%). As for the forest layer preference, male lizards prefer to stay on the main trunk (95%), following by on the branch (5%). While the females, choose to stay on different parts of the tree, mainly on the clump (67%). On the average, the male lizards stay at the height of 115.4 cm above the ground, while the females prefer at the height of 87.9 cm above the ground. As for diurnal activities, mainly from ten in the morning to two in the afternoon. During the night, *J. luei* used the ferns 87%, branches of the tree 9% and the brushes 4% as resting places. We know the different microhabitat preference between different sexes, and the information about to ecological requirements of this rare species, this can provide information for the conservation and management strategy in the future for this endemic lizards in Taiwan.

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439 Fish Conservation I, Parlor ABC, Sunday 26 July 2009

Barry Chernoff, Katherine Miller, Michelle Tipton

Wesleyan University, Middletown, CT, United States

River of the Undamed: "Recovery" of the Eightmile River after Dam Removal

The Eightmile River is an important tributary of the Connecticut River basin on its eastern slope. The Eightmile river was designated as a U.S. Wild and Scenic River in May 2008. In October, 2007, a small dam (>100 years old) was removed from the headwaters of the east branch of the Eightmile River near Salem, CT. Prior to removal, the water was lowered in the spring and summer. We began studying this system above and below the dam in 2005 and have followed it since. Our data show that communities above and below the dam site have changed dramatically and differ significantly from control populations in the east and west branches of the river. Notably, tesselated darters, *Etheostoma olmstedi*, have increased dramatically in the section above the former dam. Brown bullheads, *Ameiurus nebulosus*, increased in abundance during draw down with lowered flows but have declined since the dam was removed. Measures of diversity, H', have increased above and below the dam site while control areas have remained constant. The data from both fish and benthic macroinvertebrates indicate that the patterns of change or "recovery" differ in the sections of river above and below the dam. We will discuss downstream effects of dam removal as well as the concept of recovery.

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405 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Chee Kong Chim[1], Cheong Hoong Diong[2]

[1]Tropical Marine Science Institute, National University of Singapore, Singapore, Singapore, [2]National Institute of Education, Nanyang Technological University, Singapore, Singapore

Reproduction in a Female Population of the Dog-faced Water Snake *Cerberus rynchops* (Homalopsidae) from the Sungei Buloh Wetland Reserve, Singapore

The Homalopsinae is a colubrid subfamily of Oriental-Australian rear-fanged water snakes noted for its ecological and morphological diversity. The homalopsid snake assemblage in coastal mangrove forests in Singapore is dominated by the dog-faced water snake *Cerberus rynchops*. Although reproduction in homalopsids has been described as viviparous, not much is known about the reproductive biology of the group, but their reproductive strategies and that of other viviparous snakes as capital breeders have been a subject of interest among evolutionary ecologists. In a mark-recapture study of the autecology of a free-ranging *C. rynchops* population in the coastal mangal ecosystem of Sungei Buloh Wetland Reserve, Singapore, we captured and maintained female snakes in various stages of pregnancy in a dedicated animal research facility to record pre-partum, birth, and post-partum reproductive data. Reproductive females were encountered in the field throughout the study period, suggesting aseasonal reproduction. All experimental female snakes continue to feed during pregnancy. Litter size averaged 4.4 ± 1.9 (n = 32) neonates, with a range from 2 to12 neonates. As observed in many other snakes, larger female *C. rynchops* produced larger litter size and larger neonates. Gestation length is estimated at four to seven months. Deformed and underdeveloped neonates were observed. The primary sex ratio was 1:1. Neonates did not differ in south-vent length, body mass or head width, but males had relatively longer tail than females. The reproductive strategy of the dog-faced water snake is discussed.

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290 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Min-Chia Chiang, I-Shiung Chen

Marine Biology, Keelung, Taiwan

Systematics and Identification of Larvae and Juveniles of the Genus *Enneapterygius* (Teleostei: Tripterygiidae) Collected from Taiwan

Larvae and juveniles of the genus *Enneapterygius* were described and illustrated from specimens captured with light trap and trawl net in the coastal waters around Taiwan. Fifteen morphological types were identified to 10 *Enneapterygius* species by the

comparison of molecular characters. The mtDNA genes (COI and ND5) and nuclear gene (S7 ribosomal protein intron 1) markers reveal significant species-level divergence and have congruent results of species identification. Phylogenetic trees including adults and larvae were also constructed using the maximum parsimony and Bayesian analyses of aligned mtDNA genes, an aligned nuclear gene, and the combined dataset. All trees show the genus *Enneapterygius* may not be a monophyletic group and *E. tutuilae* diverged from other congeneric species very early in their evolutionary history.

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704 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Mark Christie[1], Christopher Stallings[2], Darren Johnson[1], Mark Albins[1], Jim Beets[3], Brian Tissot[4], Stephen Thompson[5], Yanli Jia[1], Mark Hixon[1]

[1]Department of Zoology, Oregon State University, Corvallis, OR, United States, [2]Florida State University Coastal and Marine Laboratory, St. Teresa, FL, United States, [3]Department of Marine Science, University of Hawaii at Hilo, Hilo, HI, United States, [4]Washington State University, Vancouver, Vancouver, WA, United States, [5]Cascadia Conservation Trust, Sisters, OR, United States, [6]International Pacific Research Center, University of Hawaii, Honoluu, HI, United States

Larval Retention and Population Connectivity in Two Coral-Reef Fishes

Patterns of demographic connectivity among and retention within local populations of marine fish are poorly understood due to the difficulty of directly tracking pelagic larvae. To address this issue, we conducted population genetic analyses of two species of coral reef fishes. In 2005, bicolor damselfish (*Stegastes partitus*) were collected from 5 islands within the Exuma Sound, Bahamas. Fifty adults and fifty recruits from each site were genotyped at 7 polymorphic microsatellite loci. In 2006, 500 adult and 500 recruit yellow tang (*Zebrasoma flavescens*) were collected from 9 sites distributed around the Big Island of Hawai'i. Significant differences between populations of bicolor damselfish located on the eastern and western sides of the Exuma Sound were detected. This pattern suggests that there is limited dispersal across the eastern and western sides of the Exuma Sound and higher levels of connectivity among sites located north and south of one another, coinciding with prevailing northerly currents. Additionally, the high levels of polymorphism found within the genetic markers allowed for the detection of parent-offspring pairs in both species using novel statistical methods. The existence of parent-offspring pairs of fish in the same region provides unequivocal documentation of larval retention and self-recruitment. Given that the overall levels of genetic differentiation in both systems are low, parentage analysis in marine systems may prove to be a powerful tool for informing population-level genetic analyses as well as for providing insights into gene flow and dispersal at ecological timescales.

1021 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jonathan Choquette, Daniel Noble, Ronald Brooks

University of Guelph, Guelph, Ontario, Canada

The Status, Ecology and Genetics of Butler's Gartersnake (*Thamnophis butleri)* in Southern Ontario

The Butler's Gartersnake (*Thamnophis butleri*) is a Threatened snake in Canada inhabiting moist prairies in Southern Ontario. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is reassessing the 'Threatened' (2001) status of this species due to the lack of data on population abundance, trends and persistence. This species occupies one of the smallest ranges of any Canadian snake, with the majority of isolated populations situated in human-altered landscapes, many of which have not been substantiated for decades. Furthermore, supposed adult *T. butleri* in Dufferin County have been found with scale counts consistent with the Short-Headed Gartersnake (*Thamnophis brachystoma*), a closely related species known only from Pennsylvania and New York, adding further uncertainty to its overall taxonomic and population status. 1) Is Butler's Gartersnake (and appropriate habitat) still present at historic sites and what is its contemporary abundance at select localities? 2) Do scale counts indicate that there are actually two species, *T. brachystoma* and *T. butleri* in Dufferin County? Site visits for presence/absence of snakes and habitat will take place April-June of 2009. Five of the sites will be monitored to obtain estimates of contemporary population abundance via mark-recapture techniques. Tail tips will be removed from individuals found in Dufferin County for genetic analysis. This information is vital to determine whether Butler's Gartersnake should be elevated to Endangered status in Canada and to ensure the development of informed conservation decisions, aimed at maintaining viable and genetically diverse populations in the future.

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353 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009

Lorenzo Ciannelli[1], Denise Breitburg[1]

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Hypoxia and Fish Early-life Stages: A Comparison between Human-enriched and Upwelling-driven Systems

Increases in coastal hypoxia can be traced to two major mechanisms: increased nutrient enrichment linked to human activities, and increased surfacing of nutrient-rich, oxygen-poor deep waters linked to upwelling currents. These two mechanisms can co-occur with synergistic consequences. The Gulf of Mexico, Chesapeake Bay, and Adriatic Sea

are examples of systems where increases of hypoxic events originate largely from increases in nutrients related to human activities. In contrast, the shelf region of the Pacific Northwest of the United States, which is part of the California Current System, provides an example of hypoxia caused by increased surfacing of nutrient-rich, oxygen-poor deep waters. Both proximate and ultimate effects of hypoxia vary considerably between human-enriched and upwelling-driven systems, as well as among regions within system type, because of variation in the rapidity of onset, duration, severity and frequency of events. We review studies focusing on effects of hypoxia on fish early-life stages in these two contrasting systems and provide a synoptic view of their differences and similarities. The goal of our comparative approach is to improve understanding of how hypoxia affects fish early life stages under a variety of environmental conditions, and to ask whether there are fundamental differences in responses and adaptations to naturally occurring and anthropogenically-induced hypoxia. Both coastal upwelling hypoxia and hypoxia related to nutrient enrichment are predicted to increase; an improved understanding of their effects should contribute to basic understanding of these systems and to the ability to develop science-based management strategies.

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863 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Angela Cicia[1], William Driggers[2], Jill Hendon[3], Eric Hoffmayer[3], John Mandelman[4], James Sulikowski[1]

[1]University of New England, Biddeford, ME, United States, [2]National Marine Fisheries Service, Pascagoula, MS, United States, [3]Gulf Coast Research Laboratory, Ocean Springs, MS, United States, [4]New England Aquarium, Boston, MA, United States

Investigating the Physiological Effects of Environmental Salinity on the Distribution of Adult Female Atlantic Sharpnose Sharks, *Rhizoprionodon terraenovae*, in the Northern Gulf of Mexico

Understanding the habitat preferences exhibited by distinct life stages, particularly in nursery areas, can be instrumental for effective conservation and management of coastal shark populations. However, little is known about how abiotic factors such as salinity, temperature, and dissolved oxygen, influence the distribution of shark populations. Euryhaline waters of the Gulf of Mexico and South Carolina are both reported to be nursery areas for the ubiquitous Atlantic sharpnose shark, *Rhizoprionodon terraenovae*. Interestingly, two studies have observed virtually the complete spatial segregation among *R. terraenovae*, with adult females rarely occurring in areas influenced by freshwater outputs. Nearly 10 years of sampling within the Mississippi sound have yielded less than 20 adult females, all of which were captured in salinities exceeding 30 ppt. Similar findings were reported off South Carolina, resulting in the capture of only 26 adult females over a six year study. The relative absence of adult females from low salinity areas suggests a physiological limitation could play a role in restricting inshore habitat utilizations. Thus, the objective of the current study is to provide insight into this

anomaly by investigating compensatory changes in intracellular and extracellular solutes and hematological properties among sharks caught at differing salinities in the northern Gulf of Mexico.

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173 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Diego Cisneros-Heredia

Universidad San Francisco de Quito, Quito, Ecuador

Habitat Loss and Climate Change Impacts on Neotropical Anurans: Implications for In-situ Conservation

This study sets out to improve the understanding of the effects of habitat loss and climate change on the biodiversity and how protected areas (in-situ conservation initiatives) help to mitigate them. I used ecological niche modelling to predict current geographic ranges of glassfrogs of the family Centrolenidae from the eastern Andes and Amazonia of Ecuador, and how current deforestation rates and future climate conditions may affect them. General results are encouraging and replication in other amphibians should be performed. Museum data are invaluable sources of information, unfortunately locality data for many species of Neotropical amphibians is poorly available. Results indicate that despite uncertainties, deforestation represents an important factor that threats the long-term conservation of amphibian populations, in some cases even more importantly than other threats proposed such as deseases. Climate change is likely the greatest threat, and effects derived from the interactions between both aspects severely diminishes the capacity of species to adapt to future changes. Low temperature-scenarios produce effects considerably lower than high temperature-scenarios, suggesting that mitigation of temperature-increase due to anthropogenic activities is valuable and urgent. Governmental protected areas play an important role for the conservation of amphibians, protecting them against deleterious effects of deforestation, and mitigating effects of climate change. Private protected areas are important especially to mitigate deforestation in areas left outside of official protection though highly biodiverse.

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600 AES Physiology, Galleria South, Sunday 26 July 2009

Julien M. Claes, Jérôme Mallefet

Catholic University of Louvain, Louvain-la-Neuve, Belgium

Luminescent Camouflage in a Deepwater Shark

Pelagic organisms are particularly vulnerable as they live in an habitat which offers no places to hide and were predation is the only way to feed below 100 m. In response to this, many of them developped adaptations to render their body less conspicuous to their predators and/or their preys: organismal transparency, side silvering, counter-shading and counter-illumination. Counter-illuminating animals are animals which emit a ventrally-directed luminescence to replace the downwelling light absorbed by their body. The efficiency of this camouflage depends on the physical characteristics (intensity, wavelenght, and angular distribution) of the luminescence which have to be as close as possible as those of the surrounding environment. In this work we used different techniques including luminometry, spectrophotometry, pharmacology and light microscopy to analyse the bioluminescence characteristics of a luminous deep-sea shark, the velvet belly lantern shark Etmopterus spinax. Experiments show that the light emitted by this shark appears to be particularly well-designed for camouflage by counter-illumination. This result is discussed with the ecology of the animal.

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345 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Kerin Claeson

The University of Texas at Austin, Austin, TX, United States

Phylogenetic Systematics of the Electric Rays (Torpediniformes: Batoidea)

Torpediniformes, the electric rays, are a monophyletic group of cartilaginous fishes. There are 11 valid genera within the Torpediniformes that are distributed among four recognized subfamilies (Torpedininae, Hypninae, Narcininae, and Narkinae). There is currently no published phylogeny treating all of these genera together. A total of 67 embryonic, fetal, and juvenile specimens, representing ten of the 11 torpediniform genera, were examined for this study. Focus was on external and skeletal morphology. A combination of histology, dissection, clearing and double-staining, x-radiography, and computed tomography was used to investigate skeletal morphology with particular emphasis placed on the vertebral skeleton. New data were discretized, scored, and combined with previously published species diagnoses to create a matrix of 59 characters, which was subjected to a parsimony analysis. One most parsimonious tree results, and it supports the four previously hypothesized subfamilies. Newly resolved relationships within the subfamilies Narcininae and Narkinae are hypothesized. Within

Narcininae, the genus *Discopyge* is considered sister taxon to (*Narcine* + (*Diplobatis* + *Benthobatis*). The following hierarchical structure is proposed within Narkinae: *Electrolux* + (*Heteronarce* + (*Temera* + (*Typhlonarke* + *Narke*))). This topology supports the hypothesis that Heteronarce is only superficially similar to the narcinine genus *Narcine* but is does not support the hypothesis that *Heteronarce* and *Electrolux* are sister taxa. Further taxonomic and ontogenetic sampling is underway to add support to this hypothesis of torpediniform interrelationships.

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307 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Todd Clardy, Eric Hilton

Virginia Institute of Marine Science, Gloucester Point, VA, United States

Morphology and Ontogeny of Trunk Lateral Line Canals of the Rock Prickleback, *Xiphister mucosus* (Perciformes: Zoarcoidei: Stichaeidae), with Preliminary Comparisons with other Stichaeids

Fishes of the family Stichaeidae, commonly known as pricklebacks, are a diverse group of about 37 genera and 76 species distributed in the intertidal and continental slope waters of the North Pacific, Arctic and North Atlantic Oceans. The phylogenetic relationships of stichaeids and their relatives have been studied to a limited degree, but these efforts generally have been hampered by a lack of fundamental descriptive data. A peculiar characteristic of some stichaeid genera is the presence of multiple, complexly-branching trunk lateral line canals. This condition is rare among teleostean fishes, found in only twelve other families. In this presentation, we describe the morphology of the lateral line system of *Xiphister mucosus*. The genus *Xiphister* has seven trunk lateral line canals: a short median dorsal midline canal, a pair of dorsolateral trunk canals, a pair of mid-lateral trunk canals, and a pair of ventrolateral trunk canals that also contain a short loop along the ventral midline. Each of the seven canals is supported by dermal, ring-like ossifications and is branched with short extensions off the main axis of the canal. Ontogeny of trunk lateral line canals in *X. mucosus*, which proceeds dorsoventrally and rostrocaudally, will be described using cleared and stained specimens (28.9-196 mm SL), and the order of development, growth, and branching pattern of each canal will be discussed. Preliminary comparisons with other stichaeid taxa also will be discussed.

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782 Snake Ecology, Pavilion East, Monday 27 July 2009

Rulon Clark, Matthew Barbour

San Diego State University, Department of Biology, San Diego, CA, United States

Quantifying the Foraging Behavior of Ambush Hunting Snakes

Our ability to understand the foraging behavior of predators is often limited by our lack of quantitative information on their predatory behavior. This is especially true for sit-and-wait foragers, which are difficult to study in the field because they are generally secretive and feed infrequently. In this study, we used video surveillance equipment to quantify and compare aspects of the foraging behavior of free-ranging individuals of three rattlesnake species (*Crotalus horridus*, *C. ruber*, *C. scutulatus*). All three species are sit-and-wait predators on small mammals, waiting long periods of time at one location for prey to move within strike range. During periods of prey activity, rattlesnakes exhibited frequent chemosensory probing: the extension of the head and anterior body beyond the resting coil while tongue-flicking. Chemosensory probing was sometimes accompanied by mouth-gaping behavior, which suggests that mouth-gaping may facilitate the reception of prey-derived chemosensory cues. All snakes utilize chemical information while foraging and it is probable that other ambush hunting snake species exhibit similar behaviors to what we observed. Quantifying detailed aspects of snake behavior will permit comparative studies of the evolution of foraging behavior in a variety of snake taxa that exhibit ambush-style predation.

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588 Fish Genetics I, Pavilion East, Thursday 23 July 2009

William Clark[1], Chris Johnson[1], Yongjiu Chen[2], Mark Clark[1]

[1]North Dakota State University, Fargo, ND, United States, [2]Texas A&M University, Corpus Christi, TX, United States

Landscape Genetics of White Sucker (*Catostomus commersoni*) in North Dakota and Minnesota

The mechanisms by which landscape-level changes affect populations and communities are poorly understood, partly because of the complex relationships between species and their environments. The technique of landscape genetics has the potential to identify landscape features that influence population genetic structure. In this study, we used 12 microsatellite DNA loci to analyze genetic variation of white sucker (*Catostomus commersoni*) from 15 geographical locations across North Dakota and Minnesota. Using a geographical information system (GIS) we quantified land-cover (agricultural, urban, range land, forest, and grassland) at three spatial scales: the entire catchment, the riparian corridor, and 200 m upstream of sampling reaches. Preliminary results suggest that genetic structure (FST) is correlated with land-cover, topographical distance,

elevation, hydrological variables, and water temperature. North Dakota and Minnesota populations of white sucker exhibit a fairly high degree of genetic variation, although this analysis is not complete for all sites and all loci.

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395 Poster Session I, Exhibit Hall, Friday 24 July 2009

Pamela Clarkson, Christopher Beachy

Minot State University, Minot, ND, United States

Examination of Metamorphosis and Growth on Developmental Allocation in the Axolotl (*Ambystoma mexicanum*) and the Tiger Salamander (*Ambystoma tigrinum*)

We tested the hypothesis that variation in growth history and exogenous T4 on axolotls affects the vector of allocation variables (i.e., growth, metamorphosis, maturation, and storage) by using a full-factorial 4 X 2 randomized complete block design with four growth treatments (constant rapid growth, constant slow growth, rapid-then-slow growth, slow-then-rapid growth) and two T4 treatments (no T4, 5 nM T4). We supplemented this with an examination of wild caught tiger salamanders, measuring allocations to metamorphosis, storage, and gonad development. Axolotl embryos were hatched and larvae were raised individually in plastic containers in reverse-osmosis water and were fed freshly hatch brine shrimp. As larvae grew, they were fed tubificid worms. We examined growth by periodic weighings (to the nearest mg). Metamorphosis was scored when tail fin and gill resorption were complete. Salamanders were then killed by prolonged immersion in MS-222, fixed in 10% formalin, and stored in 70% ethanol. Gonads and fat bodies were dissected and weighed to the nearest milligram. Feeding treatments had desired growth effects. Treatment with T4 resulted in complete metamorphosis of all treated salamanders. In the T4 treated axolotls, metamorphosis was independent of larval growth rate. In all axolotls, allocation differed among treatments and was sex dependent. Females stored less than males and had larger gonads. Female gonad mass was influenced by feeding treatment whereas male gonad mass was not, indicating the expensive allocation cost of reproduction in females. This trend was not observed in the tiger salamanders, partly due to the virtually ad libitum food available.

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153 Storm Symposium, Pavilion West, Friday 24 July 2009

David Clayton[1], Dede Olson[2], Hartwell Welsh[3], Ed Reilly[4], Richard Nauman[6], Nobuyu Suzuki[7], Brenda Devlin[5]

[1]US Forest Service, Rogue River-Siskiyou National Forest, Medford, OR, United States, [2]US Forest Service, Pacific NW Research Station, Corvallis, OR, United States, [3]US Forest Service, Pacific SW Research Station, Arcata, CA, United States, [4]USDI Bureau of Land Management, Medford, OR, United States, [5]US Forest Service, Six Rivers National Forest, Gasquet, CA, United States, [6]National Center for Conservation Science and Policy, Ashland, OR, United States, [7]Quest University Canada, Squamish, British Columbia, Canada

A Conservation Strategy for the Siskiyou Mountains Salamander, *Plethodon stormi*

In 2007, a Conservation Agreement for the Siskiyou Mountains Salamander (*Plethodon stormi*) was approved by three federal agencies: the US Fish and Wildlife Service; the Medford District of the Bureau of Land Management (BLM); and the Rogue River-Siskiyou National Forest. This Agreement is based upon the Conservation Strategy developed for the species under the federal Interagency Special Status and Sensitive Species Program. The goal is to maintain well-distributed populations throughout the species' range on Forest Service Region 6, and Oregon/Washington BLM lands, and to not contribute to the need for listing under ESA. Management is addressed at multiple spatial scales, including known sites, habitat areas, sixth-field watersheds, and the Applegate River watershed area. Habitat and risk maps of the area assisted in the selection of sites chosen for management. Of 316 federal sites now known for the species in the area, 110 were chosen for long-term management. These are distributed across 19 sixth-field watersheds, with 2-12 sites per watershed. Two management strategies are outlined for sites, a conservative approach to retain habitat conditions, and a restoration approach to reduce the likelihood of stand-replacement fires, particularly in forests within Wildland Urban Interface that need fuels reduction treatments.

Benjamin Clemens[1], Carl Schreck[2]

[1]Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, U. S. Geological Survey, Oregon State University, Corvallis, OR, United States, [2]USGS, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, United States

Migration and Maturation Characteristics of Adult Pacific Lamprey, *Entosphenus tridentatus*: Do Warm Summer Temperatures Act as a Controlling or a Selecting Factor?

Pacific lamprey, *Entosphenus tridentatus*, populations are declining in the Pacific Northwest and there is a paucity of information about these imperiled fish. We have undertaken a mixture of manipulative, radio tracking, physiological and morphological monitoring of adult Pacific lamprey throughout their run timing in the Willamette River, Oregon. This research is aimed at elucidating the maturation and migration characteristics of adult Pacific lamprey in order to better understand their biology and inform management/conservation actions. Previous laboratory and radio tracking studies by us suggest that warm (> 20 ^{o}C) summer temperatures are associated with expedited maturation timing and changes in migration characteristics returning adult Pacific lamprey. These characteristics suggest a unimodal maturation/spawn timing between April and early June and immaturity from mid-June through September. The immature, late migrating fish may be next year's maturing and spawning cohort. We hypothesize that the seasonal change in maturation and migration characteristics of Pacific lamprey are primarily plastic responses to a single cohort/stock that has a broad run timing (April - Sept). The alternative hypothesis is that summer temperatures (or some other auto-correlated, or as yet unknown factor(s)) not only have a plastic effect on maturation and migration characteristics, but that they also have already selected for different cohorts/stocks, and that these different cohorts/stocks can be discerned by patterns in morphological characters, fecundity, maturation status and migration timing. We explore these hypotheses with a focus on the maturation and morphological characteristics and include a brief discussion of our research on the migration biology.

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834 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Matthew Close, David Cundall

Lehigh University, Bethlehem, PA, United States

Anatomical and Histological Correlates to Snake Lower Jaw Function

Snakes that swallow very large prey increase gape size by separating the tips of the mandibles. We relate the extensibility of the intermandibular soft tissues of northern watersnakes (*Nerodia sipedon*) during feeding on fish of different sizes to anatomical and histological differences in soft tissue structure in unstretched, moderately stretched (3-5X resting interramal distance) and highly stretched (>6X resting interramal distance) conditions. Behavioral records show that the distance between the tips of the mandibles increases up to six times resting distance when watersnakes ingest large fish. Anatomical and histological data reveal structural differences in the soft tissues that correspond to the intermandibular region's behavioral response to stretch. For skin, increasing distance between scales arises by both unfolding and stretching of the interscale regions. The oral mucosa and subepithelial tissues unfold in the postglottal region, and the preglottal region stretches. Intermandibularis anterior muscles increase in angle of orientation relative to the midline and increase in overall length, which corresponds to increases in sarcomere length. Sarcomeres dissapear in highly-stretched regions of muscle fibers, the highest measurable length being approximately 3.3 times resting length. The interramal pad increases in width by reorientation of collagen fibers comprising the tissue. Nerves supplying the intermandibular region are highly convoluted at rest and respond by unfolding. These initial results provide a framework for future studies involving the effects of phylogeny and ontogeny on the response of the region to stretch, which is critical to understanding the evolution of the macrostomatan gape.

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98 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Rui Coelho[1], Fábio Hazin[2], Mariana Rego[2], Mirna Tambourgi[2], Paulo Oliveira[2], Paulo Travassos[2], Felipe Carvalho[1], George Burgess[1]

[1]Florida Program for Shark Research, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States, [2]Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil

Abundance, Distribution and Reproductive Biology of the Oceanic Whitetip Shark Caught by the Tuna Pelagic Longline Fishery in the Southwest Atlantic Ocean

Oceanic whitetip sharks, *Carcharhinus longimanus*, are regularly caught as by-catch by northeastern Brazil-based longliners, targeting mainly tuna and swordfish. We analyzed fisheries data collected by fishery observers since 2004 and biological data gathered since August 2007, the latter to determine reproductive parameters. The oceanic whitetip represented 3.1% of the total shark catch by number and, even though it is not targeted directly by the fishery, captured specimens were usually retained for marketing. A high proportion of the catch was composed of juvenile specimens, and even though only a few mature specimens have been caught, preliminary analysis of the temporal variation in gonad morphology and weight suggests that size at maturity is occurring between 160 to 196 cm total length (TL) for males and 181 to 203 cm TL for females. Litter sizes in pregnant females varied from 1 to 14 embryos. In this region, mating seems to be occurring in March and parturition 10 to 12 months later. *Carcharhinus longimanus* occurred throughout the entire study area, from latitudes 5ºN to 25ºS. While juveniles dominated and were homogenously distributed throughout the region, it is interesting to note that the few pre-ovulatory females recorded occurred exclusively in the southern region (20ºS to 25ºS) while the few pregnant females recorded occurred exclusively in the equatorial region (around 5ºS), suggesting spatial variations of this population in the southwest Atlantic Ocean.

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397 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Kathleen Cole

University of Hawaii at Manoa, Honolulu, HI, United States

Reproductive Morphology among Hermaphroditic Gobiine Fishes: Insights into Phylogeny and Evolution

Within the subfamily Gobiinae (F. Gobiidae), hermaphroditism is found in several clades. A comparison of hermaphroditic gonad morphology among these clades supports the hypothesis that hermaphroditism has arisen independently two or more

times. In the Gobiosoma group (Gobiosomatini) hermaphroditism may have been a shared feature early in its evolution. If so, sexual lability may have played a contributory role in the evolution of microhabitat specialization, rapid evolution and high rates of speciation found in this clade. Hermaphroditic genera *Trimma* and *Eviota* also exhibit considerable microhabitat specialization as well as high rates of speciation and adaptive radiation, possibly facilitated by the early appearance of hermaphroditism. In contrast to the above, hermaphroditism is widespread among several other gobiine genera including *Gobiodon*, *Paragobiodon*, *Priolepis, Braninops* and *Lythrypnus.* None of these genera are particularly speciose and only the obligate coral dwellers, *Gobiodon* and *Paragobiodon*, exhibit significant microhabitat specialization. Thus, hermaphroditism within the Gobiinae is associated with two differing radiation patterns, one of which is highly speciose and the other, not. However, these patterns are not necessarily taxon-consistent. One pattern of gonad morphology is shared by several closely-related genera (*Coryphopterus*, *Rhinogobiops, Lophogobius, Fusigobius*) and a differing pattern is shared by the putative sister taxa, *Gobiodon* and *Paragobiodon*. If shared gonad morphology among hermaphroditic gobiines does reflect close phylogenetic relationships, then the speciose genus *Eviota* may be closely related to the much less speciose genera of *Gobiodon* and *Paragobiodon*, while *Trimma* (speciose) may be most closely related to the relatively small genera of *Priolepis* and *Bryaninops.*

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682 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD I, Galleria North, Sunday 26 July 2009

Andrew Coleman[1], Thane Wibbels[1], Ken Marion[1], John Dindo[2]

[1]University of Alabama at Birmingham, Birmingham, AL, United States, [2]Dauphin Island Sea Lab, Dauphin Island, AL, United States

Diamondback Terrapin Hatchling Orientation Behavior: To Sea or Not To Sea? That Is The Question

After nest emergence, several cues, ranging from brightness and color of ambient light to presence or absence of shapes and silhouettes, influence the orientation behavior of sea turtle hatchlings as they crawl toward the sea. Hatchlings use these cues to determine the position of the open horizon and move in that direction. Orientation behavior of another turtle, the diamondback terrapin (*Malaclemys terrapin pileata*), has not been as thoroughly examined. Hatchlings of this species encounter nesting habitat similar to sea turtles but seemingly choose to venture in the opposite direction to the safety of salt marshes. The current study utilized newly hatched diamondback terrapins to perform orientation trials so the strength of this innate behavior could be investigated and quantified. A six meter wide orientation ring was constructed on the hatchlings' native nesting beach, which had been greatly scoured of its vegetation by a recent storm. A hatchling was placed in the middle of the ring in a random direction and was given ten minutes to pass through one of twelve available gates. The chosen gate and time were recorded. Of the sixty terrapin hatchlings tested, five remained in the ring

after the ten minutes expired. Of the remaining fifty-five, only one chose a seaward gate while the other fifty-three hatchlings chose a gate facing the salt marsh. The results supported the hypothesis that terrapin hatchlings use similar visual cues that influence sea turtle orientation behavior but respond to them quite differently. This dichotomy poses interesting evolutionary questions.

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706 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Andrew Coleman[1], Thane Wibbels[1], Ken Marion[1], John Dindo[2], David Nelson[3], Willem Roosenburg[4]

[1]University of Alabama at Birmingham, Birmingham, AL, United States, [2]Dauphin Island Sea Lab, Dauphin Island, AL, United States, [3]University of South Alabama, Mobile, AL, United States, [4]Ohio University, Athens, OH, United States

Biology and Conservation of Diamondback Terrapins (*Malaclemys terrapin pileata*) in Alabama

Diamondback terrapins (*Malaclemys terrapin pileata*) were historically abundant in Alabama. Both a terrapin cannery and a large terrapin farm existed near Dauphin Island, AL in the late 1800's and early 1900's. Unfortunately, a drastic decline has occurred potentially due to commercial crab trapping, habitat modification, and historical over harvesting. However, the extent of this decline is unknown since these populations have not been thoroughly studied. The objective of the current study is to evaluate the current status of diamondback terrapins in Alabama for the development of an optimal recovery plan. The utilization of several survey methods in both the salt marshes (head counts, modified crab traps, otter trawl) and on the nesting beaches (depredated nest counts, drift fences with pitfall traps, wildlife cameras) provided crucial data on location and relative abundance of terrapins. Based on our findings, diamondback terrapins in Alabama exist in a small number of isolated remnant aggregations. The confirmed decline is the impetus for the initiation of a headstarting program at U.A.B. Sixty-one terrapin hatchlings from twelve clutches were successfully reared and will be released once they reach a desirable size. Obtaining these hatchlings offer a number of research opportunities to examine sex ratios, multiple paternity, and hatchling orientation behavior. In addition to these topics, the genetic health and reproductive physiology of these terrapin aggregations were examined. This great range of data will be critical in the future implementation and maintenance of a successful recovery plan to ensure the survival of diamondback terrapins in Alabama.

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287 General Ichthyology I, Pavilion East, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Madhavi Colton

Department of Zoology, University of Melbourne, Melbourne, Vic, Australia

Do Temperate Marine Fishes Follow the Rules? Relationships Between Body Size, Geographic Range Size and Abundance

Relationships between abundance, body size and geographic range size have long fascinated ecologists. The positive relationship between geographic range size and abundance is so ubiquitous that it has been described as a general law of ecology. The relationship between body size and abundance, though less general, is usually negative and described by a slope of -0.75. Most of the research into these relationships, however, has focused on terrestrial ecosystems. The few studies conducted on marine fishes have occurred in the tropics and have found little evidence for a relationship between abundance and either geographic range size or body size. We explored relationships between these three variables using data collected on 81 species of fish inhabiting nearshore rocky reefs in southeast Australia. Contrary to other research, we found no strong relationships between any of these variables, suggesting that these general laws of ecology may not apply to marine fishes.

1023 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Heather Constable[1], Carol Spencer[1], Laura Russell[2]

[1]*Museum of Vertebrate Zoology, University of California, Berkeley, CA, United States,* [2]*Natural History Museum and Biodiversity Research Center, University of Kansas, Lawrence, KS, United States*

VertNet: The Future of HerpNET and FishNet in the Biodiversity Informatics Revolution

VertNet is the next step in distributed database networks for natural history collections. VertNet (www.vertnet.org) is uniting four taxon-based networks (MaNIS, HerpNET, ORNIS and FishNet2) under one project, allowing participants to capitalize on economies of scale while maintaining the integrity of existing networks. Currently, there are 127 museums globally, together sharing over 20 million vertebrate specimen records online through HerpNET (www.herpnet.org) , FishNet2 (www.fishnet2.net), MaNIS (www.manisnet.org), ORNIS (www.ornisnet.org). These projects mobilized large collaborative efforts to digitize museum catalogs, networked these databases to a searchable portal and added geospatial data for the mapping of specimen localities. With the tandem development of BioGeomancer (www.biogeomancer.org) and

GeoLocate (www.museum.tulane.edu/geolocate/), the museum biodiversity community now has the ability to research and enhance their collections with geospatial data at an exponentially increasing pace. These projects have revolutionized biodiversity informatics and created momentum to further develop conservation research tools. The benefits of participation are measurable, as VertNET will continue to develop appropriate standards and protocols for georeferencing and data-sharing, and allow providers to control access according to local policies. The implementation of new technologies will provide opportunities for more communities to participate. Future plans include soliciting additional community involvement and governance, an online VertNet users survey, enhancement of the portal design, and a dynamic cache to expand performance and analytic features. National Biological Information Infrastructure (NBII) has provided the current funding for the coordinator and programmer. The VertNET Interim Steering Committee (from multiple institutions) are pursuing funding sources to continue and enhance participation and tools.

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561 General Ichthyology I, Pavilion East, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Kevin W. Conway

Saint Louis University, St. Louis, MO, United States

How Bizarre: Swim Bladder Sexual Dimorphism in *Psilorhynchus* (Ostariophysi: Cypriniformes)

Ostariophysans are characterized by having a swim bladder divided in to separate anterior and posterior chambers. Though radical modifications in swim bladder morphology have been documented for some ostariophysan groups the majority of ostariophysans have deviated little from this general swim bladder bauplan, and to date no ostariophysan has been reported to exhibit a sexually dimorphic swim bladder (associated musculature excluded). Examination of the swim bladder of *Psilorhynchus* revealed an astonishing sexual dimorphism of both chambers. In males the anterior chamber bears a pair of lateral diverticuli that are extended posteriorly, dorsal to the posterior chamber, and are connected along the midline to form a U-shaped tube. The posterior chamber of males is also subdivided into several smaller compartments, giving this chamber the overall appearance of a honeycomb. The anterior swim bladder chamber of females lacks diverticuli and the posterior chamber is singular, as in other ostariophysan fishes, but is greatly reduced in size (~10x smaller) compared to that of the male. Examination of cleared and stained specimens revealed further sexually dimorphic characteristics of the Weberian apparatus and the 5th rib, which are accompanied by pronounced sexual dimorphism of the associated musculature (in males part of the hypaxial muscles forms a greatly hypertrophied bulbous muscle). This astonishing sexual dimorphism has been overlooked until now because previous descriptions of the swim bladder of *Psilorhynchus* appear to have been restricted to females only. The function of these complex dimorphisms is currently unknown.

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110 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009; ELHS SALLY RICHARDSON AWARD

Geoffrey Cook

Scripps Institution of Oceanography, La Jolla, CA, United States

Population Connectivity of a Temperate Rocky Reef Pomacentrid: How do Temperate Damsels Compare?

Studies of population connectivity and self-recruitment have focused primarily on fishes in tropical systems, with many data from pomacentrid (damselfish) research. This paper examines empirically derived patterns of population connectivity of garibaldi (*Hypsypops rubicundus*), a temperate rocky reef pomacentrid, among a suite of open rocky coast sites, including three MPAs in San Diego County, CA. Data are presented describing basic life history traits, including habitat requirements for nesting, juvenile and adult life-stages. During the 2008 spawning season larval fish were collected fortnightly from benthic nests (n=95) spanning six study sites located along 65km of San Diego's coastline. From these, individual otoliths (n=1133) were extracted and analyzed with LA-ICPMS, creating a spatially and temporally explicit chemical reference map. Preliminary data analyses (i.e. DFA) suggest populations separated by as little as 5 - 10 km of linear coastline can be distinguished using otolith trace-elemental chemistry. From August 2008 to November 2008 young-of-the-year (YOY) settlers were collected (n=72) from these same focal sites, and after extraction, otolith cores were examined using LA-ICPMS to yield natal chemical signatures. These forthcoming data allow one to infer connectivity among study sites by comparing natal signatures of YOY fish with the chemical reference map generated by the larval fish otoliths obtained from benthic nests. Results will be used to discuss implications for San Diego County MPAs, and allow direct intra-family comparisons of connectivity between temperate and tropical damselfish to help develop broader generalizations about population connectivity.

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241 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Daniel Cooper[1], Janet Duffy-Anderson[1], William Stockhausen[1], Phyllis Stabeno[2], Christina Jump[1]

[1]National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fishery Science Center, Seattle, WA, United States, [2]National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory, Seattle, WA, United States

Northern Rock Sole (*Lepidopsetta polyxystra*) Connectivity between Larval And Juvenile Stages along the Alaska Peninsula in Relation to Currents and Hydrography

Northern rock sole (*Lepidopsetta polyxystra*) connectivity from the larval to juvenile stages was studied in the Bering Sea along the north side of the Alaska Peninsula. Larval distribution and transport, age-0 distribution and abundance, and juvenile distribution from age-1 to age-3 were examined. Larval distribution was determined by ichthyoplankton surveys in May 2006 and 2008, and settlement sites were predicted based on wind patterns and results from an individual-based bio-physical coupled model that permitted depth-discrete tracking of dispersed particles. Predicted settlement sites were compared with the results of juvenile beam trawl surveys in September 2006 and 2008. Age-0 northern rock sole were present at water depths generally less than 50 m, and age-0 mean length decreased with depth. One possible explanation is that juveniles settle in or around the seasonally-established Bering Sea inner front, a hydrographic feature that occurs in the vicinity of the 50 m isobath, and then the newly-settled juveniles move to shallower nursery areas as they grow. Alternatively, age-0 individuals could be subject to temperature-mediated growth differences between juvenile nursery areas in cold, deep water and warm, shallow areas. Older age-classes of sub-adults progressively move to deeper depths, and adult habitat appears to be over the middle and outer shelves. Implications for shifts in northern rock sole population distributions with climate variation will be explored.

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220 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Louise Copeman[1], Christopher Parrish[1], Robert Gregory[2]

[1]*Ocean Sciences Centre, Memorial University of Newfoundland, St. John's NL, Canada,*
[2]*Fisheries and Oceans Canada, Environmental Sciences Division, St. John's NL, Canada*

Increased Terrestrial Dietary Input and Decreased Lipid Storage in Juvenile Cod (*Gadus morhua*) during Settlement into Eelgrass Habitat

We characterized the lipid classes/fatty acids/compound specific isotopes (CSI) in the food web of age 0 juvenile cod (*Gadus morhua*) during late-summer/fall settlement into eelgrass (*Zostera marina*) in coastal Newfoundland, Canada. Examination of available prey demonstrated a high abundance of small zooplankton with no larger lipid-rich *Calanus* sp. Breakpoint analysis showed significant changes in the accumulation of relative (mg.g-1 wet weight) and absolute (µg.fish-1) amounts of lipid with standard length at the time of settlement (~60 mm standard length). Settling juvenile cod showed an alternate lipid utilization strategy where they catabolized phospholipids (PL) to a greater extent than triacylgylcerols. Polyunsaturated fatty acids (PUFA) content in cod flesh decreased as fish grew indicating that nearshore zooplankton quality was not optimal for PL formation. Food web fatty acid analysis along with CSI data indicated that increasing short chain PUFA during the fall was due to elevated terrestrial carbon throughout the food web. Despite a reduction in "food quality", juvenile cod continued to grow, leading to decreased lipid stores and suggesting that cod settling into eelgrass are under intense selection pressure for growth prior to the onset of winter, possibly as a means of escaping gape-limited predation. Increased terrestrial input of organic carbon coupled with low proportions of dietary essential fatty acids, indicates that the functional significance of this habitat is refuge and not nutrition.

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771 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Stephen Corn[1], Ron Marlow[2]

[1]*USGS Aldo Leopold Wilderness Research Institute, Missoula, MT, United States,*
[2]*University of Nevada, Department of Biology, Reno, NV, United States*

Sources of Bias in Line-Distance Sampling of Desert Tortoises

Line-transect distance sampling (LDS) is used to monitor populations of the threatened Desert Tortoise (*Gopherus agassizii*) in the Mojave Desert. Although LDS is robust with relatively few assumptions, there are sources of bias, both general to the method and specific to tortoises, that must be accounted for. A central assumption of LDS is that all objects on the transect centerline are detected (detection probability = 1 at distance = 0).

Trials with single observers and tortoise models show that detection on the transect centerline consistently is < 1, but that with two independent observers, bias is minimized. If a portion of the target population is unavailable to be sampled, the estimated abundance will also be biased low. Tortoise activity above ground is limited and varies from year to year. Observations of focal animals are used to estimate the proportion of the population available for sampling. Tortoises may be above or below ground (in burrows), and visible or not visible (tortoises above ground but not visible are hidden in dense vegetation). Only visible tortoises constitute the population available for sampling, and this proportion is the basis of a multiplier used to adjust the estimated abundance. However, comparison of proportions of observations of focal tortoises above and below ground to observations of tortoises above and below ground on transects suggests that tortoises below ground are undersampled during LDS. This potential bias varies from year to year and may be a significant obstacle to accurate assessment of tortoise populations.

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978 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Taylor Cotten

Stephen F. Austin State University, Nacogdoches, TX, United States

The Effects of Chinese Tallow (*Sapium sebiferum*) Leaf Litter on Four Species of Anuran Tadpoles

East Texas contains an abundance of ephemeral and permanent forest pools that provide breeding sites for resident anurans. Leaf litter that falls from the surrounding trees enters these aquatic ecosystems. Anuran eggs and larvae that are found in these pools are exposed to chemicals such as tannins, and any other water chemistry changes that may be associated with the leaf disassociation. I tested the effects of deciduous leaf fall from the invasive exotic tree Chinese tallow (*Sapium sebiferum*) on tadpole growth and development within experimental mesocosms. I compared survival and rate of development of four species of anuran larvae, Grey Tree Frogs (*Hyla versicolor*), Cajun Chorus Frog (*Pseudacris fouquettei*), Gulf Coast Toad (*Ollotis nebulifer*), and the Southern Leopard Frog (*Lithobates sphenocephalus*) exposed to *Sapium* leaf litter and that of two native tree species, *Acer rubrum* (Red Maple), and *Quercus michauxii* (Swamp Chestnut Oak). Tadpoles from the four species of anurans were placed in mesocoms containing only water and either *Sapium*, *Quercus*, or *Acer* leaf litter. Preliminary results show that tadpoles exposed to just Sapium leaf litter had decreased survivability, and differing developmental rates then tadpoles exposed to the two native species of deciduous leaf fall. This research is some of the first investigating the impacts of an exotic deciduous tree species on amphibian larvae. With populations of amphibians in decline the impacts of invasive plants on amphibians is an area requiring more attention.

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968 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Charles Cotton[1], Dean Grubbs[2], Toby Daly-Engel[3], John Musick[1]

[1]Virginia Institute of Marine Science, Gloucester Point, VA, United States, [2]Florida State University Coastal and Marine Laboratory, St. Teresa, FL, United States, [3]3University of Hawaii at Manoa, Honolulu, HI, United States

Age, Growth and Reproduction of *Squalus mitsukurii* from Hawaiian Waters

The shortspine spurdog, *Squalus mitsukurii*, is a medium-sized dogfish with a cosmopolitan, but patchy distribution throughout warm waters. This dogfish inhabits continental and insular shelves and upper slopes, as well as seamounts and ridges, usually in depths of 100-500 meters. This species is quite abundant around the Hawaiian Islands, where fishing pressure is likely minimal. Specimens were collected by demersal longlines, with sizes ranging from 39-cm to 101-cm for females and from 41-cm to 71-cm for males. Ages were assigned by counting bands on the enamel caps of both fin spines from 126 females and 30 males. Readability was similar between fin spines for both sexes. Likewise, age estimates obtained from each fin spine were similar for both sexes. However, sexual dimorphism of fin spines was noted, with male spines being somewhat more difficult to interpret, due to a constriction of the enamel cap on the anterior surface of each spine. Age estimates ranged from 3 to 25 years for females and 2 to 15 years for males. Growth parameters were estimated using several growth models. Spine morphometrics are also presented with growth model estimates. Age validation was not performed, though it is inferred though other age validation studies on a congener, *S. acanthias*. Observed fecundity, as well as maturity and maternity ogives are also presented. Our results are compared with other studies of *S. mitsukurii* from Pacific waters.

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584 Poster Session I, Exhibit Hall, Friday 24 July 2009

Robert Cowen[1], Cedric Guigand[1], Gavriil Tsechpenakis[1], Charles Cousin[2], Adam Greer[1]

[1]University of Miami, Miami, FL, United States, [2]Bellamare, LLC, San Diego, CA, United States

Analysis of Fine Scale Larval Fish Distribution Using the In-Situ Ichthyoplankton Imaging System (ISIIS)

One driving factor improving the resolution of oceanographic sampling has been the observation of fine structure in the ocean. As sample resolution improves, the finer patterns that are discovered lead to a better understanding (and new questions) about dynamic processes in the ocean. To date, current technologies available for the study of

many zooplankters remain limited in comparison to the spatial-temporal resolution and data acquisition rate available for physical oceanographic measurements. To overcome these challenges, we have built a towed, very high resolution digital imaging system capable of sampling water volumes sufficient for accurate quantification of meso-zooplankton in situ. The images are high quality, enabling clear identification of meso-zooplankters (e.g. larvaceans, gelatinous zooplankters, chaetognaths, larval fish), often to family or genus level. However, the efforts directed toward high speed and high-resolution imaging have created a bottleneck in data analysis. To address this problem we also have developed efficient algorithms for automated detection and recognition of organisms using shape and texture information. A total of 76,956 full frame images, representing a total imaged volume of 443 m^3, were manually scored for fish larvae from the data collected offshore Long Key, Florida, USA, using ISIIS in a towed undulating (tow-yo) fashion between the depths of 4 m and 40 m for 73 minutes. The results of the manual classification are compared to the performance of the extraction and classification algorithm. Further, scaling of observed patchiness of larval fish and dominant zooplankters, as well as orientation to the surface, are presented.

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701 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Robert Cowen, Su Sponaugle, Joel Llopiz

University of Miami/RSMAS, Miami, FL, United States

Perception versus Reality: Does Larval Biology Differ with Latitude?

Advancements in the study of larval biology and ecology over the last two decades have added tremendously to our knowledge of this important life stage. Research agendas, dogma, and opportunities have structured the direction of this work, with some distinct differences in outcomes appearing to emerge among high and low latitude studies. However, the degree to which these latitudinal differences in early life history stages reflect reality is unclear. With regard to larval biology studies, there has been a historic emphasis on transport-related studies in the tropics, while studies in higher latitudes often focus on predator-prey and growth-survival processes. Recently, however, an increasing number of 'cross-over' studies have addressed aspects of larval fish growth, feeding, condition, and survival in the lower latitudes. Similarly, recent work in temperate regions is shedding light on the implications of larval dispersal and population connectivity. Results of both of these types of studies in both of these general regions are beginning to help us distinguish between real and perceived differences in processes influencing population connectivity at different latitudes. We focus our discussion on differences in physical and ecological factors (especially temperature and trophic interactions) driving spatial and temporal patterns of larval condition and survival as related to issues of connectivity.

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670 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009

Kevin Craig

Florida State University, Tallahassee, FL, United States

Developing Mechanistic Links Between Hypoxia and Juvenile Finfish Bycatch in the Gulf of Mexico

The Gulf of Mexico shelf experiences a large (up to 20,000 km^2) area of hypoxic (≤ 2.0 mg l^{-1}) bottom water during summer. The shrimp fishery overlaps in time and space with the area of severe hypoxia, but the effects of hypoxia on shrimp harvest and juvenile finfish bycatch are not well known. We combined synoptic aerial and shipboard surveys with fishery-independent monitoring data to address the hypothesis that hypoxia-induced shifts in the spatial distribution of brown shrimp and juvenile finfishes influence bycatch interactions with the commercial fishery. At local scales (10-50 km), brown shrimp and juvenile finfishes had similar, low (< 2.0 mg l^{-1}) dissolved oxygen avoidance thresholds and aggregated at short (<5 km) distances just beyond the edge of the hypoxic zone. Overlap between shrimp and juvenile Atlantic croaker in the vicinity of the hypoxic zone was scale-dependent, with the highest overlap occurring at spatial scales similar to individual shrimp tows (<10 km). These effects at small spatial scales were reflected in changes in patch size and spatial overlap of shrimp and croaker at the shelfwide (>100 km) scale. Shrimpers also avoided hypoxia and focused fishing effort near the edges of the hypoxic zone where both shrimp and juvenile finfishes densities were high. These results suggest that behavioral avoidance of low oxygen and shifts in the spatial distributions and overlap of target and bycatch species could lead to enhanced fishing mortality on early life stages.

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674 Poster Session I, Exhibit Hall, Friday 24 July 2009

Kevin Craig, Samantha Bosman

Florida State University, Tallahassee, FL, United States

Do Cownose Rays Prefer Habitats with Hypoxic Bottom Waters?

Mobile organisms generally avoid waters with low dissolved oxygen (DO) by moving horizontally or vertically to alternative oxygenated habitats. Even so, some organisms are found in low DO habitats, due either to constraints on their ability to avoid low DO or tradeoffs involving exposure to low DO with other biotic and abiotic processes. We investigated the response of cownose rays (*Rhinoptera bonasus*) to large-scale, summertime hypoxia (dissolved oxygen ≤ 2.0 mg l^{-1}) on the northwestern Gulf of Mexico shelf. Fishery-independent trawl surveys throughout the northwestern Gulf indicated that rays were most abundant in regions of the shelf influenced by the Mississippi River plume, suggesting that shelfwide spatial distributions may be driven in part by regional

variation in ocean productivity. Trawl and aerial surveys in a particular region of the hypoxic zone indicated that rays selected habitats with low bottom DO but appeared to occupy oxygenated waters from the surface to just above the hypoxic bottom layer. While rays occupied the upper water column above hypoxic bottom waters, their diets were comprised of a variety of benthic epifaunal and infaunal prey and were similar between animals sampled in hypoxic versus normoxic habitats. Collectively these results indicate that cownose rays preferentially use habitats with hypoxic bottom waters, perhaps for benthic foraging. Because hypoxia coincides with the reproductive period of cownose rays (May-July), effects of low DO on the spatial distribution and foraging success of mature rays may lead to subsequent effects on next-generation early life stages.

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327 Poster Session I, Exhibit Hall, Friday 24 July 2009

Brian Crawford[1], Caleb Hickman[2], Thomas Luhring[3]

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Chemosensory Responses of an Arcane Amphibian to Predators with Different Feeding Strategies

Several organisms have developed remarkable sensory systems to detect the threat of predation, which are usually based on visual, tactile, or chemical cues. In a system with multiple predators, prey response to these senses should correlate to the perceived risk of predation, which may account for predator size, recent diet, or foraging strategy (generalist vs. specialist). Most studies have looked at differences in foraging strategies from the predator's perspective, but prey response may also indicate the relative importance of predators. Previous studies have found that amphibians, especially salamanders, living in murky, aquatic habitats rely heavily on chemical cues. The greater siren, *Siren lacertina*, is a permanently-aquatic salamander that inhabits sluggish bodies of water throughout the Southeast United States and is prey of aquatic snakes. To examine the greater siren's chemosensory abilities, we performed two experiments in tandem where we recorded sirens' behavioral responses to chemical cues from specialist and generalist snake predators, which were compared to responses to non-predator and blank control stimuli. Sirens retreated faster and exhibited reversing movements away from specialist and non-predator scents. They also responded with a unique behavior, gill-flushing, to specialist cues only. However, we observed no behavioral responses to generalist predator cues. These results indicate the greater siren's ability to use chemical cues to distinguish between a specialist and generalist predator and respond differently based on their perceived risk of predation.

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684 Poster Session II, Exhibit Hall, Saturday 25 July 2009

John A. Crawford[1], William E. Peterman[2], Andrew R. Kuhns[3]

[1]Indiana University School of Medicine-TH, Terre Haute, IN, United States, [2]University of Missouri, Columbia, MO, United States, [3]University of Illinois Institute of Natural Resource Sustainability: Illinois Natural History Survey, Champaign, IL, United States

Assessing the Distribution of a Secretive Species Using Ecological Niche and Cccupancy Models

One of the primary difficulties in protecting imperiled species is determining their distribution and habitat use. We used ecological niche modeling (MaxEnt) along with occupancy models to examine the distribution and status of Jefferson salamanders (*Ambystoma jeffersonianum*), a threatened species in Illinois. Based on predictive maps generated in MaxEnt, we sampled 55 ponds during the 2008 and 2009 breeding seasons. Results through 2009 resulted in a good fit to the MaxEnt model (AUC=0.791, C.I.=0.642-0.941), with 72% of ponds classified correctly by the model. MaxEnt values were significantly different between ponds where Jefferson salamanders were present or absent ($F_{1,37}$= 10.723, p= 0.0023) but model discrimination was hindered by the presence of predatory fish in some ponds with high probability values. When we removed ponds with fish from the analysis, the overall model fit was substantially improved (AUC=0.882, C.I.=0.761-1.00). We considered 17 models to estimate detection probabilities and overall site occupancy using PRESENCE 2.0. The best fit model had constant detection probabilities and predatory fish presence as a site covariate; further elucidating the negative effect of predatory fish on salamander occupancy. The overall estimate of proportion of sites occupied was 0.6267 with a probability of detection of 0.7192. Ecological niche modeling proved useful for quickly and efficiently identifying areas to survey for rare species. Our surveys identified 29 new breeding ponds used by Jefferson Salamanders and verified the continued presence of the species at four historical localities.

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839 Snake Conservation, Pavilion West, Monday 27 July 2009

Matthew Cross, James Gillingham

Central Michigan University, Mt. Pleasant, MI, United States

Responses of the Eastern Massasauga Rattlesnake (*Sistrurus c. catenatus*) to Prescribed Fire in a Southwestern Michigan Wetland Prairies

The eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is currently listed as endangered in Canada and has been a candidate for listing under the U.S. Endangered Species Act since 1999. Major threats to its existence are habitat destruction, fragmentation, and individual persecution. Recently, land management has been

targeted as one of the possible causes leading to the massasauga's decline, specifically prescribed fires. This study examined how prescribed burns affect the snake's behavior and habitat utilization. Eleven massasaugas were captured between 2 study sites and implanted with radio transmitters. In the spring of 2008, a 6-ha burn was conducted on a treatment plot that went over 5 radio-tagged massasaugas. Posts were set up around snake locations so observers could monitor the fire's rate of spread and flame length. The snakes were located immediately after the burn to determine mortality and record behavioral changes. Mortality was observed for two of the five snakes. Snakes that sought shelter survived and continued to follow normal movement patterns throughout the rest of their active season. The snake's behavior and habitat utilization did not differ between the treatment and control plots. These data suggest that massasaugas are a fire-adapted species. Altering the type and timing of burns may prove to be beneficial for this species. It is recommended that brush piles be placed away from potential or known over-wintering sites or that they are burned at another time of year. More monitoring is necessary to determine what long-term effects prescribed fires may have on massasauga populations.

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920 Herp Systematics, Pavilion West, Thursday 23 July 2009

David Cundall, Frances Irish, Douglas Grapski, Joseph Constentino

Lehigh University, Bethlehem, PA, United States

Drinking Homologies in Snakes: Another Window on Evolution

We compared drinking kinematics in 40 snake species representing 27 genera in 11 families. At least four distinct modes of drinking can be defined based on mandibular movement, palatomaxillary movement, snout flexion and tongue use. Most pythons and boas use very limited mandibular excursions but obvious tongue-sealing behavior in which part of the tongue emerges in the lingual groove during the compressive phase of drinking cycles. The same pattern is seen in the New World erycines. Old World erycines show anteroposterior instead of mediolateral palatomaxillary movement. *Casarea dussumieri* and *Xenopeltis unicolor* both display extraordinary flexion of the snout, marked mandibular movement, and no visible tongue movement, unlike the clades they are currently nested within on the basis of recent molecular analyses. Colubroid species tested show various patterns but typically use no visible tongue movement, little or no snout flexion, and varying degrees of mandible movement. Comparing kinematic patterns to muscle activity in a few colubroid species suggests that drinking in non-booid snakes may be based on a similar motor program. The unusual snout flexion in *Casarea* and *Xenopeltis* could stem from a generalized pattern of dorsal constrictor activity combined with a jointed or bendable maxilla. Tongue-sealing behavior in boas, pythons, and erycines suggests the evolution of a novel motor program that differs from that of all other snakes examined to date. Drinking mechanics may provide additional evidence for evaluating higher-level relationships in squamates.

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964 Poster Session I, Exhibit Hall, Friday 24 July 2009

Paul Cupp

Eastern Kentucky University, Richmond, KY, United States

Kentucky Spring Salamanders, *Gyrinophilus porphyriticus*, Avoid Eastern Garter Snake Odors

Northern spring salamanders, *Gyrinophilus porphyriticus*, were tested for the ability to detect odors of the eastern garter snake, *Thamnophis sirtalis*, a species known to feed on salamanders. Individual *G. porphyriticus* were placed into rectangular plastic chambers (31 x 23 x 6 cm) containing two substrate choices. One substrate consisted of a moist paper towel exposed to *T. sirtalis* odor for 24 hours.The other substrate was a moist paper towel without *T. sirtalis* odor. Salamanders were released at the center of the chambers and their positions were monitored for two hrs. *G. porphyriticus* exhibited significant avoidance of *T. sirtalis* (N=12) substrates. The results suggest that *G. porphyriticus* can detect odors of predatory snakes and thus may reduce their risk of predation by avoiding sites with these odors.

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124 Herp Ecology, Galleria North, Monday 27 July 2009

Annie Curtis

University of Rhode Island, Kingston, RI, United States

Modeling Detection Probabilities and Occupancy Estimates of Ambystomatid Salamanders

Scientists now appreciate the statistical biases associated with assuming a species is absent from a site, when in fact the species was present but not detected. To account for false absences in detection histories, researchers must estimate interspecific variation in detection probabilities (p) (the probability of detecting a species when actually present during a single visit) for specific survey techniques. Biologists need to estimate detection probabilities to correctly interpret the effects of biotic and abiotic parameters on amphibian occupancy. From mid-May through July 2008, I conducted up to 9 dip net surveys at 10-d intervals at 36 isolated ponds in Rhode Island. I assessed survey-specific and site-specific factors affecting detection probabilities for two species, *Ambystoma maculatum* and *A. opacum*. I then determined within-pond and landscape-scale factors influencing each species' occupancy patterns. *A. maculatum* larvae reached peak detection rates between mid June and mid July, while *A. opacum* detection rates declined throughout the study. Water depth negatively affected detection probabilities of both species, while cloud cover was positively associated with detection probabilities of *A.*

maculatum. *A. opacum* displayed a quadratic relationship with water temperature. Woody vegetation within the pond basin significantly diminished the detection probability of *A. maculatum*. Occupancy probability estimates for both species exhibited a negative relationship with road density and a positive relationship with pond depth and canopy cover over a pond. Persistent emergent vegetation significantly enhanced occupancy probability estimates of *A. maculatum*. After accounting for detection probabilities, biologists can reliably evaluate habitat associations for management purposes.

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902 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Judd Curtis

Texas A&M University Corpus Christi, Corpus Christi, TX, United States

Identification of Wild versus Hatchery-reared Spotted Seatrout Using Otolith Chemistry

The spotted seatrout, *Cynoscion nebulosus*, comprises an economically valuable recreational fishery along the Texas coastline with over one million fish harvested annually. Stock enhancement efforts from local hatcheries have attempted to supplement wild populations to increase abundance and potential harvest of this species. The efficacy of these efforts is obviously dependent upon survival of these hatchery-reared fish once released into the wild. Although significant resources are spent on stock enhancement, the fate of hatchery-reared fish is still largely unknown. Otoliths represent a natural chemical tag and by using stable isotope analysis we can track the fate of hatchery-reared fish and make inferences about their movement and survivorship upon release into the wild. Juvenile spotted seatrout (25-40 mm) were collected from four Texas bays and from three Texas hatcheries. Sagittal otoliths were analyzed for stable isotopic compositions of $\delta^{13}C$ and $\delta^{18}O$. Preliminary evidence suggests that stable isotopes are a powerful tool for identifying natal origins of spotted seatrout as we were able to assign wild fish to natal bay systems with 80 - 100% success. These results will be combined with trace element otolith chemistry and genetic analyses, thereby enhancing our ability to track the fate of hatchery-reared fish. These data will provide managers with information needed to make decisions concerning the better management of the Texas spotted seatrout fishery.

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285 Poster Session I, Exhibit Hall, Friday 24 July 2009

Theresa Dabruzzi, Wayne Bennett

University of West Florida, Pensacola, Fl, United States

Take My Breath Away...

Atlantic stingrays, *Dasyatis sabina*, exploit some of the most abiotically extreme aquatic habitats known. These fish exhibit the highest thermal and salinity tolerance levels seen in any elasmobranch tested to date. As shallow-water seagrass inhabitants, Atlantic stingrays are almost certainly exposed to natural cycles of hypoxia as well. In our study we will look at changes in gill morphology and hemoglobin levels as possible tactics utilized by Atlantic stingrays to survive in capricious oxygen habitats. Gill remodeling, i.e., increasing the surface area and/or number of gill lamellae, has been studied in several teleosts as a means to cope with low oxygen environments, but currently no studies have determined if elasmobranchs utilize this tactic. Hypoxic tolerance will be recorded before and after stingrays are exposed to 30 days of cycling hypoxic conditions. Gills from hypoxic (treated) and normoxic (control) fish will then be assessed to determine if gill remodeling has taken place. In addition, blood hematocrit will be estimated before and after hypoxia exposure to assess for changes in carrying capacity. Data from our study may lead to a better understanding of why these fish are so successful at exploiting shallow-water habitats.

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267 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Evan D'Alessandro, Su Sponaugle

RSMAS/University of Miami, Miami, FL, United States

Spatio-Temporal Distribution and Growth of Larval Snapper (Lutjanidae) along a Transect across the Straits of Florida

Snappers are one of the most economically important groups of fish in the western Atlantic. Management of snappers is essential, however, very little is known about the early life history of most species. Progress in this area has been hampered by the difficulty involved in collecting and identifying young snapper larvae to species. In this study morphological and molecular techniques were used to identify 1500 snapper larvae collected during 23 monthly, ship-based paired multiple opening closing net and environmental sampling system (MOCNESS) and neuston tows at 17 fixed stations along a transect spanning the Straits of Florida (SOF; latitude 25.5^{o} N) in 2003 and 2004. All but 3% of larvae were successfully identified and species-specific abundance and distribution data indicated that larvae of all species of snapper occurred from spring

through fall with peak abundance during summer months and almost entirely in the upper 50 m of the water column. Of the seven most abundant species (n > 100), only *Etelis oculatus* was distributed evenly across the SOF. *Rhomboplites aurorubens*, *Pristipomoides aquilonaris*, *Lutjanus synagris*, and *Ocyurus chrysurus* were all more abundant on the west side of the SOF while *Lutjanus apodus* and *Lutjanus analis* were more abundant on the east. Otolith-based growth analysis of the four most abundant shallow water reef-associated snappers revealed a pattern of higher larval growth in the western SOF, which was closely related to the distribution of their zooplankton prey.

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236 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Wasila Dahdul[1], John Lundberg[2]

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Systematic Revision of the South American Catfishes of the Subgenus *Megalonema* Eigenmann, 1912 (Siluriformes: Pimelodidae)

Species of the pimelodid catfish genus *Megalonema* are widely distributed in the major freshwater drainages of South America and are characterized by flexible dorsal and pectoral fin spines and elongate adipose fin. The nominotypical subgenus *Megalonema* Eigenmann, 1912, is diagnosed by the distinctive anteroventrally notched opercle and correspondingly fan-like and deep dorsal process of the interopercle. Subgenus *Megalonema* also differs noticeably from subgenus *Eretmomegalonema* in possessing plesiomorphic states: outer pelvic-fin rays not greatly elongated, anterior processes of basipterygium not hypertrophied, and relatively few 9-15 gill rakers (vs. >17) on the first branchial arch. The type species, *Megalonema platycephalum*, is notably variable across its wide range in the Orinoco, Essequibo and Amazon basins. In particular, eastern populations of *M. platycephalum* on the Brazilian and Guiana Shields have a markedly larger eye size compared to western lowland populations. The subgenus includes two additional valid species: *M. platanum* (Paraná basin), characterized by 15 gill rakers (vs. <13 in *M. platycephalum* and *M. psammium*) on first branchial arch and short maxillary barbels, and *M. psammium* (Maracaibo basin) characterized by long dorsal fin to adipose fin distance. A principal components analysis revealed morphometric distinctiveness of the three species of subgenus *Megalonema*. The nominal species *M. pauciradiatum* is a junior subjective synonym of *M. platycephalum*. *Megalonema* (*Perugia*) *argentina* is transferred to the genus *Pinirampus* and is questionably distinct from *P. pirinampu*. *Megalonema rhabdostigma* Fowler is a synonym of *Pimelodus ornatus*.

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489 Poster Session I, Exhibit Hall, Friday 24 July 2009

Elizabeth Daly[1], Toby Auth[1], Richard Brodeur[2], Bill Peterson[2]

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Winter Ichthyoplankton Abundance: Predictor of Summer Prey Fields and Ultimate Survival of Juvenile Salmon?

Summer diets of small coho and Chinook salmon are primarily made up of late-larval and early-juvenile winter-spawning taxa such as rockfishes, sand lance, sculpins, and smelts. Plankton and large trawl nets under-sample these salmon prey in the marine environment, so we investigated whether fish larvae abundance estimates in the winter and early spring could be used to create an index of food available to young salmon. We examined winter (January-March) ichthyoplankton abundance estimates from the Newport Oregon Hydrographic line (NH, 44° 39′ N) from 1997-2008 as a potential indicator of future feeding conditions for young salmon in the marine environment. The relationship between the abundance of fish larvae in winter and subsequent coho salmon survival based on the Oregon production index (OPI) was found to be highly significant (r^2 = 69.5, p = 0.0027). This relationship was not significant for Chinook salmon but we are investigating other prey taxa and months for this species. Annual winter larval fish composition and direct comparisons with juvenile salmon summer diets will be made to test for overlap. Larval fishes have been shown to be a good indicator of ocean conditions and we believe they can be a useful and cost-effective performance indicator of future fish prey dynamics for juvenile salmon, and can provide an early warning of major shifts in the availability of food resources and subsequent effects on survival and returns of adult salmon.

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481 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Toby Daly-Engel[1], Dean Grubbs[2], Kevin Feldheim[3], Brian Bowen[1], Robert Toonen[1]

[1]Hawaii Institute of Marine Biology, Kaneohe, HI, United States, [2]Florida State University Coastal and Marine Laboratory, St. Teresa, FL, United States, [3]Field Museum's Pritzker Laboratory, Chicago, IL, United States

Beneficial or Unavoidable? Sexual Conflict Drives Low Multiple Paternity and Genetic Diversity in the Shortspine Spurdog Shark (*Squalus mitsukurii*)

Causes of multiple paternity derive from ultimate evolutionary mechanisms driving a proximate life-history strategy that promotes a polyandrous or polygynandrous mating

system. The most frequently proposed benefit of multiple paternity is its potential for maintaining population genetic diversity. Here we examine mechanisms responsible for the evolution of a polyandrous mating system in sharks, in particular its role in the reproductive strategy of the shortspine spurdog shark, *Squalus mitsukurii*. *S. mitsukurii* has one of the longest reproductive intervals of any vertebrate, making it especially vulnerable to overfishing. To estimate rate of multiple paternity and characterize population structure of *S. mitsukurii* in Hawaii, we genotyped 27 litters using eight microsatellite loci and sequenced 670 bp of the mitochondrial control region in 112 unrelated individuals collected throughout the Hawaiian Archipelago. Parsimony analysis showed that *S. mitsukurii* in Hawaii are likely a single breeding population (K = 1), despite deep-water stratification between islands that exceeds the known depth range of this species. Direct allele count and Bayesian approximation methods returned concordant estimates of 11% multiple paternity in this population. Proximate causes such as sexual conflict-driven mating avoidance and an asynchronous reproductive cycle are likely responsible for the low rate of multiple paternity, the lowest observed in any shark species. *S. mitsukurii* also has the lowest observed nucleotide diversity (π = 0.0010 ± 0.0008). A correlation meta-analysis of published multiple paternity estimates for sharks revealed that 40% of genetic diversity is explained by variation in rate of multiple paternity.

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992 Fish Behavior, Parlor ABC, Monday 27 July 2009

Kari Dammerman, Carolyn Bergstrom, David Tallmon

University of Alaska Southeast, Juneau, AK, United States

Substrate Color Preference and Adaptive Coloration in Two Populations of Freshwater Coastrange Sculpin

Adaptive color change in fishes has long been of interest to biologists, but little is known about how costly it is and if it is correlated with behavior. One adaptive consequence of color change is that it enhances camouflage and therefore reduces detection by predators. However, because color change is not instantaneous, movement by fish among sediments of different color may affect how conspicuous they are to predators. In addition, fish may choose sediments to which they are already matched in order to avoid the cost of changing color. In the following study, we tested the hypothesis that when given the choice, fish that were acclimated to a particular color would choose to remain on that color. The experiment was conducted using two different stream populations of Coastrange sculpin (*Cottus aleuticus*) from Glacier Bay National Park, Alaska. Fish were acclimated to colors naturally occurring in their streams (dark tan, light beige, red, or green) in a series of trials using pairs of colors to examine preference for one or the other during a post-acclimation period. The mean and total visit times spent on each color, relationship between stream population and color preference, and total activity levels were quantified for each acclimation color. Results are discussed as a

contribution to our understanding of the implications of color change in fishes and their behavior in possible predation situations.

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877 Fish Systematics, Pavilion East, Monday 27 July 2009

Alessio Datovo[1], Flavio A. Bockmann[1]

[1]Laboratorio de Ictiologia de Ribeirão Preto (LIRP), Universidade de Sao Paulo, FFCLRP, PPG Biologia Comparada, Ribeirão Preto/SP, Brazil, [2]Laboratorio de Ictiologia de Ribeirão Preto (LIRP), Universidade de Sao Paulo, FFCLRP, PPG Biologia Comparada, NSF/ACSI project, CNPq, Ribeirão Preto/SP, Brazil

The Cheek Muscles of Trichomycterid Catfishes: Morphology and Phylogeny (Siluriformes: Loricarioidea: Trichomycteridae)

A phylogenetic analysis of all major clades of Trichomycteridae was conducted using 36 terminal-taxa and 39 characters of cheek musculature. Two equally parsimonious cladograms were obtained, both mostly agreeing with the current hypothesis of trichomycterid intrarelationships, including the monophyly of the clade formed by Copionodontinae and Trichogeninae, the basal most lineage of Trichomycteridae. The monophyly of the clades formed by Glanapteryginae plus Sarcoglanidinae; Stegophilinae plus Tridentinae plus Vandelliinae; and the assemblage comprising all of these five subfamilies (TSVSG clade) were also confirmed and reinforced. However, one of our findings - the monophyly of Trichomycterinae including *Scleronema* and *Ituglanis* - is blatantly discordant with the mainstream hypothesis in which these genera are successive sister-groups of the TSVSG clade, while all other trichomycterines would compose a polytomy with the clade TSVSG + *Scleronema* + *Ituglanis*. We discovered a new muscle that is exclusively found in all Trichomycterinae examined, including *Ituglanis* and *Scleronema*. In addition, the previously proposed synapomorphies supporting the relationships of *Scleronema* and *Ituglanis* with the TSVSG clade were revised, revealing that they are either inconsistent or homoplastic. The hypothesis of a monophyletic Trichomycterinae has a high impact to understanding of the evolution and biogeography of the Trichomycteridae. Most of myological characters herein surveyed are unreversed and homoplasy-free synapomorphies, with some of them corroborating the monophyly of weakly-supported groups, such as Stegophilinae. Particularly noticeable is the degree of modification in the cheek musculature of the hematophagous Vandelliinae, that exhibit three new muscles unreported in any other teleostean.

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867 Poster Session III, Exhibit Hall, Sunday 26 July 2009; NIA BEST STUDENT POSTER

Alessio Datovo, Ricardo M. C. Castro

Laboratorio de Ictiologia de Ribeirão Preto (LIRP), Universidade de Sao Paulo, FFCLRP, PPG Biologia Comparada, Ribeirao Preto/SP, Brazil

Cheek Musculature And Phylogenetic Relationships In Characidae (Ostariophysi: Characiformes)

The family Characidae has one of the oldest and most complicated systematic histories among Neotropical fishes. Its phylogenetic limits and interrelationships are still poorly known, with the major part of its diversity currently placed under *incertae sedis* genera. In our ongoing study of cheek musculature, based on 50 characiform terminal taxa (mostly characids), we discovered potentially important features for the elucidation of higher-level phylogenetic relationships of characids. An apparently large monophyletic group, composed by all characids - except Agoniatinae and Iguanodectinae - and possibly also Alestidae, share a peculiar condition of attachment of section A2β of adductor mandibulae on suspensorium. *Agoniates*, which has been many times hypothesized as a basal Characidae, also exhibits some distinctive features related to the sections A2α and A3α of adductor mandibulae also found in Acestrorhynchidae, Cynodontidae, and Erythrinidae. Notwithstanding, the precise nature of the phylogenetic relationships among these taxa is still not clear. Within our putatively monophyletic group of characids (and, perhaps, alestids), at least four shared derived myological characters, together to other skeletal ones, strongly support the proposition of a monophyletic group comprising the scale-eaters *Bryconexodon*, *Exodon*, and *Roeboexodon*. Additional myological evidences reinforce the previously hypothesized monophyly of some subgroups of Characidae, such as the clade composed by *Creagrutus* and *Piabina*. In addition, at least one still undescribed characid species, currently being studied by the second author and collaborators, might eventually be considered as the sister-group of the *Creagrutus*+*Piabina* clade due to their shared possession of two uniquely derived conditions of their cranial muscles.

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718 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER HERPETOLOGY AWARD

Julian Davis

University of New Mexico, Albuquerque, NM, United States

A New Species of *Anolis* (Squamata: Iguania) Similar to *Anolis fuscoauratus* from the Andes of Bolivia and Peru

Anolis fuscoauratus is a slim brownish-grey forest lizard that is widely distributed and often abundant in Amazonia. The species has the largest range of any *Anolis*. It has been reported in Panama, Colombia, Ecuador, Peru, Bolivia, Brazil, Venezuela, Suriname, French Guiana, and Guyana. Populations of *A. fuscoauratus* display different dewlap colors depending on locality. The differences in dewlap coloration, which are consistent within populations, suggest *A. fuscoauratus* may be composed of multiple evolutionary lineages, or species. We assess whether populations of *A. fuscoauratus* from the Eastern Andes of Peru and Bolivia are a distinct species. We compared the morphology of the putative new species to that of similar species of small Peruvian and Bolivian anoles including *A. fuscoauratus*, *A. trachyderma*, *A. chrysolepis*, *A. meridionalis,* and *A. bombiceps*. We found the new form to be distinct from each of these species and describe this form as a new species.

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698 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Matthew Davis

University of Kansas Natural History Museum and Biodiversity Research Center, Lawrence, KS, United States

Integrating Molecular Evolution and Morphology to Study the Evolutionary History of Deep Sea Character Adaptations of Lizardfishes and their Allies

The extreme habitats of the deep sea have produced fascinating evolutionary events among the 2000 species of marine fishes that have invaded this realm. This study focuses on one such lineage, the order Aulopiformes, which includes 43 genera and 220 species of lizardfishes and their allies. Fish inhabiting the deep sea are subject to similar selective pressures as a result of the extreme habitat; thus, convergent adaptations are extremely common (e.g., tubular or greatly reduced eyes). Beyond photic adaptations ranging from telescopic eyes to bioluminescence, aulopiforms have fascinated ichthyologists because they are one of four teleostean clades that have independently evolved simultaneous hermaphroditism, and are the only lineage where this reproductive strategy has evolved in the deep sea. This study reexamines aulopiform

relationships with molecular and morphological data to provide a robust phylogenetic framework necessary for exploring character evolution of deep sea evolutionary adaptations under a parsimony, likelihood, and Bayesian framework.

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157 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Michael Davis

NOAA Fisheries, Newport, Oregon, United States

Reflex Impairment is an Index for Larval and Juvenile Fish Vitality and Mortality Potential

Reflex impairment is a whole animal sign of stress that appears rapidly, can be easily tested, and is correlated with reduced feeding and growth, impaired predator evasion, and delayed mortality. Reflex actions are present in first-feeding larvae and are fixed stereotypical responses (orientation, startle, optimotor) that can be repeatedly stimulated by gravity, light, sound, or touch. A reflex action is scored as present (1) if strong and obvious, or scored as absent (0) if weak or not apparent. Scores for several reflex actions are totaled to calculate an index representing the proportion of reflex impairment in individuals or populations. Present-absent scoring standardizes for the effects of increased response strength in larger fish and allows for comparisons of condition among fish sizes and ages. A three-step process can be used to validate reflex impairment as an index for vitality and mortality potential. First, appropriate reproducible reflex testing procedures are determined for control fish. Second, experiments are conducted that expose fish to multiple stressor gradients of concern (environmental, capture, handling, social) and then associated reflex impairment and mortality outcomes (sublethal, morbid, lethal) are measured. Third, reflex impairment and mortality (immediate and delayed) are correlated to produce RAMP (Reflex Action Mortality Predictor) sigmoid curves that can then be used to predict fish vitality and mortality potential in natural and human controlled ecosystems.

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827 General Ichthyology I, Pavilion East, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Ryan Day

The University of Queensland, Brisbane, Queensland, Australia

Digestion in Stomachless Fishes with Diametric Diets

The lack of a stomach seems best defined from a digestive physiology perspective, as digestive function is the key process in the definition of an alimentary organ's function. The stomach is lacking in at least 28% of extant teleost families, and the diets of stomachless fishes covers the spectrum, from micro-carnivores to herbivores and piscivores. We assessed existing models for stomachless digestion and how they apply to stomachless fishes with differing trophic habits. To develop our model, we chose the halfbeak (Hemiramphidae: Beloniformes) and the needlefish (Belonidae: Beloniformes), as these fishes are worldwide in distribution, occur in both fresh and marine environments and have diets at the opposite ends of the trophic spectrum. Despite the superficial similarity in gut morphology (presence of a pharyngeal jaw apparatus and a short straight alimentary tract that lacks a stomach), we found that these fishes process food very differently. Halfbeaks use a robust pharynx as a grinding mill, whereas needlefish use their pharynx only to grasp prey and move it from the mouth into the intestine. Once food is in the digestive tract, both fishes rely heavily on digestive enzyme activity tailored to their diet, yet halfbeaks pass food rapidly while needlefish retain their food in the posterior portion of the gut for extended periods. The differences in these digestive mechanisms indicate that the current models for digestion in fishes require revision in order to accurately illustrate the differences displayed in the diverse assemblage of stomachless fishes.

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549 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Mason Dean[1], Adam Summers[1]

[1]*University of California, Irvine, CA, United States, and Friday Harbor Laboratories, Friday Harbor, WA, United States*

From Molecules to Jaws: Structural Hierarchy and Functional Morphology of the Tessellated Skeleton of Cartilaginous Fishes

The complex, multi-tiered design of biomaterials lends them unequalled emergent material properties; however, to understand the basis for these properties many structural levels must be taken into account. This is increasingly possible for biologists due to the growing accessibility of micro/nanoscale imaging and materials testing tools:

we use a variety of high-resolution techniques to investigate the microstructure and material properties of cartilaginous fish skeletons, in an effort to understand material-, skeletal- and organismal-level performance. Endoskeletal elements of sharks and rays are comprised of an uncalcified, hyaline cartilage-like core overlain by a thin layer of mineralized hexagonal tiles (tesserae), often joined by intertesseral fibers. The macroscopic spatial relationships of the tissue phases (unmineralized cartilage, mineralized cartilage, fibrous tissue) are well-known — endoskeletal tessellation is a long-recognized synapomorphy of elasmobranch fishes— but the functional advantages of a tessellated and purely cartilaginous skeleton have been unclear. The tesserae are a necessary feature of a 'shelled' skeletal element that will grow and we have found several places where "typical" morphologies are modified, such as high-stress or curved regions of the skeleton. We also find that the micrometer-scale subunits of the skeleton —the tesserae and uncalcified cartilage — have material properties comparable to mammalian analogs, but when layered together, the resultant tissue is both stiff and good at damping mechanical energy. Furthermore, our structure level mechanical models suggest that the tessellated design helps to distribute bending stresses to the "safest" regions of the skeleton: tesserae on the compressive side of the element.

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233 Poster Session I, Exhibit Hall, Friday 24 July 2009

Bruno Alexandre de Franco, Fernando Fernandes Mendonça, Diogo Teruo Hashimoto, Fábio Porto Foresti, Cláudio Oliveira, Fausto Foresti

Universidade Estadual Paulista - Unesp, São Paulo, Brazil

Forensic Identification of the Guitarfish Species *Rhinobatos horkelli*, *Rhinobatos percellens* and *Zapteryx brevirostris* Using Multiplex-PCR and PCR-RFLP

Rays species *Rhinobatos percellens*, *Rhinobatos horkelli* and *Zapterix brevirostris*, known as guitarfish, are commonly found inshore and can be captured by the use of a trawl net. Recently, these species have been suffering sharp decreases in their populations. One of the great impediments to the development of conservation plans is the lack of information related to catches of each species. Gathering this information is made more difficult by the fishermen's practice of removing parts of the animals before landing as well as the morphological similarities found between the three species. In order to address these issues, this work presents multiplex-PCR and PCR-RFLP protocols developed to distinguish these species using their genetic characteristics. Both the multiplex-PCR and PCR-RFLP methodologies provide low-cost, easy applicability and contribute to a more refined compilation of fishing statistics. It is considered that the use of this technique will help in the development of plans for sustainable exploitation, as well as compliance with species protection laws. Additionally, these techniques can identify samples that have been processed and prepared for sale. Also permits the evaluating of the genetic status of individuals in population and provide information to subsidize conservation plans. Financed by FAPESP

1035 Storm Symposium, Pavilion West, Friday 24 July 2009

Douglas DeGross, Stevan J. Arnold

Watershed Sciences, Corvallis, OR, United States

Isolating Contact Zones and Identifying Populations Between the Closely Related Species the Del Norte (*Plethodon elongatus*) and Siskiyou Mountains (*P. stormi*) Salamanders

The systematic relationship of *Plethodon elongatus* and *P. stormi* has been controversial for decades despite allozyme analysis and recent sequencing of mitochondrial genes. The use of highly variable nuclear (microsatellite) markers to provide additional perspective on the relationship of these two species reveals limited gene flow between *P. elongatus* and *P. stormi* at a contact zone in western Siskiyou County, California, USA. These results agree with the evolutionary picture drawn from previous allozyme and mtDNA analyses. These species have apparently been geographically separated and have recently come back into contact in the vicinity of Happy Camp and Seiad Valley, California.

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556 Lizard Ecology, Pavilion East, Friday 24 July 2009

Jennifer Deitloff, John Steffen, Craig Guyer

Auburn University, Auburn, AL, United States

Understanding Biodiversity of Ground Anoles in Costa Rica

Previous research has suggested geographic species delineation for *Norops humilis* from the northern regions of Costa Rica and Nicaragua versus populations in the southern regions of Costa Rica and Panama (*N. quaggulus*). Evidence presented for this separation is primarily based on hemipenal morphology of very few individuals throughout the geographic range of these species. We hypothesized that, if *N. humilis* and *N. quaggulus* are indeed different species, evidence of this separation will be found by examining differences in head morphology, hemipenal morphology, and/or dewlap color from a greater sample of individuals throughout Costa Rica, especially from the area where the ranges of these two species abut. We found that *N. humilis* and *N. quaggulus* do not significantly differ in head morphology; however, there is a general geographic change in head morphology where distance between locations is correlated with shape difference. In addition, hemipenal morphology is variable, but not exclusively associated with the proposed species differences. These two proposed species seem to overlap in several morphological characteristics that may be important to maintain reproductive barriers. We suggest that molecular phylogenetic techniques may be the best source of

evidence for conspecifity or division between *N. humilis* and *N. quaggulus*. Further research would be needed to determine how species boundaries are maintained if these are two different species.

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557 Poster Session I, Exhibit Hall, Friday 24 July 2009

Jennifer Deitloff, John Steffen, David Laurencio, Craig Guyer

Auburn University, Auburn, AL, United States

Morphological Description of Aquatic Anoles from Costa Rica Using Shape and Color

Typical morphological descriptions of anole species consist of scale counts and distance measurements. However, more powerful tools to compare shape of organisms have been developed in recent years. Geometric morphometric analyses allow comparisons of shape within populations or species when differences are small. In addition, color comparisons have, in the past, been made qualitatively using color swatches or subjective color scales. Color can now be quantitatively compared using spectrometry. Furthermore, spectrometry allows the examination of ultraviolet color which is reflected and perceived by many organisms, including lizards. We used geometric morphometrics to examine head shape, body shape, and limb shape of aquatic anoles in Costa Rica, *Norops oxylophus* and *N. aquaticus*. In addition, we compared dewlap colors using spectrometry. Differences between species are discussed. We suggest that species comparisons continue to use these quantitative tools.

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693 Fish Genetics I, Pavilion East, Thursday 23 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Anna Belia De Los Santos

Department of Biology, Saint Louis University, St. Louis, MO, United States

Genetic Structure of the Undescribed Mexican Native Trout: An Assessment with Microsatellite Loci

High elevation rivers of the northern portion of the Sierra Madre Occidental (SMO), Mexico, contain a high diversity of native salmonids, commonly recognized as Mexican trout and members of the genus *Oncorhynchus*. In Mexico there are two species formally described: *O. mykiss nelsoni* in northern Baja California, and *O. chrysogaster* from the rivers Fuerte, Culiacan and Sinaloa in the SMO. However, most of the trout diversity discovered by the binational group **Truchas Mexicanas** over the past decade remains undescribed. Until only recently there have been limited data synthesized regarding

their delimitation. Previous analyses of 748 individuals of Mexican trout with 11 microsatellites markers from the rivers in the states of Baja California, Durango, Chihuahua and Sinaloa, Mexico, supported the existence of at least seven taxonomic units (Guzmán/Yaqui-Bavispe, Yaqui-Sirupa/Mayo, North Conchos, San Lorenzo/Piaxtla, Acaponeta/Baluarte/Presidio, one unique group in La Sidra of the San Lorenzo basin, and a group from Arroyo Aparique of the Rio Fuerte). All of these groupings were genetically distinct from the described trout (*O. mykiss nelsoni* and *O. chrysogaster)* and the exotic hatchery rainbow trout. These results will be discussed, along with evidence for two new taxomonic units recently discovered in the rivers Conchos, Fuerte and Sinaloa.

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832 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Naomi Delventhal

University of Manitoba, MB, Canada

What I Found in Kolkata: A Trip to the Zoological Survey of India Type Collections

The ichthyological collections of the Zoological Survey of India (ZSI) in Kolkata originally included type material (holotypes, syntypes and paratypes) of more than 900 species of South Asian fishes deposited most significantly from the late 19th through mid 20th century. Some of those species are known to have additional type material deposited in foreign museums (especially in Europe and North American), but in many cases the only known material is in the ZSI type collection. Unfortunately, in the past 30 years very few outside ichthyologists have taken the trip to examine these types or even determine their condition or continued existence. This has been due in part to difficulties in corresponding with ZSI staff and the logistics of getting to Kolkata. In Dec 2007, I visited ZSI for two weeks for the purpose of examining the types of 21 species, mostly gobies. Of these types, I was able to examine 13 lots, although 3 were in poor condition. One lot was apparently extant but misplaced, and the remaining 7 lost or destroyed. Although the working conditions and bureaucratic processes at the ZSI are not like those most ichthyologists have come to expect in a major museum, with a little extra preparation and patience it is possible to work successfully within the system. Ichthyologists planning a trip to the ZSI should be prepared for situations that may be every bit as challenging - and rewarding - as a field collection trip.

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487 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Mario de Pinna

Museu de Zoologia da Universidade de Sao Paulo, Sao Paulo-SP, Brazil

Diversity and Evolution of Vampire Catfishes: a Taxonomic Review and Phylogenetic Analysis of Subfamily Vandelliinae (Siluriformes, Trichomycteridae)

Parasitic catfishes of the trichomycterid subfamily Vandelliinae feed exclusively on blood when adults, being the only strictly hematophagous vertebrates in addition to vampire bats. They are also famous for their occasional, and apparently accidental, penetration of human urethras. Despite their biological interest, vandelliines are poorly known on all aspects. A taxonomic review, based on most of the material available and including several recently-made collections, shows that the subfamily was so far one of the least-known groups of vertebrates. A total of 31 vandelliine species are recognized, 22 of which are new. The species are diagnosed on the basis of traditional as well as new characters, including SEM observations. Their geographical distribution is also plotted. The rather confusing taxonomic and nomenclatural situation of the Vandelliinae is untangled in detail, on the basis of examination of nearly all available type material. Members of Vandeliinae display extraordinary anatomical modifications, mostly related to their unusual feeding habits, a number of which are unique among bony fishes. Some of those suggest the existence of remarkable adaptations, yet unstudied, in other levels of biological phenomena. Vandelliines also undergo metamorphosis in late ontogeny, associated with the onset of hematophagy. 140 morphological characters are analyzed by parsimony to generate a hypothesis of relationships among species of Vandelliinae. Those results form the basis for a redefinition of generic limits and a new classification. Five monophyletic genera are recognized, including one new. The phylogenetic hypothesis elucidates several features of the evolution of the peculiar adaptations, structure and habits of vandelliines.

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39 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Kevin de Queiroz

National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

Darwin and the Tree of Life

Charles Darwin (1809-1882) was largely responsible for the widespread acceptance of the idea that diverse life forms are related thorough common ancestry. He accomplished this feat both by marshaling numerous lines of corroborating evidence

and by identifying an incontrovertible mechanism of evolutionary change. In the *Origin of Species*, Darwin (1959) used both a branching diagram and a metaphor of a great living tree to represent what we now call phylogeny-the history of descent with modification from common ancestors. This conceptualization and representation of phylogeny as a branching process is the basis for our now common reference to the "tree of life." In the post-Darwinian era, the idea of common descent has itself been transformed, from an explanation for previously recognized phenomena into a first principle from which new concepts and methods are derived. Similarly, the tree has been transformed from a descriptive metaphor into a fundamental model that now underlies a vast body of biological research. One hundred fifty years after the publication of the *Origin of Species*, biologists have developed sophisticated methods for inferring evolutionary trees (especially branching events and character transformations) and for using those trees to address questions in a diversity of fields, from morphology and physiology to molecular biology and genomics, and even applied fields such as forensics and medicine. From so simple a beginning (the branching diagram in Darwin's first transmutation notebook) endless forms of tree-based approaches, principles, concepts, methods, and particularly applications have been, and are being, evolved.

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901 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Carlos David de Santana, William G. R. Crampton

University of Central Florida, Orlando, FL, United States

Neotropical Electric Knifefishes of the Genus *Brachyhypopomus* (Teleostei, Ostariophysi, Gymnotiformes): Monophyly, Diversity and Relationships

CANCELED

Electric fishes of the genus *Brachyhypopomus* range in maximum to medium size species, occurring from coastal rivers of Panama to the Rio de La Plata, reaching the highest levels of diversity in the Amazon basin. The diversification of *Brachyhypopomus* identified in recent studies will be described. An analysis of ninety-five morphological characters provided a hypothesis of species-level relationships within *Brachyhypopomus*. The results support the monophyly of *Brachyhypopomus* and place it as the sister taxon to *Microsternarchus* + *Racenisia*.

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66 Fish Systematics, Pavilion East, Monday 27 July 2009

Carlos David de Santana[1], Richard P. Vari[2]

[1]University of Central Florida, Orlando, FL, United States, [2]National Museum of Natural History, Washington, DC, United States

Phylogenetic and Taxonomic Studies of the Electric Fishes of the Genus *Sternarchorhynchus* (Teleostei, Ostariophysi, Gymnotiformes): Diversity, Asymmetric Divergence, Key Innovation, and Adaptive Radiation

Electric knifefishes of the genus *Sternarchorhynchus* are tube-snouted, elongate, distinctly laterally compressed fishes. Species in the genus are moderate-sized predators of benthic invertebrates living from the Río Orinoco basin in Venezuela and Colombia south through the rivers of the Guianas and the Amazon basin to the upper Rio Paraná in the Río de La Plata basin. Thirty-two species of *Sternarchorhynchus* are recognized, [illegible] 22 are new to science and the genus representing approximately [illegible] the present known species level diversity within the Apteronotidae. [illegible] analysis of eighty-eight characters of external and internal body systems [illegible] hypothesis of phylogenetic relationships of and within *Sternarchorhynchus*. The results support a hypothesis of *Sternarchorhynchus* as the sister group to *Sternarchella*. A [illegible] of synapomorphies, many involving major innovations [illegible] jaws, suspensorium, and associated structures that permit an unusual mode of grasp-suction feeding, support the monophyly of both genera. Synapomorphies largely resolve relationships within *Sternarchorhynchus* with basal nodes strongly supported by characters pertaining to prey capture and initial processing of food items. These possible key innovations may provide *Sternarchorhynchus* a competitive advantage over other clades within Apteronotidae and account for the species diversity of the genus in Neotropical rivers. Adaptive radiation in *Sternarchorhynchus* is analyzed. The convergence in elongation of snout between *Sternarchorhynchus* and *Campylomormyrus* (Mormyriformes) from Africa, the two genera among freshwater fishes known to possess grasp-suction feeding, is discussed.

CANCELED

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137 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Shannon DeVaney

Natural History Museum of Los Angeles County, Los Angeles, CA, United States

Phylogeny of Elopomorpha Based on Nuclear and Mitochondrial DNA

The clade Elopomorpha is composed of the bonefishes, ladyfishes, eels, and their allies. Adult elopomorphs vary enormously in body plan and ecology, but they are united based on the presence of a leptocephalus larval stage. Some authors, however, argue

that the leptocephalus may be plesiomorphic and Elopomorpha may not be monophyletic. Furthermore, the relationships of elopomorph taxa (whether monophyletic or not) to other lower teleosts has been the subject of some debate. The object of the present study is twofold: first, to test the monophyly of Elopomorpha; second, to examine the relationships of elopomorph fishes to other extant lower teleost groups. Taxon sampling for this study includes 40 species, 17 of which are elopomorphs; the remaining taxa are other lower teleosts with *Amia calva* the designated outgroup. The character set includes DNA sequence data from four nuclear genes: the recombination activating gene RAG1, the zinc finger protein gene ZIC1, the ectodermal neural cortex gene ENC1, and the myosin heavy chain gene MYH6; and one mitochondrial gene: the cytochrome oxidase gene COI. Phylogenetic inference was performed using three different methods: parsimony, maximum likelihood, and Bayesian inference.

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766 Herp Genetics, Galleria North, Saturday 25 July 2009

Tom Devitt

University of California, Berkeley, CA, United States

Simultaneous Analysis of Interindividual Spatial and Genetic Data from a Hybrid Zone Between Terminal Forms of the Salamander Ring Species *Ensatina eschscholtzii*

The plethodontid salamander *Ensatina eschscholtzii* has featured prominently in evolutionary biology because it represents one of the few examples of a ring species. Previous conclusions that the terminal forms (*E. e. eschscholtzii* and *E. e. klauberi*) are reproductively isolated are paramount to the ring species interpretation, and to unresolved debates about species boundaries in this complex. Although previous studies have been sufficient to document variation in rates of hybridization across the four contact zones between the terminal forms, more detailed genetic analyses are needed to understand the nature and extent of reproductive isolation at the end of the ring. Here, I report on the joint analysis of interindividual spatial and genetic data from one of these contact zones (Palomar Mountain, San Diego County, California, USA), using multilocus genotypes from georeferenced individuals to detect and characterize patterns of spatial genetic structure, with an emphasis on identifying and locating genetic discontinuities.

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763 Poster Session I, Exhibit Hall, Friday 24 July 2009

Anna Deyle, Henry Mushinsky, Earl McCoy

University of South Florida, Tampa, FL, United States

Anuran Species Composition in Urban and Natural Cypress Dome Wetlands of Florida

From May to September of 2007 and 2008 we collected frog call data from cypress dome wetlands in south west Florida. The study purpose was to determine if differences exist in anuran species composition at cypress domes in urban sites when compared to those at natural sites. We sampled four domes each at four natural sites and one semi-urban site and three domes each at two highly urban sites. Each dome was visited one night every two weeks during the study period. We listened at the edge of the dome for five minutes and recorded all anuran species heard within the dome during that time. No species that were heard at the natural sites during the two years were not also heard at the semi-urban site. Three species, *Bufo quercicus*, *Hyla gratiosa*, and *Pseudacris ocularis*, were heard at the natural sites in both years but were not heard at either of the highly urban sites. Two additional species, *Hyla femoralis* and *Acris gryllus*, were absent both years from one highly urban site but were present in one of the years at the other highly urban site. The absence of these five species from the highly urban sites likely reflects a lack of suitable habitat in the areas surrounding the cypress domes and/or the increased presence of the invasive hylid *Osteopilus septentrionalis* in urban areas, as the presence of this species has been shown to harm native hylids.

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254 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Amelia Díaz de Pascual, Javier García, Andrés Mora, Sayuri Kiyota, Moises Escalona

Universidad de Los Andes, Mérida, Venezuela

Contributions on the Natural History of the Salamanders in the Andes of Venezuela

Terrestrial salamanders (*Bolitoglossa orestes* and *B. spongai*) were study in the Andean of Mérida from June-August 2008, from 2000 to 2500 m of altitude. Animals were hand collected by raking through leaf litter, along logs and under rocks. Snout-vent length was measured to the nearest 0.1mm (SVL) of all specimens and dissected to determine sex and reproductive condition. Ovarian follicles were removed and its number was recordered and diameters were measured (mm). Testis surface (length and width) were recorded (mm). Stomach contents were separated and identified with. Specimens were placed in the herpetological collection of the Universidad de Los Andes. Refuges sites

were associated with moist leaf litter, mats of mosses, lichen and rocks. Salamanders were also frequently found underground in root channels and old woods. Soil invertebrate including pseudo scorpions, spiders, acari, adult and larval beetles, and isopods were the most common prey items recovered. From eleven adult specimens; females are larger than males (*B. orestes* 101.24 mm: 70.81mm) and *B. spongai* were (103mm:82mm). *B. orestes* females (3) had 16±5 (Mean± SE) enlarged and convoluted oviducts containing two egg rows of 1.51±0.21mm. A female of *B. spongai* with enlarged and convoluted oviducts had 21 large yellow yolk-filled adherent eggs (1.7±0.54mm) rather than stranded. Two males of the same species had whitish enlarged testis (11.96±1.13mm). Juveniles were found in groups of two to three associated with females. Although our data are limited; this is the first observation of salamander natural history in the cloud forests of Venezuela.

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622 Poster Session I, Exhibit Hall, Friday 24 July 2009

Eric Dichter[1], Scott Boback[1], Hemlata Mistry[1]

[1]Dickinson College, Carlisle, PA, United States, [2]Widener University, Chester, PA, United States

Embryonic Jaw Development in the African House Snake (*Lamprophis fuliginosus*)

Evolutionary developmental biology is a rapidly emerging field of research in recent years. One area of particular interest to ecologists is the study of the developmental mechanisms responsible for phenotypic divergence. Previous research has demonstrated that populations of boas (*Boa constrictor*) occurring on islands off the coast of Belize exhibit divergent head morphologies (e.g., longer jaws) compared to populations on the adjacent mainland. These island populations forage exclusively on passerine birds whereas those on the mainland have a more varied diet that includes much larger prey. Therefore, these head shape differences are likely important factors in the success of these populations, yet we currently do not understand how these phenotypes are produced. As a first step towards understanding the developmental mechanisms behind these divergent phenotypes, we have created a staging series for the embryonic development for *Lamprophis fuliginosus*, the African House Snake. In this study, we describe the external morphology of *L. fuliginosus* embryos, characterizing the development into specific developmental stages. We also describe preliminary experiments to determine the spatial and temporal expression profiles of candidate genes responsible for pattern formation in the developing jaw of *L. fuliginosus* embryos.

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576 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

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Overlooked Utility of mtDNA Sequence Data in Native Trout? Insights from the Native Fauna From Mexico

Resident freshwater trout of genus *Oncorhynchus* (Teleostei: Salmonidae) form a significant component of biodiversity in streams, rivers and lakes of western North America. While trout from the western United States and Canada have received extensive systematic and population genetic investigation, the full range of diversity from native trout endemic to the Sierra Madre Occidental (SMO) of northern Mexico has arguably received less study. It is only recently that this native diversity has started receiving the necessary, in depth, investigation for proposing systematic relationships and understanding population history. In this study we present the first phylogenetic hypothesis for this native fauna based on mtDNA sequence data from two loci. We place the recovered lineages in a geographic context and use these hypotheses for understanding the native diversity. Stocking of non-native *Oncorhynchus* threatens this fauna with imminent peril and a consortium of biologists from Mexico and the US are diligently working to inform governmental agencies such that information-based management of the native trout occurs. Though hypotheses based solely on mtDNA sequences suffer several drawbacks, they do provide excellent opportunity for preliminary investigations into the history of a fauna.

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591 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Ruth DiMaria[1], Jessica Miller[1], Thomas Hurst[2]

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Temperature and Growth Rate Effects on Otolith Elemental Composition of Larval Pacific Cod, *Gadus macrocephalus*

Variation of some elements in otoliths can reflect variation in water chemistry. However, fish physiology and environmental conditions can also influence otolith elemental composition. Greater understanding of the mechanisms regulating otolith elemental chemistry will improve field data interpretations. We examined temperature and growth rate effects on the otolith elemental composition of larval Pacific cod, *Gadus macrocephalus*. Immediately after hatching, larvae were acclimated to 2C, 5C and 8C and reared for 38-51 days in three replicate tanks at each temperature. Experimental water concentrations (Mg, Ca, Zn, Sr and Ba) were measured to determine partition coefficients (DMe). Using laser ablation inductively coupled plasma-mass spectrometry (LA ICP-MS), otolith concentrations of Li, Mg, Ca, Mn, Zn, Sr and Ba were examined. Li and Zn otolith concentrations were near detection limits and were excluded from subsequent analyses. Experimental otolith growth was located between the primordia, as identified by Mn-enrichment, and the otolith's outer edge. Water elemental concentrations did not differ among temperature treatments or tanks. Temperature and growth rate effects on partition coefficients varied among elements. DSr decreased with increasing temperature, but within temperature treatments DSr was inversely related to otolith and fish growth rates at 2C and showed no relationship at 5C and 8C. DBa showed similar trends as DSr. DMg was elevated at the highest acclimation temperature and showed no effects from otolith and fish growth rates within temperature treatments. Understanding variable relationships among otolith elemental signatures, environmental conditions, and fish physiology can improve the accuracy of reconstructions and interpretations of field data.

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306 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Lynda Dirk[1], Lawrence Glenn[2], David Anderson[2]

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Influence of Restoration on the Food Web of the Kissimmee River: Stable Isotopes and Diet Analysis

Stable isotope analysis is used to evaluate trophic response to changing ecosystems, whether seasonal or due to external factors. This is possible because of the natural differences in stable isotope ratios of various ecosystem components. In a changing ecosystem such as the Kissimmee River, where the landscape is changing so dramatically due to restoration efforts, it is important to understand the shifts that are occurring throughout the food web. Stable isotope analysis allows for an overview of any shifts that occur to the energy flow and trophic levels due to seasonal and landscape level alterations. Sampling will be conducted in three areas of the Kissimmee River: the control (unrestored), impact (to be restored), and a projected site (restored). Individuals form five trophic level representative species will be collected from each pool during each wet and dry season, for two years. Both muscle and liver tissue samples will be collected, as well as stomach contents and otoliths for age and diet analysis. Various sources of carbon in the system must also be analyzed for their $\delta^{34}S$, $\delta^{15}N$ and $\delta^{13}C$ signatures, including particulate organic matter (POM) and precipitated dissolved inorganic carbon (DIC), submerged vegetation, C_4 and C_3 vegetation, epiphyton, filamentous green algae and detritus. Invertebrate prey items will also be collected for analysis. Samples will be analyzed with a continuous-flow analysis system consisting of an elemental analyzer interfaced to a mass spectrometer.

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235 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Valentina Di Santo, Wayne Bennett

University of West Florida, Pensacola, FL, United States

Effects of Thermotaxis on Digestion Efficiency in Two Elasmobranchs

Recent telemetry and laboratory studies have shown that some rays and sharks feed in warmer water, but rest in cooler waters. Thermoregulatory behavior has been suggested as a means for elasmobranch fishes to improve the efficiency of metabolic processes such as digestion. For shuttling to be effective, however, temperature mediated movements must affect absorption and evacuation rates differently - a result that, to date, has never been empirically demonstrated. In this study, the post-feeding thermotaxis hypothesis was tested in the laboratory using two elasmobranch species, the Atlantic stingray

(*Dasyatis sabina*) which inhabits thermally variable environments, and the whitespotted bamboo shark (*Chiloscyllium plagiosum*), a stenothermic fish living on thermally stable Indo-Pacific reefs. Experiments at temperatures similar to those experienced in nature reveled that temperature change had no significant effect on bamboo shark absorption ($p=0.560$) or evacuation rates ($p=0.982$), suggesting that sharks inhabiting thermally stable environments may lack the ability to exploit temperature differences as a means to improve digestion efficiency. On the other hand, Atlantic stingrays showed significantly lower evacuation ($p<0.001$) and absorption ($p=0.035$) rates at lower temperatures. The relative decrease was greatest for evacuation, however, resulting in a significant increase in total absorption ($p<0.001$), i.e., although absorption per minute decreased, slower evacuation allowed the food to remain in contact with the ileum longer, resulting in an overall increase in absorption. These data suggest that Atlantic stingray may benefit from using shuttling behavior to exploit thermal variability in their environment thereby maximizing energetic uptake.

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246 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Valentina Di Santo, Wayne Bennett

University Of West Florida, Pensacola, FL, United States

Temperature Effect on Resting Routine Metabolic Rates of Two Benthic Elasmobranchs

The capacity of two benthic elasmobranchs to enhance metabolic efficiency by exploiting thermal variability was examined. The Atlantic stingray, *Dasyatis sabina*, inhabits a wide range of coastal and estuarine habitats where it experiences large annual as well as daily temperature fluctuations. Conversely, the whitespotted bamboo shark, *Chiloscyllium plagiosum*, lives in thermally stable Indo-Pacific waters. We used flow-through respirometry to test the effect of acute temperature change on resting routine metabolic rates of Atlantic stingrays (n=7) and whitespotted bamboo sharks (n=7) kept under a fluctuating temperature regime. Atlantic stingrays and whitespotted bamboo sharks showed a temperature sensitivity (Q_{10}) of 2.10 (21 - 31°C) and 2.08 (20 - 28 °C), respectively. Not surprisingly, oxygen consumption (MO_2) increased in both species as temperature was increased. Acute increases in metabolic uptake may be useful during some activities such as foraging; however, further studies are needed to better understand how temperature variation may affect behavior of fishes in nature.

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22 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Christopher Distel

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Effects of Sublethal Pesticide Exposure and Larval Competitors on Multiple Life Stages in Two Pond-Breeding Anurans

In the face of rapid worldwide declines, understanding mechanisms to slow amphibian loss is crucial. We sought to determine whether pesticides can detrimentally affect amphibian communities by changing competitive interactions between tadpole species. We addressed the effects of sublethal levels of carbaryl, a short-lived insecticide, on competition among larval American toads (*Bufo [=Anaxyrus] americanus*) and Northern leopard frogs (*Rana [=Lithobates] pipiens*) using mesocosms. Carbaryl differentially affected these two species. Toad survival increased from exposure in the presence of heterospecifics, while leopard frog survival was unaffected. Toads and leopard frogs were subsequently reared in terrestrial pens to look at the effects of aquatic treatments on overwinter survival and growth. Carbaryl affected the life histories of these species in different and unexpected ways. Population-level effects cannot be predicted by following one life stage alone.

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261 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER HERPETOLOGY AWARD

Christopher Distel

Miami University, Oxford, OH, United States

Priority Effects for Larval Anurans are Changed by the Insecticide Carbaryl

Sublethal pesticide exposure has been linked with amphibian declines, but no mechanism has yet been described. We tested for the effects of the short-lived insecticide carbaryl and its interaction with priority effects on pond communities containing American toads and northern leopard frogs. Green frogs were added to each community type later in the season after the insecticide had degraded. Priority effects were observed on mean tadpole survival, mass, larval period, and pond biomass for toads and leopard frogs, but there were few interactions with carbaryl. Carbaryl exposure generally had negative effects on toads and positive effects on leopard frogs. Priority effects were observed on developmental stage at the end of the experiment and biomass for green frogs. Additionally, carbaryl changed priority effects in this species on mean survival, stage, and biomass. This study demonstrated that (1) interactions of

biotic and abiotic stressors do not affect all anuran species equally, and (2) short-lived pesticides can have lasting effects on aquatic communities.

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904 Herp Ecology, Galleria North, Monday 27 July 2009

Laura Dixon, Charles Dieter

South Dakota State University, Brookings, SD, United States

False Map, Spiny Softshell and Smooth Softshell Turtle Nest and Nest-site Habitat Characteristics Along the Lower Stretch of the Missouri National Recreation River in South Dakota

Little is known about the ecology and reproductive habits of turtles in South Dakota. The spiny softshell (*Apalone spinifera*) and smooth softshell (*A. mutica*) are listed as species of concern in South Dakota and the false map turtle (*Graptemys pseudogeographica*) is listed as state threatened. Surveys were conducted for turtle nests along the Missouri National Recreation River from Lewis and Clark Lake (RM 835) to Ponca State Park (RM 753) in 2006 and 2007. In 2007, 230.5 hours were spent searching sandbars resulting in a detection rate of one nest every 5.5 hours. Seventeen false map and 45 softshell nests were located. The mean straight line distance to water traveled by nesting *Apalone* sp. was 61.27 m and the mean straight line distance to water traveled by nesting *G. pseudogeographica* was 54.24 m. There was no difference in straight line distance to water between *Apalone* sp. and *G. pseudogeographica* ($p = 0.552$, $t = 0.601$, $df = 36.47$). The depredation rate of monitored nests was 36%. Straight line distance to the water and habitat characteristics at the nest site had no effect on nest predation rates of located nests. A nest site selection model for *Apalone* sp. was constructed using a matched-pair stepwise logistic regression. The final calculated model included max vegetation height and leaf debris ($p = 0.007$, McFadden $Rho^2 = 0.123$). A selection model could not be constructed for *G. pseudogeographica*. Both *Apalone* sp. and *G. pseudogeographica* utilize natural and man-made sandbar habitat for nesting.

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644 Lizard Ecology, Pavilion East, Friday 24 July 2009

Tiffany Doan

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Is Rock Selection by Andean *Proctoporus* Lizards Adaptive?

Lizards of the genus *Proctoporus*, which occur in the Andes Mountains, have strikingly different ecology than most lizards in the world. Unlike nearly every other lizard species, *Proctoporus* species spend the entirety of their lives under the shelter of rocks,

without ever emerging to bask, display, or feed. Because of such a lifestyle, *Proctoporus* is very restricted for foraging, finding mates, and locating nesting sites. However, never leaving the shelter of rocks allows these species to escape predation from mammalian and bird predators. A set of permanent plots was initiated in two sites in the Peruvian Andes to examine the migration patterns and evolutionary ecology of two species of *Proctoporus*. All lizards found in the plots were marked and recaptured during six sampling periods to date. Lizard morphometrics, temperatures, humidities, and locations were recorded for all captures. Results demonstrate that *Proctoporus* lizards do not select rocks at random but select larger than average rocks; rock size is not correlated with substrate temperatures, cloacal temperatures, or under-rock humidity. Daytime cloacal temperatures ranged from 13 to 33 degrees C and varied with substrate and ambient temperatures. Unlike most reptiles, *Proctoporus* does not appear to be actively regulating its body temperature. Most *Proctoporus* individuals are highly sedentary, being caught under the same rock or a neighboring rock even years later. Natural selection has likely caused *Proctoporus* to be choosy in selecting the best rocks, but which rock characteristics are most important to the lizards remain a mystery.

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388 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Alana Domingo[1], Joseph Neigel[2], Eldredge Bermingham[3], Luis D'Croz[4]

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A Missing Link In Population Biology Of Reef Fishes: Molecular Ecology of Larval Dispersal in Gobies

Planktonic larval dispersal is of critical importance in the ecology, evolution and management of marine fish populations. Regardless of novel modelling studies focus on understand how physical and oceanographic processes play significant influences on propagule dispersal dynamics, little is known about scale and pattern of larval dispersal for most marine fishes. A major obstacle to progress has been the impracticability of surveying distributions of fish larvae in planktonic communities. Identification by microscopy is labor intensive, often inaccurate and in many cases larvae can only be identified to family. DNA barcoding(DNABC) is a novel method for taxonomic identification based entirely on the 5' portion of the mitochondrial gene, cytochrome oxidase subunit I. Gobiidae is the most diverse family of marine fishes, with more than 30 genera and approximately 125 species described for the Western Atlantic region. We surveyed the distribution of larval gobies in plankton samples from the Bocas del Toro Archipelago, Panama, using DNABC. Over half of the larvae were identified to at least to genus. Our study adds additional species to 11 previously reported as adults in the area. Results suggest correlation between species composition in larval assemblages and habitat associated with adult populations, including spawning and recruitment sites. Strong onshore winds are the likely reason for increased larval density and biomass in

shallow nearshore waters during dry season. Goby larvae aggregations mostly occurred close to adult habitats suggesting nearshore larval retention. Our results demonstrate practicability and accuracy of DNABC to identify early developmental stages of fishes.

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139 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Omar Dominguez-Dominguez[1], Gerardo Perez-Ponce de Leon[2], Ignacio Doadrio[3]

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Uncovering the Evolutionary History of the Goodeinae

From a biogeographical perspective, common geological and climatic events that have influenced the evolutionary history of co-distributed species represent the first explanation to describe processes among concordant taxa. In cases of no concordance, other processes have to be invoked. The ichthyofauna of Central Mexico is a key component in the study of the evolutionary history of that transitional area. A large array of ecological, biological and distributional conditions can be found within the Goodeinae. We investigated the evolutionary history of the Goodeinae based on extensive sampling effort, field work and by using a variety of methods such as molecular phylogenetics, phylogeography, biogeography, morphometrics, autoecology and experimental biology. The geologic and climatic activity of the area is a major determinant of the early diversification of the different species groups, but some differences are found at the intraspecific level. Likewise, these differences shed some light into the influence of the intrinsic characteristics of the species in the evolutionary history of the Goodeinae, as sexual selection, dispersal capabilities and morphological plasticity. We also found a high degree of genetic and morphological differentiation within some species, suggesting the existence of an undescribed fish diversity within a "well studied" group. Anthropogenic activities have been impacted goodeid's populations and as a result, some populations are now critically endangered. Habitat fragmentation and desiccation of water bodies promoted bottlenecks events and genetic drift, which apparently generated genetic erosion of some species and the lost of genetic diversity. These events also influenced the genetic differentiation within some species.

1024 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Terry Donaldson

University of Guam Marine Laboratory, Mangilao, Guam, United States

Climate Change, Ocean Acidification, and Extinction Risks in Reef Fishes

Reef fishes face considerable challenges from climate change and ocean acidification effects acting upon coral reef systems in which they live. These may include habitat reduction from coral bleaching and decreasing pH, and a cascade of subsequent effects upon trophic webs and larval/post-larval development. Impacts may be direct in that fishes will experience a loss of obligate or facultative microhabitat, food supply, and breeding sites, or larvae/post-larvae may not develop skeletal systems properly, and olfactory and auditory behaviors may be compromised. Impacts may be indirect also in that community phase shifts from coral to algal domination may occur, with corresponding effects upon fish assemblage structure. Range extensions, and hence species invasions, are expected. Further, populations of non-obligate coral reef species may decline also because of the loss of prey associated with corals or as plankton. In addition, cumulative negative effects upon reef fish diversity and abundance from other sources may accrue. Over-exploitation of target and by-catch species is expected to continue regardless of local and regional declines in their diversity and abundance from climate change and ocean acidification effects. Cumulative impacts will have a profound effect upon marine biodiversity because of increased risks of extinction at various scales. The application of methodologies that can be used to gain an understanding of how species respond to these impacts, as well as how we might minimize extinction risks and conserve species at various scales of distribution, is necessary.

1051 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

J. Sean Doody[1],Des Grainer[2]

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Pig-nosed Turtles and their Importance to Diverse Communities in Australia

The pig-nosed turtle, *Carettochelys insculpta*, is restricted to southern New Guinea and a few rivers in tropical northern Australia. In Australia, it is listed as "threatened" at the international level (IUCN) and "near threatened" at the state level (Northern Territory: NT). Current expansion of agriculture and associated irrigation practices may threaten the persistence of the turtles in the middle and upper reaches of the Daly River, the stronghold for the species in Australia. Yet, a recent nomination for listing on the federal level was unsuccessful. Herein we highlight the importance of pig-nosed turtles to

scientists, laymen, and the Wagiman aboriginal people who reside on the Daly River. We discuss the uniqueness of this species and recent research from the Daly River, and how the Wagiman people view and utilize the species. We conclude by reviewing the evidence for and against listing the species at the federal level.

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523 Poster Session III, Exhibit Hall, Sunday 26 July 2009

James Dooley[1], Kethika Kelleperuma[1], Lizandra Jimenez[2]

[1]Adelphi University, Garden City, NY, United States, [2]Albert Einstein School of Medicine, NY, United States

Cladistic Analysis of the Tilefishes (Percoidea: Malacanthidae and Branchiostegidae) Using the Mitochondrial 16S and Cytochrome b Genes

Cladistic analyses utilizing maximum parsimony and Bayesian analyses produced similar trees for both the 16S and cyt.b mitochondrial genes. Weighted analysis utilizing phylogenetically informative sites was compared to unweighted. Intraspecific base-pair variation was found to be low [< 0.5 %; or 0.19% for 16S, 521 bp; and 0.44% for cyt.b, 904 bp]. Clades found were generally consistent with the extant five tilefish generic groups. *Hoplolatilus* however, is paraphyletic within the malacanthids. The *Hoplolatilus* clades were similar to previously established subgeneric groups based upon morphological data. Previously, the tilefishes were designated as two families (Malacanthidae and Branchiostegidae). Presently, some have placed the tilefishes in two subfamilies belonging to the single family Malacanthidae. Preliminary conclusions based upon molecular data does not clearly support a monophyletic tilefish hypothesis. Morphological analysis is being examined for its concordance with the molecular results to further test a monophyletic tilefish hypothesis.

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865 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Michael Doosey

Tulane University, New Orleans, LA, United States

Cypriniformes Tree of Life: A Molecular Phylogenetic Perspective on Evolution of Pharyngeal Feeding Apparatus of Suckers (Actinopterygii: Catostomidae)

Family Catostomidae is a diverse group of benthic freshwater fishes commonly known as suckers because of their suctorial mouths and suction feeding mode. An important component of the suction feeding adaptation of suckers is a pharyngeal apparatus comprising gill rakers, pharyngeal teeth, and the palatal organ, which projects down from the roof of the pharynx and works with the gill arches to separate food items from sediment taken in during suction feeding. The skeletal base of the palatal organ is formed by dorsal gill arch elements and the pharyngeal process of the basioccipital bone (PPBO). Cyprinids also have a pharyngeal structure referred to as a palatal organ supported by a PPBO. However, feeding mode and other aspects of pharyngeal anatomy in cyprinids differ from that seen in suckers, making it difficult to determine homology of pharyngeal structures seen in these groups. Relationships of suckers to other groups of cypriniform fishes are inferred using mitochondrial ND4/ND5 and nuclear GH and IRBP2 genes. The resulting phylogeny is used to hypothesize about homology and origin of pharyngeal feeding apparatus in suckers. The best trees from the phylogenetic analysis provide stronger support for a sister relationship between suckers and minnows than between suckers and any other cypriniform family. This suggests that anatomical similarities in aspects of palatal organ morphology in minnows and suckers reflect common ancestry. However, the palatal organs of minnows and suckers have diverged in a number of other respects, due to differences in feeding mode between the two groups.

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470 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Michael Dorcas[1], J. Whitfield Gibbons[2], Leigh Anne Harden[3]

[1]Davidson College, Davidson, NC, United States, [2]Savannah River Ecology Laboratory, Aiken, SC, United States, [3]University of North Carolina Wilmington, Wilmington, NC, United States

Conservation of Diamondback Terrapins in the Carolinas: What Do We Know, Not Know, and Need to Know?

Diamondback terrapins (*Malaclemys terrapin*) are thought to be declining throughout their range. Many factors have been proposed as contributing to terrapin declines, including human-subsidized predation of nests and adults, habitat loss and degradation, road mortality, commercial harvest, and mortality as a result of bycatch in crab traps.. We have conducted a mark-recapture data (>3000 captures; >1500 individuals) at Kiawah Island, South Carolina, since 1983 and have observed a substantial decline in numbers of terrapins. Evidence points to mortality in crab traps as a primary cause of the decline, but other factors have also been shown to affect the survivorship of terrapins at Kiawah Island (e.g., major injuries resulting from boat collisions). Although anecdotal reports of declines exist, population data are lacking for most of the Carolinas and definitively determining the status of terrapins is difficult. However, given the known threats (e.g., one million deployed crab pots in North Carolina alone), declines and extirpations of terrapin populations throughout the Carolinas is likely occurring at unprecedented levels. We discuss these threats, evidence for population declines, and actions necessary to stem the decline of diamondback terrapins in North and South Carolina.

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317 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Marlis R Douglas, Matthew H Hopken, Michael E Douglas

Illinois Natural History Survey, Champaign, IL, United States

Range-wide Population Structure in a Long-lived Species, the Bluehead Sucker (*Catostomus discobolus*)

The spatial population structure of widespread, long-lived species reflects their ecological and evolutionary success. It also serves as a barometer for contemporary anthropogenic impacts at the landscape level. Both are best visualized in the ancient, big river fishes of the American West, many of which fall under the ESA or are listed as 'endangered' by state agencies. The Bluehead Sucker (*Catostomus discobolus*; Catostomidae), is broadly distributed in the Colorado, Bonneville and Snake river basins, yet has attracted conservation attention by its steady range-wide decline. To

compensate, regional agencies have developed a unified plan to adaptively manage this species. Our contribution is to designate management units for this species through a molecular quantification of range-wide population structure and gene flow. To this end, 1092 fish were sampled from 39 locations and genotyped at 16 microsatellite loci. Genetic diversity was high and population structure resolved into 11 gene pools. Bluehead Sucker in the Bonneville Basin and Upper Snake River are clearly distinct from conspecifics in the Colorado River Basin. Mainstem Upper Colorado River Basin populations showed high levels of admixture, whereas tributary populations were largely isolated. Three unique gene pools were found in Arizona tributaries. Gene flow in this species is clearly important for the maintenance of genetic diversity, with genetic erosion reflected in small, isolated populations. A prerequisite for the long-term success of this species is the maintenance of distinct management units with open migration corridors that foster natural gene flow.

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346 Herp Genetics, Galleria North, Saturday 25 July 2009

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ESUs, MUs, DPSs, Msats and Biodiversity Conservation

Most organisms can be grouped infraspecifically (geography, phenotype, etc.) and most deem these appropriate units of conservation. Yet can they be sufficiently protected, particularly given their often nebulous status? The ESU ("evolutionarily significant unit") was proposed as the minimal unit for conservation management in that it attractively avoids taxonomic issues yet may provide a solution to the corundum above. Many judge it synonymous with another amorphous term, "distinct population segment" (DPS) of the U.S. Endangered Species Act. Today, the ESU focuses on historic vs. recent 'exchangeability' of populations, and here molecular genetics can assist. But is the latter a working tool or instead a wrench in the works? We applied these concepts along with, 9 microsatellite loci and 865 bases from two mtDNA genes to estimate demographic parameters and visualize historic/ contemporary connectivity among populations of a sky-island rattlesnake (New Mexico Ridge-nosed Rattlesnake, *Crotalus willardi obscurus*), distributed patchily within three borderland mountain ranges [Animas (ANM), Peloncillo (PEL), Sierra San Luis (SSL)] of southeastern Arizona, southwestern New Mexico and north-central México. Molecular data support an hypothesis of northward range expansion from México, with subsequent isolation on sky-islands through vicariant desertification. Populations are linked via ancestral polymorphism yet are not a single mtDNA gene pool. They are genetically bottlenecked with most recent declines ~4,000 ybp. Using exchangeability, we suggest PEL comprises one ESU, while SSL and ANM comprise MUs within a second ESU. We then discuss the ESU concept and its relevant pitfalls and idiosyncrasies.

193 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Stephanie Dowell, Elizabeth Dakin, Brady Porter

Duquesne University, Pittsburgh, PA, United States

Morphological and Genetic Investigations of Pennsylvania Populations of the Channel Shiner, *Notropis wickliffi*

The channel shiner, *Notropis wickliffi*, is listed as a vulnerable species in Pennsylvania. Little is known about this species of minnow due to taxonomic confusion with a closely related species, the mimic shiner, *N. volucellus*. Taxonomic studies have been performed in other drainage systems; however, due to regional variation in morphology, key identification characters from other studies might be problematic for Pennsylvania populations. The goal of this investigation is to distinguish between Pennsylvania populations of mimic and channel shiners using both morphological and genetic means. Specimens were obtained from multiple pools of the Allegheny and Monongahela Rivers, and by sequencing the mitochondrial gene *cytochrome* b, the specimens were separated into two phylogenetic clades. An average of 6.2% sequence divergence between the two clades indicated that the specimens comprise two distinct species. Three pigmentation patterns were highly correlated to the haplotype assignments for the two species, including the distribution of melanophores on the postdorsal region, the density of melanophores outlining the dorsolateral scales, and the pattern of melanophores in the ventrolateral region. Principal component analysis revealed that channel shiners differ from mimic shiners in a number of morphometric characters as well. Ghost shiners, *N. buchanani*, are morphologically distinct from mimic and channel shiners; however, the *cytochrome* b sequence obtained from GenBank as well as two ghost shiner specimens from Ohio genetically clade with mimic shiners. Additional genetic reference samples are required to resolve the relationship of the ghost shiners to other members of the *Notropis volucellus* species group.

194 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Miriam Doyle

University of Washington, Seattle, WA, United States

Contrasting Patterns of "Connectivity", and Associated Recruitment Processes, among Early Life History Dynamics of Selected Fish Species in the Gulf of Alaska

"Connectivity" refers to the exchange of individuals among geographically separated subunits of a population, or the spatio-temporal characteristics of different life stages with different habitat associations. Early life history characteristics and larval capabilities are factors that strongly influence population structure and connectivity, and recruitment success, among fish populations in marine ecosystems. For fish species in the Gulf of Alaska (GOA), patterns of connectivity are established during early life through spawning times and locations, egg and larval durations, larval development and behavior, and the dispersal patterns of eggs and/or larvae as driven by prevailing circulation patterns. A high diversity of patterns is observed in the GOA reflecting a variety of life history adaptations to prevailing climate and ocean conditions. Connectivity patterns are described for four key species in the GOA ecosystem that represent contrasting environmental exposure and early life history response scenarios; a deep water flatfish and top predator (*Atheresthes stomias*), a shallow water flatfish (*Platichthys stellatus*), a mesopelagic forage fish (*Stenobrachius leucopsarus*), and a shallow water forage fish (*Ammodytes hexapterus*). Environmental exposure is evaluated through the temporal and spatial characteristics of ontogenetic sub-intervals for these species. Their potential early life history response to environmental forcing is assessed using model generated links between time-series of late spring larval abundance and physical variables representing climate and ocean conditions. The emergent connectivity patterns and ecological relationships contribute to our understanding of early life history aspects of recruitment processes, and potential mechanistic links between climate change and recruitment among GOA fish populations.

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640 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Kristina Drake, Kenneth Nussear, Todd Esque, Lesley DeFalco, Richard Inman, Philip Medica

US Geological Survey, Henderson, NV, United States

Fire in the Mojave Desert: Understanding Desert Tortoise Use of Burned Critical Habitat

Wildfires in 2005 burned more than 32,000 acres of designated desert tortoise (*Gopherus agassizii*) critical habitat in southern Nevada. With the proliferation of invasive plants, particularly red brome and split grasses, fire regimes in the Mojave Desert have increased. Changes in plant communities caused by exotic plants and recurrent fire can negatively affect the desert tortoise by altering habitat structure and food availability. To understand the secondary effects of wildfire we compared movement patterns, home range, microhabitat use and behavior of 26 tortoises using a mix of burned and unburned habitat. From 2006-2008, these tortoises were monitored via radio telemetry to investigate how the shifts in dominant vegetation from native shrubland to invasive grasses have impacted habitat use and tortoise activity three years post fire. Mean home range size was 53 ha and ranged from 9 to 148 ha with males having larger ranges than females. Approximately 45% of observed home ranges in the post-fire environment contained burned habitat. Observational data (n=5,482) also indicated that tortoises used both habitat types (51.3% burned, 48.7% unburned). Behavior and microhabitat differences were noted between the habitat types. Most foraging behavior occurred within burned habitat, while tortoises were more often observed resting and moving in unburned areas. Burned habitat had more forage available as a result of an increase in invasive annual grass production. Tortoises were also encountered more frequently in the open landscape within burned habitat, while tortoises in unburned areas were frequently found in burrows and underneath vegetation.

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247 Fish Ecology II, Pavilion East, Sunday 26 July 2009

Jeffrey Drazen[1], Brian Popp[1], C. Anela Choy[1], Charles Phleger[2], Peter Nichols[2], Michaela Guest[2], Kenneth Smith[3]

[1]University of Hawaii, Honolulu, HI, United States, [2]CSIRO, Marine and Atmospheric Research, Hobart, Tasmania, Australia, [3]Monterey Bay Aquarium Research Institute, Moss Landing, CA, United States

Bypassing the Abyssal Benthic Food-Web: Macrourid Diet in the Eastern North Pacific Inferred from Stomach Contents, Stable Isotopes, and Fatty Acid Biomarkers

Deep-sea fishes prey on benthic fauna and scavenge on the carcasses of surface-living animals. Few studies have addressed the relative importance of each trophic pathway. Recent documentation of inter-decadal fluctuations in macrourid densities in the abyssal Pacific, related to changing food supplies, hastens the need for information. We conducted stomach content, stable isotope, and fatty acid (FA) biomarker analyses of two abyssal macrourids, carrion sources, and benthic prey, collected concurrently at 4100 m off California. *Coryphaenoides armatus* consumed crustaceans, squids and fishes. The diet of *Coryphaenoides yaquinae*, included more crustaceans and polychaetes. Carrion was present in both species and it was 69% of the mass of food of large *C. armatus*. Carrion had an unique isotopic signature compared to benthic prey sources. Results of isotope mass balance suggest that carrion was the most important prey resource for both species. The FA profiles of the macrourids were similar to benthic crustaceans and carrion sources suggesting these were the dominant food sources. Their FA profiles were very different from echinoderms and most polychaetes suggesting that these groups while dominant on the abyssal plain were not important prey. The datasets all suggest that these two fishes bypass the conventional phytodetritus-based abyssal food web for much of their nutrition and rely on dead fishes and squids sinking from the overlying water column. Thus macrourid population dynamics may be tied more closely to fluctuations in epipelagic nekton populations through fishing effects and direct climatic forcing on top trophic levels.

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347 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Joshua Drew, Mark Westneat

Field Museum, Chicago, IL, United States

Multi-Locus Biogeography of *Amblyglyphidodon* and the Evolution of Marine Biodiversity in the Coral Triangle

The advent of new molecular markers has provided a wealth of information to researchers interested in the evolution of marine fishes. However statistical methods to construct species trees from sometimes contrasting gene trees have limited the ability for us to make sound phylogenetic inferences. Here we present a phylogeny of *Amblyglyphidodon* (Pomacentridae) from the Indo-Pacific and Western Pacific, constructed using six genes using the program BEST (Bayesian Estimation of Species Trees). This program essentially integrates out uncertainty between conflicting gene trees and provides a more biologically, and statistically sound species level phylogeny. Our results are then interpreted in the light of peripheral evolution of endemic species within the Pacific.

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775 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Elizabeth A. Droessler, Andrew J. Wallace, Richard D. Durtsche

Northern Kentucky University, Highland Heights, KY, United States

Invasive Honeysuckle Induced Hypoxia in Aquatic Systems and its Effects on Wood Frog Tadpoles

Amur Honeysuckle (*Lonicera maackii*) is an invasive edge shrub species that is currently taking over stream and pond banks in the eastern part of North America including the Ohio River Valley. The leaves of this alien shrub decompose quickly in water and release tannins and potentially novel oxygen binding proteins. These substances were found to drastically decrease dissolved oxygen levels, and their effects were nullified when denaturing procedures were applied to the system. Wood frogs (*Lithobates sylvaticus*) are found in many areas L. maackii where is taking over, and their aquatic tadpoles may be directly impacted where the leaves fall into the water. Decreases in dissolved oxygen and hypoxic conditions may have numerous detrimental implications for tadpole development. Under conditions of aquatic hypoxia created by L. maackii leaves and under oxygen supplemented conditions we experimentally tested the growth rates and survivorship of *L. sylvaticus* tadpoles, success of their metamorphosis, and the fitness of frog metamorphs through their jumping performance and body lipid content. These aquatic conditions (with and without oxygen supplementation) were also tested with a mix of native tree leaves and with a non-leaf control. Only in the hypoxic *L. maackii* condition did tadpoles fail to complete metamorphosis.

Marcus Drymon[1], Sean Powers[2], John Dindo[3]

[1]NOAA Fisheries, Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula,MS, United States, [2]Department of Marine Science, University of South Alabama, Mobile, AL, United States, [3]Dauphin Island Sea Lab, Dauphin Island, AL, United States

Comparing Distributions of Sharks Among Estuarine, Coastal and Oceanic Regions of the Gulf of Mexico

Increasing evidence of declines in shark populations has sparked researchers to investigate more prudent approaches for the conservation of these fish. As managers strive to improve data collection for stock assessment, fisheries surveys should expand to include data-deficient areas such as coastal regions. To that end, a nearshore longline survey was initiated in 2006; catch series from this survey was compared to a concurrent offshore survey with identical methodology to identify differences in habitat use by overlapping species as well as identify potential nursery areas within each survey. Five shark species occurred in both surveys: Atlantic sharpnose (*Rhizoprionodon terraenovae*), blacknose (*Carcharhinus acronotus*), blacktip (*C. limbatus*), spinner (*C. brevipinna*) and tiger shark (*Galeocerdo cuvier*). Of these, blacktip sharks were sampled in significantly higher abundance nearshore. Length frequency and sex ratio analyses suggest that sharpnose and blacknose sharks show sexual segregation and may be using offshore waters for parturition, whereas blacktip sharks are likely using coastal waters as nurseries. Cuban dogfish (*Squalus cubensis*), night shark (*Carcharhinus porosus*), shortspine spurdog (*Squalus mitsukurii*), slimy shark (*Centrophorus granulosa*) and smoothhound (*Mustelus* spp.) sharks occurred only offshore, whereas all sharks sampled nearshore were seen offshore during some time of the year. Comparisons such as these highlight the need for more spatially and temporally comprehensive time series, as well as the need for researchers to examine the distributional trends for species across the extent of their range.

252 Herp Development & Morphology, Galleria North, Sunday 26 July 2009

Wei-Guo Du[2], Rajkumar Radder[1], Bo Sun[2], Richard Shine[1]

[1]School of Biological Sciences A08, University of Sydney, NSW, Australia, [2]College of Biological and Environmental Sciences, Hangzhou Normal University, Hangzhou, China

Determinants of Incubation Period: Do Reptilian Embryos Hatch after a Fixed Total Number of Heartbeats?

The eggs of birds typically hatch after a fixed (but lineage-specific) cumulative number of heartbeats since the initiation of incubation. Is the same true for non-avian reptiles, despite wide intraspecific variation in incubation period generated by variable nest temperatures? Non-invasive monitoring of embryo heartbeat rates in one turtle species (*Pelodiscus sinensis*) and two lizards (*Bassiana duperreyi* and *Takydromus septentrionalis*) shows that the total number of heartbeats during embryogenesis is relatively constant over a wide range of warm incubation conditions. However, incubation at low temperatures increases the total number of heartbeats required to complete embryogenesis, because the embryo spends much of its time at temperatures that require maintenance functions, but do not allow embryonic growth or differentiation. Thus, cool-incubated embryos allocate additional metabolic effort to maintenance costs. Under warm conditions, total number of heartbeats thus predicts incubation period in non-avian reptiles as well as in birds (and total numbers of heartbeats are similar); but under the colder nest conditions often experienced by non-avian reptiles, maintenance costs add significantly to total embryonic metabolic expenditure.

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835 Fish Ecology III, Pavilion West, Monday 27 July 2009

Tara Duffy, David Conover

Stony Brook University, Stony Brook, NY, United States

The Spatial Scale of Adaptive Variation in Temperature-Dependent Sex Determination in an Estuarine Fish, *Menidia menidia*

Local adaptation in marine teleosts is well-documented, but the spatial scale of adaptive variation across environmental gradients has rarely been defined. In an estuarine fish, the Atlantic silverside (*Menidia menidia*), gender is determined in part by temperature but the level of plasticity varies with latitude. Genetic sex determination (GSD) prevails in northern populations while temperature-dependent sex determination (TSD) predominates in southern populations. This latitudinal pattern is an adaptive response to variation in length of the growing season but the spatial scale at which these forms of sex determination diverge is unknown. We collected embryos from 32 populations of

silversides, spanning the entire range from northern FL, USA, to the Gulf of St. Lawrence, Canada. Larvae were reared in a common environment at feminizing (15°C) and masculinizing (28°C) temperatures during the temperature-sensitive period of sex determination to measure the level of TSD (strong vs. weak thermal response). When all 32 populations were analyzed, level of TSD was positively correlated with growing season, and major shifts in the form of sex determination occur along the New Jersey coast, within the Gulf of Maine, and between Nova Scotia and the Gulf of St. Lawrence. The geographic pattern of TSD differed greatly from that of two other adaptively varying traits (growth rate and no. of vertebrae) and also showed little correspondence with independently-derived estimates of gene flow. These unique geographic patterns indicate that trait-specific selection pressures create spatially unique clines in adaptive variation despite gene flow in this marine teleost.

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192 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Nicholas Dulvy

Simon Fraser University, Burnaby, BC, Canada

I have Aged some Sharks and Fitted a Growth Curve – Now what do I do?

Many budding elasmobranch scientists cut their teeth by painstakingly learning how to estimate the age and growth of sharks, skates and rays. Thankfully a large number can't kick the habit! Wouldn't it be nice if we could use these age and growth data to estimate fisheries sustainability and extinction risk in elasmobranchs? Here I outline a simple method for estimating relative risk of overexploitation and risk of extinction using only von Bertalanffy growth parameters and the size or age at first capture. The model calculates the capacity of a population or species to withstand dangerous levels of fishing mortality (F□) that will reduce the number of spawners produced per recruit (SSB/R) to below some arbitrary 'jeopardy' level. I illustrate how this model can be used to rank elasmobranch species according to their relative intrinsic vulnerability to overexploitation and extinction risk.

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13 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Andrew M. Durso, John D. Willson, Christopher T. Winne

University of Georgia, Athens, GA, United States

Detectability of Rare and Cryptic Species: A Case Study of Aquatic Snakes

Modeling species detection probability and occupancy is crucial to effective conservation of rare and cryptic species. Assessing site occupancy is the most appropriate metric for monitoring populations of secretive species on a landscape scale. For categorical, presence-absence data to provide an accurate picture of a metapopulation, estimates of species detection probability must be incorporated into surveys. Here, aquatic snakes serve as a proxy for use of detection probability in surveys of herpetofauna, which epitomize among vertebrates the very qualities that necessitate the use of qualitative population analysis. Repeated visits (aquatic minnow traps) were made to 20 isolated wetlands in the South Carolina coastal plain, and estimates of detectability (p) and occupancy likelihood (ψ) were obtained from most-favored models built in program PRESENCE, using wetland permanence, prey type availability and distance to the Savannah River as site covariates likely to affect occupancy and detection. The number of visits necessary to declare absence of a species with 95% confidence were calculated for each of seven species. Quantitative estimates of state variables like p and ψ, and of their variability as a consequence of environmental factors allow for assessment of survey quality and improve conservation and management of aquatic snakes and other rare species. Because these species are uncommonly encountered, they are seldom specifically targeted in inventories and many view them as too scarce to be feasible candidates for population monitoring. We show that although detection probability is low, it can be calculated and these species can be inventoried with statistical confidence.

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105 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009

David Ebert[1], William White[2], Kenneth Goldman[3], Leonard Compagno[4], Toby Daly-Engel[5], Robert Ward[2]

[1]Moss Landing Marine Labs, Moss Landing, CA, United States, [2]CSIRO Marine & Atmospheric Research, Hobart, Tasmania, Australia, [3]Alaska Department Fish & Game, Homer, AK, United States, [4]Iziko -- South African Museum, Cape Town, Western Cape, South Africa, [5]Hawaiian Institute Marine Biology, University Hawaii, Kaneohe, HI, United States

Resurrection and Redescription of *Squalus suckleyi* (Girard, 1854) from the North Pacific, with Comments on the *Squalus acanthias* Subgroup (Squaliformes: Squalidae)

A taxonomic re-evaluation of the status of the North Pacific *Squalus suckleyi* (Girard, 1854) combining the use of meristic, morphological and molecular data reveal this species to be clearly distinct from the widespread *Squalus acanthias* (Linneaus, 1758). Differences in the external morphology between *S. acanthias* and *S. suckleyi* are subtle and masked by considerable intraspecific variation within individuals. However, we found *S. suckleyi* to differ from *S. acanthias* based on the following morphological and meristic characteristics: a short, broadly-rounded to acute snout; first dorsal-fin midpoint more posterior to pectoral-fin insertion; pelvic-fin origin closer to second dorsal fin than first dorsal fin; total vertebral counts average 99 (97-106). Molecular analysis of approximately 650 bp of the CO1 mitochondrial gene (DNA barcode region) showed separation of *S. suckleyi* and *S. acanthias* into two distinct genetic clades with 98% bootstrap support. Within species genetic diversities were 0.109±0.036% and 0.176±0.041% for *S. suckleyi* and *S. acanthias* respectively; between species diversity was 5 — 6 fold greater at 0.765+0.307%. *Squalus suckleyi* is thus resurrected and a neotype for this endemic North Pacific *Squalus* species is designated.

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206 Fish Phylogeography, Pavilion West, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Jeff Eble

Hawaii Institute of Marine Biology, Kaneohe, HI, United States

Phylogeography of the Yellow Tang (*Zebrasoma flavescens*) Indicates a Hawaiian Origin and Dispersal to the West Pacific

The isolation of the Hawaiian Archipelago has produced a depauperate marine community with strong affinities to West Pacific marine biota. In reef fishes, 612 species are reported from Hawaii compared to more than 3,000 species found among reefs of the West Pacific. Hawaii's low inshore diversity is matched only among similarly isolated reefs at the periphery of the Indo-Pacific. A number of competing theories have been proposed to account for the observed decline in species richness radiating outward from the biodiversity center of the West Pacific, with the two most prevalent indicating the West Pacific to be either a center of species origin or a center of species accumulation. Concordant findings for a multi-locus survey of the Indo-Pacific reef fish, *Zebrasoma flavescens* revealed 1) a clear genetic break between central and West Pacific populations, 2) a strong signature of isolation by distance within the Hawaiian Archipelago, and 3) a likely Hawaiian origin for *Z. flavescens* with subsequent westward range expansion. These findings, taken together with recently published evidence that species can arise throughout the Indo-Pacific, indicate that both origin and accumulation may explain the exceptional diversity of West Pacific marine communities.

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493 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Tom Ecay, James Stewart

East Tennessee State University, Johnson City, TN, United States

Reproductive and Developmental Physiology of Calcium Provision to Embryonic Snakes

Calcium is an essential nutrient for vertebrate embryonic development. Oviparous amniotes invest eggs with two potential sources of calcium for embryonic development, yolk and eggshell. Compared with other reptile lineages, squamate eggs have poorly calcified shells and embryonic development is more heavily dependent on yolk calcium reserves. These characteristics are likely shared with early reptiles and squamate eggs and embryos are an appropriate model for an early stage in the evolution of calcium deposition and mobilization in reptilian eggs. We have begun to define the timing of calcium mobilization and the mechanisms of calcium transport from yolk and eggshell

by embyos of the oviparous snake, *Pantherophis guttatus*. Comparison of the developmental physiology of calcium provisioning and calcium transport mechanisms in the cornsnake with lineages that evolved greater dependence on shell calcium and remained oviparous (turtles, crocodilians and birds) and with viviparous sister taxa among squamates will yield insights into the placiticity of these mechanisms during the evolution of reproductive modes among reptiles. Our focus is primarily on the timing of calcium transport and expression of calcium transport proteins (calbindin-D28K and plasma membrane calcium ATPases). In addition, we have begun to characterize a potential mechanism for the dissolution of eggshell calcium carbonate, which is required to provide transportable calcium to the developing embryo. (Supported by a grant from NSF – IOB 0615695)

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873 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Brandon Eck, Todd Jackman, Aaron Bauer

Villanova University, Villanova, PA, United States

Phylogeny and Phylogeography of the *Trachylepis varia* and *T. striata* Species Groups (Squamata: Scincidae)

The scincid genus *Trachylepis* is a widespread and species-rich group of chiefly African lizards. In southern Africa there are 19 recognized species of Trachylepis, including some of the most dominant members of diurnal lizard communities in all major habitat types. We used nuclear and mitochondrial DNA sequence data to investigate broad scale patterns of relationships among members of the genus and to examine relationships among species in the *T. varia* and *T. striata* species complexes in more detail. Our samples included 250 specimens representing more than 40 taxa. Mainland African *Trachylepis* have given rise to two separate clades of Malagasy skinks as well as *T. atlantica*, a species endemic to the Fernando de Noronha Archipelago, Brazil. Both the *T. varia* and *T. striata* complexes are part of a large, chiefly southern African clade but include representatives that range northwards into Central and East Africa. Relationships within these groups were investigated using the mitochondrial genes 16s and cyt b and nuclear genes RAG-1 and KIF24. *Trachylepis varia* includes several major subclades corresponding to southern African, Zambian, Tanzanian, and Congolese populations. An undescribed species from South Africa, previously signaled on the basis of morphology, is the sister to all other members of the *T. varia* group. Within the *T. striata* group, three of five recognized species were found to be monophyletic, but *T. striata* sensu stricto and *T. punctatissima* are not. Divergences between members of the complex are low and call into question the specific status of the group members.

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34 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Mallory E. Eckstut[1], Alison M. Hamilton[2], Christopher C. Austin[3]

[1]School of Life Sciences, University of Nevada, Las Vegas, Las Vegas, NV, United States, [2]Center for Tropical Research, UCLA Institute of the Environment, Los Angeles, CA, United States, [3]Museum of Natural Science & Department of Biological Sciences, Louisiana State University, Baton Rouge, LA, United States

Uniform Bisexuals and Variable Unisexuals: Morphological Variation in the *Nactus pelagicus* Complex (Reptilia: Gekkonidae) on Tanna Island, Vanuatu

The *Nactus pelagicus* complex consists of several genetically distinct bisexual lineages currently considered *N. multicarinatus*, as well as a unisexual lineage, *N. pelagicus*, which is hypothesized to have arisen from hybridization between two *N. multicarinatus* lineages. Previous morphological analyses of the *N. pelagicus* complex (Reptilia: Gekkonidae) identified differences in chin scalation patterns and slight adult female size variation between the *N. multicarinatus* lineages and *N. pelagicus*. However, previous analyses did not include data from islands where both species occur sympatrically, and species were designated solely on presence or absence of males from a sample. This raises the question about whether or not the two species co-inhabit a given area, which at present cannot be identified in field. To definitively address morphological variation between *N. pelagicus* and the hypothesized paternal lineage of *N. multicarinatus*, specimens representing both unisexual and bisexual populations were examined from Tanna Island, Vanuatu in the South Pacific. We used mitochondrial DNA to assign individuals to accurately designate species. Specimens of *N. pelagicus* showed a wide range of chin scalation patterns including some patterns not reported previously. Individuals of *N. multicarinatus* had only one type of pattern, and there was no overlap in scalation patterns observed in *N. pelagicus* and *N. multicarinatus*. These findings support the hypothesis that the two species, as delineated by mode of reproduction, can be distinguished based on chin shield patterning. Additionally, while the two species do co-occur on Tanna Island, based on both molecular and morphological analyses, they do not occur in syntopy.

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27 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Mallory E. Eckstut[1], David M. Sever[2], Mary E. White[2], Brian I. Crother[2]

[1]School of Life Sciences, University of Nevada, Las Vegas, Las Vegas, NV, United States, [2]Department of Biological Sciences, Southeastern Louisiana University, Hammond, LA, United States

Phylogenetic Analysis of Sperm Storage in Female Squamates

Female sperm storage is a common but variable phenomenon observed in a number of vertebrate lineages. The utility of female sperm storage has been widely debated, but has been suggested to benefit species by lengthening breeding seasons as well as enhancing colonization abilities. Additionally, the variation in sperm storage traits has been suggested to have value for assessing phylogenetic hypotheses. To date, little is known regarding the evolutionary and ecological implications of sperm storage in female squamates (lizards and snakes). Utilizing previous studies of reproductive morphology and four competing squamate phylogenies (two morphological and two molecular, including a new hypothesis), we address character state evolution of sperm storage characters and overlay a variety of ecological factors. We also test the hypothesis that sperm storage may offer reciprocal illumination in choosing among hypotheses of squamate phylogeny. At present there is minimal value for phylogenetic inference from these reproductive characters. We found that several sperm storage characters are relatively conserved across the sampled squamates (including presence of sperm storage and sperm storage tubules (Ssts), embedding of sperm, and sperm storage with eggs in utero). Alternatively, location of Ssts, secretions within the Ssts, and length of sperm storage are highly variable traits. We suggest that these differences are correlated with ecological differences in the reproductive tactics of each species. Because of limited data for many of the taxa, statements regarding the ecological utility of the traits are highly speculative. Additional studies will likely find that these traits are more variable than currently recognized.

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795 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Sarah Eddy, Elyse Vaccaro, Lynne Houck

Oregon State University, Corvallis, OR, United States

Long Term Sperm Storage in a Lungless Salamander, *Plethodon shermani*

Several conditions promote post-copulatory sexual selection, including the retention of sperm for long periods of time in the female reproductive tract. Long term sperm storage has been reported in insects, reptiles, and salamanders. Sperm storage in salamanders is highly variable and has been a contentious issue. Some species are thought to store sperm between seasons and others to only store sperm for a short

period of time (days to a month). The documented length of sperm storage among five plethodontid salamanders previously surveyed ranged from 3 to 8 months. The proposition that salamanders store sperm for long periods of time (including between breeding seasons) has been met with skepticism. In some cases the sperm, though retained, seemed degraded such that they could not fertilize the female's ova. In this study, we addressed the issue of sperm degradation by incorporating fertilization into our assessment of sperm storage. We mated females under laboratory conditions and for every month afterwards a subset of 10 females were hormonally induced to oviposit. We reared each clutch for 2 months and recorded whether or not larvae developed in the eggs. Duration of sperm storage was identified as the time between mating and oviposition. We found that female *P. shermani* can store viable sperm in their spermathecae for at least 6 months. To our knowledge, this is the first study of long term sperm storage to test the viability of sperm through fertilization.

1039 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Robert Edwards, Deborah Edwards

University of Texas-Pan American, Edinburg, TX, United States

Selected Life History Attributes of the San Felipe Gambusia, *Gambusia clarkhubbsi*, in San Felipe Creek, Texas

Habitat use by the little known San Felipe gambusia, *Gambusia clarkhubbsi*, was studied in the spring-fed San Felipe Creek which flows through Del Rio, Texas. Seines were used in two contrasting mesohabitat types and minnow traps were used in various habitats in a smaller area to test their habitat utilizations in various combinations of flow and vegetation regimes. These were compared to a series of experiments conducted using artificial streams that mirrored these environment types. *Gambusia clarkhubbsi* was consistently found in sparsely vegetated habitats next to sources of swiftly flowing water while the sympatric Tex-Mex gambusia, *G. speciosa*, was found in greater abundance in sparsely vegetated backwater environments. *Gambusia clarkhubbsi* was also found in greater abundance than *G. speciosa* in densely vegetated habitats, regardless of flow regime. Within these habitats, both species of *Gambusia* appear to reproduce throughout the year. *Gambusia clarkhubbsi* was found to have fewer, but larger embryos than the sympatric *G. speciosa*. A small number of *G. clarkhubbsi* x *G. speciosa* hybrid individuals have also been obtained, however, this seems not to be widespread in the creek.

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370 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jacob Egge, Paul Nicholson, Theodore Krogh

Pacific Lutheran University, Tacoma, WA, United States

Incongruent Patterns of Morphological and Molecular Variation in the Least Madtom

The Least madtom, *Noturus hildebrandi*, is distributed across a series of drainages in the Mississippi Embayment ranging from western Tennessee in the north to western Mississippi in the south. Two subspecies, *N. h. latus* and *N. h. hildebrandi*, are recognized on the basis of variation in head size and pigmentation patterns. Previous phylogenetic analyses of populations sampled from across the species' range using DNA sequence data from the mitochondrial gene cytochrome b (cyt b) recovered a pattern of population relationships that was not consistent with the subspecific designations. Additionally, these analyses indicated that *N. hildebrandi* was paraphyletic with respect to *N. baileyi*. In order to further illucidate phylogenetic relationships and better quantify morphological variation in *N. hildebrandi*, we sequenced 731 bp of the nuclear recombination activating gene 2 (rag2) from 42 individuals and examined over 200 museum specimens for six pigmentation characters, 42 morphometric measurements, and osteology. Analyses of the morphological data demonstrate a pattern of clinal variation in pigmentation and morphometric characters extending from populations in the north to populations in the south, consistent with the current subspecific designations. The phylogeny recovered using rag2 is less well resolved than that using cyt b and the pattern of relationships is incongruent with the clinal pattern observed in the morphological data.

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574 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Jennifer Eichelberger, Matthew Krampe, Edward Heist

Southern Illinois University Carbondale, Carbondale, IL, United States

Development of SNP Markers to Differentiate Pallid and Shovelnose Sturgeons and their Putative Hybrids

Federally endangered pallid sturgeon (*Scaphirhynchus albus*) occurs in the main stem of the Missouri and Mississippi Rivers from Montana to the Gulf of Mexico. Pallid sturgeon are sympatric with the much more common shovelnose sturgeon (*S. platorhynchus*) throughout their range, and pallid sturgeon hybridize with shovelnose sturgeon. A variety of genetic markers have been explored for distinguishing these closely related species and morphological intermediates that are presumed hybrids. Allozymes and mitochondrial DNA fail to exhibit fixed differences between species. More variable microsatellite DNA markers reveal allele frequency differences between

morphologically identified pallid and shovelnose sturgeon; however, it is difficult to discern pallid and shovelnose from potential hybrids and back-crossed individuals. Disadvantages to using microsatellite DNA markers include the potential for homoplasy (shared alleles not due to common ancestry) and difficulty in standardizing data across laboratories. Single nucleotide polymorphisms (SNPs) are bi-allelic nuclear markers that are less subject to homoplasy and can be scored quickly and consistently in different laboratories at relatively low cost. Discovery of SNPs is directed at functional nuclear genes. All sturgeon have polyploid ancestry, and most genes in *Scaphirhynchus* appear to have functional paralogs that occur in both species. High sequence homology between paralogs makes development of locus-specific SNP assays additionally challenging. SNP markers will provide powerful new tools for examining phylogenetic relationships between pallid and shovelnose sturgeon and for characterization of morphological intermediates.

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223 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Karen Eisenreich, Christopher Rowe

University of Maryland Center for Environmental Science:Chesapeake Biological Lab, Solomons, MD, United States

Assessment of Developmental, Behavioral and Physiological Endpoints in the Common Snapping Turtle and Red-eared Slider in Response to Polybrominated Diphenyl Ethers, a Flame Retardant, Following Embryonic and Dietary Exposure

Polybrominated diphenyl ethers (PBDEs) are a group of organic compounds employed widely as flame retardants. Their potential to affect thyroid activity suggests that exposure to PBDEs may alter thyroid-dependent processes (neurological development, growth/metabolism). We examined the influences of simulated maternal transfer and food-borne exposure to PBDEs on development, growth, metabolism, and behavior in two turtle species over the first year post-hatch. Eggs were topically dosed with BDE-47 to achieve five nominal concentrations from 40 to 1000 ng/g in the eggs and a subset was dosed with a known thyroid inhibitor (sodium perchlorate) as a positive control. An additional group of hatchlings was subsequently exposed to either BDE-47 or BDE-99 in their diet (nominally 5000 ng/g wet weight) beginning eight months post-hatch. The duration of the embryonic period was significantly longer for perchlorate-exposed individuals compared to all other treatments in both species. There were no differences in growth over 14 months post-hatch in either species. Metabolic rates at hatch were elevated in both species exposed embryonically to 220ng/g; no differences were detected one year after hatching. Snapping turtles exposed through their diet had elevated metabolic rates compared to controls at 11 and 12 months post-hatch. Behavioral endpoints measured 10-12 months post-hatch showed differences among

treatments. Red-eared sliders fed BDE-47 showed elevated activity in the presence of a predator relative to controls and animals exposed to BDE-99 through the diet. Snapping turtles exposed embryonically to both compounds differed in time to right from a ventrally exposed position relative to controls.

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552 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009

Werner Ekau[1], Anja Kreiner[2], Stefanie Bröhl[1]

[1]Center for Tropical Marine Ecology (ZMT), Bremen, Germany, [2]National Marine Information and Research Center (NatMIRC), Swakopmund, Namibia

A Change in Larval Fish Community of the Northern Benguela Induced by the Extension of the Oxygen Minimum Layer

Oxygen as an environmental factor impacting significantly physiology behaviour and life cycles of marine organisms has come into focus of science only recently. Spreading of "dead zones" (anoxic or strongly hypoxic areas at the seafloor) and extension of the Oxygen Minimum Layer (OMZ) in the eastern tropical/subtropical oceans has been described. The impact of low oxygen or hypoxia on organisms can be twofold: on a macro-scale in the environment by constraining the vertical and horizontal distribution of species and forcing them to leave their normal behaviour; and on a micro-scale by causing physiological changes and shifts and thus altering life performance, capacity in growth and reproduction and vulnerability to diseases. In the Benguela upwelling area both phenomena have been found: a shoaling upper boundary of the OMZ along the Namibian shelf and a spreading of hypoxic conditions at the seafloor. The change of the OMZ boundaries results in a shift of the structure of the pelagic community. We investigated the larval fish community over the last 10 years. Changes in the species composition could be observed. The amount of sardine and anchovy larvae decreased over time while other species such as horse mackerel or mesopelagics are dominating the ichthyoplankton. A shift of the distribution areas of some species towards the South was also observed. It is argued that the cause for these changes lies in the deterioration of the oxygen conditions in the water column of the North Namibian shelf.

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540 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Andrew Eller[1], Nicola Hillgruber[1], Lisa Eisner[2]

[1]University of Alaska Fairbanks, School of Fisheries and Ocean Science, Juneau, AK, United States, [2]2NOAA/NMFS, Alaska Fisheries Science Center, Ted Stevens Marine Research Institute, Juneau, AK, United States

Abundance and Distribution of Larval Eulachon (*Thaleichthys pacificus*) in Berners Bay, Alaska in Relation to Physical Factors

Berners Bay is characterized by a seasonal, counterclockwise (east to west) surface current that is fed from freshwater discharge. The bay exhibits an estuarine circulation pattern with saltwater moving in at depth along the east and freshwater moving out along the west side of the bay at the surface. Eulachon (*Thaleichthys pacificus*), larvae were found throughout the sample period from June 5 to August 30 with density decreasing linearly away from the spawning river. Eulachon contributed to 40% of the surface (n = 7445), 55% of the 5m (n = 7037) and 28% of the 35m (n = 1635) total ichthyoplankton catch. The west side of the bay showed lower average temperatures (9.5^{o}C), lower surface salinity (4.5), and peak abundances of eulachon larvae on June 30. On the west side of the bay, larvae captured at 35m depth were larger (x=11.5 mm) than those captured at the surface, which were composed primarily of small larvae (x = 6.0 mm). The east side of the bay had higher average temperatures (13^{o}C), and higher average surface salinity (11) and peak abundances on June 24th. Larvae captured at the surface and at 35m depth along the east side of the bay did not show significant differences in standard length. High abundance of large larvae on the west side of the bay suggests that larvae are being retained in this area, with younger larvae occupying shallower water depths than older larvae. On the east side of the bay no such vertical separation is apparent.

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728 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Jeffrey Engeman[1], Paula Mabee[2]

[1]University of South Dakota, Vermillion, SD, United States, [2]University of South Dakota, Vermillion, SD, United States

Cypriniformes Tree of Life: Intriguing Patterns of Gill Arch Development and Homology Implications

Skeletal elements of the gill arches of adult cypriniform fishes vary in number, size and shape and are important characters in morphologically based phylogenetic studies. In the process of describing the sequence of chondrification and ossification of the arches in

Catostomus commersonii (Catostomidae), *Cycleptus elongatus* (Catostomidae) and *Luxilus zonatus* (Cyprinidae) we discovered intriguing patterns of fusion and segmentation in the cartilages. These patterns include fusion of cartilaginous basibranchials 4 and 5 into a posterior copula, fusion of hypobranchial 4 with ceratobranchial 4, and segmentation of the basihyal and anterior copula from a continuous median cartilage. The phylogenetic distribution of these developmental patterns outside of cypriniforms is unclear, though a literature survey indicates apparent "fluidity" in cartilage patterning across teleosts. This raises questions about the homology of these elements. We note shared spatial trends in arch development including the formation of ventral cartilages before dorsal and anterior cartilages before posterior. Qualitatively variable gill arch elements in Cypriniformes include pharyngobranchial 1 and the sublingual. These structures are absent from *Luxilus zonatus* and they are the last elements to chondrify in *Catostomus commersonii* and *Cycleptus elongatus*. We show that the sublingual bone in *C. commersonii* has two cartilaginous precursors that fuse and ossify to form the single bone in adults. This suggests homology of the sublingual in catostomids to the two separate sublingual bones in the adults of some cobitids.

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462 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Jean Enneson, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

Stochastic Population Viability Analyses for an Endangered Freshwater Turtle, *Clemmys guttata*

Over two-thirds of the world's turtle species are in decline as a result of habitat destruction and harvesting. Quantitative methods for predicting the risk of extinction of turtle populations are essential for status assessments and recovery planning. Spotted turtles (*Clemmys guttata*) are considered vulnerable internationally, and endangered in Canada. We used population viability analysis (PVA) to assess the risk of extirpation of a Georgian Bay, Ontario population that has been under study since 1977 and of the entire Ontario population, and to examine the effects of dispersal between breeding ponds on population persistence. A simple stochastic model for the Georgian Bay population projected a 60% probability of extirpation in 100 years. A metapopulation model projected an 18% probability of extirpation within 100 years, suggesting that dispersal between breeding ponds is important for population persistence. Spotted turtles at this relatively pristine site have a relatively high risk of extinction despite the absence of anthropogenic additive mortality. Probability of quasi-extinction for the entire Ontario population as a result of stochasticity was low, but the probability of six or more of the nine known Ontario populations becoming extirpated within 100 years was 26%, indicating that recovery action is necessary to prevent decline of spotted turtles within the species' Canadian range, which is restricted to Ontario.

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182 AES Physiology, Galleria South, Sunday 26 July 2009

Laura Enzor, Rachel Wilborn, Wayne Bennett

University of West Florida, Pensacola, FL, United States

The Spine of Atlantic Stingray, *Dasyatis sabina*: Venom Toxicity and Role in Life History

The stingray venomous spine is thought to be primarily a defensive adaptation, but has also been shown to play key roles in conspecific social interactions such as reproduction. My study quantifies metabolic costs associated with the venom delivery system, venom toxicity (LC_{50}), and routine resting metabolism for the Atlantic stingray, *Dasyatis sabina*. Respirometry trials estimated an average routine resting metabolism for fish of 0.484 kcal $\cdot g^{-1} \cdot h^{-1}$; whereas the average metabolic rate of the venomous delivery system was 0.000162 kcal $\cdot g^{-1} \cdot h^{-1}$, or 0.04% of the fishes' resting rate. Ballistic bomb calorimetry revealed an average spine caloric density of 0.238 kcal per gram of spine. Acute toxicity tests using sheepshead minnow, *Cyprinodon variegatus*, as a surrogate, determined a venom LC_{50} value of 0.018 mg protein $\cdot$g of fish^{-1}. The low metabolic cost of the stingray envenomation system likely reflects its structural simplicity and low toxicity. While, low venom toxicity is likely necessary for a system that is used on conspecifics, it has the disadvantage of being less effective on large predators.

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459 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Hugo Escobar, Melanie Stiassny

American Museum of Natural History, New York, NY, United States

Systematic and Taxonomic Revision of the Alestid Genus *Micralestes*

The alestid genus *Micralestes* is distributed throughout Sub-Saharan Africa and as currently recognized, comprises 16 nominal species. According to a recent morphological analysis of alestid relationships (Zanata and Vari, 2005) *Micralestes* falls within one of two major clades in the tribe Petersiini, along with *Rhabdalestes*, *Hemigrammopetersius* and *Virila*. However, in the study of Zanata and Vari (2005) no morphological character was found to be unique for this genus. The molecular study of Calcagnotto et al. (2005) recovered a somewhat different topology for the Alestidae, but neither the taxon nor the geographical sampling was extensive, however in their study *Micralestes* (two species) is resolved as monophyletic. The status and composition of *Micralestes* is currently under investigation. To date morphological examination of type specimens suggests that the species-level taxonomy of a number of widespread species is complex. Morphological characters for this study are novel or taken from Poll (1967). The results indicate that *Micralestes* may be composed of more than 16 species, although it is clear that morphology alone will not be sufficient to resolve the relationships within

the genus and allied genera. An ongoing molecular study will undoubtedly help to unravel the relationships of this widely distributed group.

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945 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Todd C. Esque[1], Kenneth E. Nussear[1], Jill S. Heaton[2], Robert H. Webb[3], Kathryn A. Thomas[3], Leila Gass[3], Cynthia S.A. Wallace[3], Joan B. Blainey[3], Richard D. Inman[1]

[1]US Geological Survey, Henderson, NV, United States, [2]University of Nevada, Reno, Reno, NV, United States, [3]US Geological Survey, Tucson, AZ, United States

A Habitat Suitability Model for the Mojave Desert Tortoise: Importance of Ecological Parameters and Conservation Implications

The Mojave population of the Desert Tortoise is listed Federally as a threatened species north and west of the Colorado River. Tortoises occur in low densities, are cryptic and fossorial, making them difficult to enumerate. Effective management depends not only on knowledge of population parameters, but also the quantification of potentially suitable habitat. However, quantitative analyses of specific habitat requirements have not been available for the desert tortoise until recently. We developed a habitat model for Mojave desert tortoises using GIS layers addressing a variety of physical and biological factors thought to be ecologically relevant in defining suitable habitat for tortoises. We explore the directions and profiles of the partial response curves for the environmental variables that explained 95% of the variance in the model, and discuss their ecological interpretations relative to the known ecological relationships of these variables to desert tortoises. While this model indicates habitat suitability generally, there are many anthropogenic impacts (both direct and indirect) that can influence the realized suitability of the predicted habitat. We further evaluate tortoise habitat by considering the effects of several anthropogenic parameters on the extent and contiguity of desert tortoise habitats, including: roads, urban areas, utility corridors, fencing, fire, land status (e.g. wilderness, or National Park, or Critical habitat, private lands), and off-highway vehicle activity. These parameters may be analyzed individually or grouped to ascertain the amount of habitat on the landscape available to desert tortoises and the protection provided to tortoises and their habitat under current management rangewide.

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343 AES Ecology II, Galleria South, Sunday 26 July 2009

Mario Espinoza, Thomas Farrugia, Christopher Lowe

California State University, Long Beach, CA, United States

Spatial and Temporal Patterns of Elasmobranchs in a Newly Restored Accessible Habitat

Approximately 90% of southern California coastal wetlands have been lost as a result of filling or dredging activities. In August 2006, a new ocean inlet was created in the Bolsa Chica wetland, allowing benthic coastal predators to enter and use the full tidal basin (FTB). Since elasmobranchs have not had access to the basin in over 100 years, it provides an ideal opportunity to study how coastal benthic predators may use this newly restored accessible habitat for different activities. Monthly abundance surveys (beach seines and long-lines) were used to quantify spatial and temporal patterns of elasmobranchs inside the FTB. Eight species of sharks and rays have been identified using the FTB (2008-2009). Round stingrays (n=521), gray smooth-hounds (n=239) and bat rays (n=234) were the most abundant elasmobranchs. The highest CPUE was found in the middle FTB between June and September 2008. CPUE and relative abundance for all elasmobranchs increased with water temperature ($p<0.05$). However, only gray smooth-hounds and round stingrays showed a clear seasonal pattern of occupancy during warmer months. Other species like shovelnose guitarfish and bat rays were found in relatively high numbers during the winter. Habitat restoration has become a popular mitigation approach in southern California; however, studies of the effectiveness of estuarine restoration as a viable ecological approach to increase habitat for coastal elasmobranchs have been very limited. This study provides valuable ecological information about how top benthic predators use the FTB of Bolsa Chica, a newly restored accessible habitat.

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611 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Paula C. Eterovick[1], José Augusto M. Scalzo[1], André Hirsch[1], Ross Alford[2]

[1]Programa de Pós Graduação em Zoologia de Vertebrados, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, MG, Brazil, [2]School of Tropical Biology, James Cook University, Townsville, Queensland, Australia

Frog Developmental Instability is a Weak Indicator of Habitat Loss Along the Espinhaço Mountain Range, Southeastern Brazil

Amphibian declines are occurring worldwide, but relatively little is known about the situation of amphibian populations in Latin America. Extant monitoring techniques are adequate to detect declines when they are already underway. Predictive techniques,

such as developmental instability (DI) monitoring, might aid to the detection of disturbances affecting a population before it declines. DI is expected to increase in individuals that undergo higher stress levels during growth and development, so we tested its adequacy as an indicator of environmental stress, represented by habitat loss, suffered by amphibians, using the treefrog *Bokermannohyla saxicola* as a model. We estimated DI through fluctuating asymmetry (FA) using tibia-fibula, femur, radio-ulna, and eye-nostril distance measurements of 126 individuals from 14 *B. saxicola* populations throughout the species distribution in the Espinhaço mountain range. We used Geographic Information Systems to estimate human impact, given by the relative area covered by human land uses (assumed to be inappropriate habitats for frogs) in relation to total area within a circle with a radius of 2.5 Km, centered at each population sampling point. Levels of FA were not related to impact level given by habitat loss, showing that FA studies are not suitable for broad use in impact assessment on frog populations. More focused approaches, though, may still be useful: frogs may respond to alterations in a different spatial level, or during younger life stages, what remains to be tested. Detected variation in the levels of FA along B. saxicola distribution may have underlying causes that need further studies.

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613 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Paula C. Eterovick, Isabela Lazarotti, Bruna P. Franco, Camila J. Dias

Programa de Pós Graduação em Zoologia de Vertebrados, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, MG, Brazil

Seasonal Variation on Tadpole Spatial Niche in Permanent Streams – The Roles of Predation Risk and Microhabitat Availability

Microhabitat choice can have important consequences for development and survival of aquatic organisms, and is expected to vary in response to stimuli such as predation risk, food availability, and temperature. At seasonal sites, microhabitat availability and associated benefits may change from season to season, what might reflect in altered patterns of microhabitat use by tadpoles. We investigated this hypothesis in 17 streams from two localities in southeastern Brazil. We tested whether water level drops significantly during the dry season, whether lower water level results in altered microhabitat availability, and whether predation risk changes between seasons, based on predator density. We then tested whether tadpoles change their pattern of microhabitat use, their spatial niche breadth (given by diversity of used microhabitats) and spatial niche overlap (in the case of co-occurring species). We were able to include in our analyses tadpoles of four species of Hylidae, which occurred throughout both seasons. Stream depth decreased in the dry season, but microhabitat availability and predator density remained relatively constant. Tadpoles of three out of the four species studied were more abundant during the dry season, what may be an adaptation to adjust time of metamorphosis to the rainy season. Tadpoles showed contracted niches and higher niche overlap during the dry season, generally avoiding shallow

microhabitats, what may be a response to selective factors such as predation by vertebrates other than fish and desiccation risk in shallow marginal microhabitats.

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394 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Michelle M. Evans, Daniel C. Abel, Sharon L. Gilman, Robert F. Young

Coastal Carolina University, Conway, SC, United States

Demographics and Habitat Partitioning of Elasmobranchs in Port Royal Sound, South Carolina

A longline and rod-and-reel survey for elasmobranchs was conducted in Port Royal Sound, a south-eastern South Carolina deep water embayment, from June - August 2007, and April - November 2008. The project's main objectives were: (1) to enumerate the elasmobranchs in Port Royal Sound; (2) to delineate nursery and breeding grounds, where present; and (3) to compare diversity and abundance of elasmobranchs at four locations at different distances from the mouth of the sound. Seventy-eight "adult" lines (16/0 hooks) and seventy-six "pup" lines (12/0 hooks), baited with Boston mackerel, were bottom-set during slack tides. Elasmobranch catch was identified, measured, tagged (only sharks) and released. We caught 540 elasmobranchs (n = 248 on longlines, 292 on rod-and-reel) comprising fourteen species: *Rhizoprionodon terranovae* (n = 368, adult M:F = 1:0), *Carcarhinus limbatus* (68, 0.3:1), *Dasyatis sabina* (24, 0.14:1), *C. acronotus* (19, 4.3:1), *Sphyrna tiburo* (13, 0.4:1), *D. americana* (12, 0.12:1), *C. plumbeus* (11), *S. lewini* (5, 1:1), *Galeocerdo cuvier* (4), *C. isodon* (2), *Ginglymostoma cirratum* (2), *C. brevipinna* (1), *Negaprion brevirostris* (1), and *Raja eglanteria* (1). Port Royal Sound may represent primary or secondary nurseries for *C. limbatus*, *C. plumbeus* and *S. lewini*. The location furthest (19.3 - 22.5 km) from the mouth had a significantly lower CPUE (#sharks·100 hooks^{-1} h^{-1}) than the three other locations. Port Royal Sound, whose watershed is rapidly developing and whose wetlands are highly susceptible to sea level rise, may represent Essential Fish Habitat for a number of species of sharks and rays.

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590 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Denise Everhardt[1], Kimberly Hughes[1], F. Helen Rodd[2]

[1]Florida State University, Tallahassee, FL, United States, [2]University of Toronto, Toronto, Ontario, Canada

Rare Morph Survival Advantage in Guppies, (*Poecilia reticulata*): Mechanisms of Frequency-dependent Selection

Survival advantage for a rare or novel phenotype has been proposed as the cause of color polymorphism present in many species; however, a mechanism has eluded evolutionary biologists for decades. Many mechanisms have been proposed, primarily the search image hypothesis, though none have been proven to occur in wild populations. Male coloration in the Trinidad guppy (*Poecilia reticulata*) exhibits one of the most extreme examples of visible polymorphism. Experiments in natural populations indicated that rare color morphs had a survival advantage over common morphs—a form of negative frequency-dependent selection that is potentially capable of maintaining polymorphism. We are now testing one the hypothesis that selective predation by the killifish *Rivulua hartii* is responsible for this selection. Specifically, we are testing several proposed mechanisms including search image formation, switching behavior performed by predators, morph-specific hunting, and morph-specific personalities that affect escape behavior. Detailed observations of the attack behaviors of R. hartii trained on a single guppy color morph and then switched to a different morph are being analyzed using a high-speed video camera.

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852 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Bryan Falk, Susan Perkins

American Museum of Natural History, New York, New York, United States

On the Importance of a Combined Approach in Taxonomy: Another Cryptic Species of Lizard Malaria Parasite

Anolis lizards of the Dominican Republic were surveyed for malaria parasites (genus *Plasmodium*). Parasites were identified based on morphological characters, and subsequent molecular analysis revealed a cryptic species formerly lumped within *P. fairchildi*. A revised species diagnosis is given, and the importance of a combined morphological and molecular approach in this group is emphasized.

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122 ELHS/LFC Ecology I, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Ana Faria[1], Alfredo Ojanguren[2], Lee Fuiman[3], Emanuel Gonçalves[4]

[1]Instituto Superior Psicologia Aplicada, Lisbon, Portugal, [2]University of Texas Marine Science Institute, Port Aransas, TX, United States, [3]University of Texas Marine Science Institute, Port Aransas, TX, United States, [4]Instituto Superior Psicologia Aplicada, Lisbon, Portugal

Ontogeny of Swimming Behavior of Two Temperate Reef Fishes, *Lepadogaster lepadogaster* and *Lepadogaster purpurea* (Gobiesocidae)

Gobiesocid larvae have been found in several studies conducted in nearshore rocky environments. At the Arrábida Marine Park, high numbers of gobiesocid larvae of all size classes have been caught in the very nearshore, which suggests a possible retention pattern. Retention may occur due to physical features of the area and/or active larval behaviour, such as swimming abilities. In the laboratory, we measured the ontogeny of swimming behaviour (routine speed and critical speed [Ucrit]) of two clingfish species, very abundant at the Arrábida Marine Park, *Lepadogaster lepadogaster* and *L. purpurea*. Routine swimming is generally considered to be important in foraging, as well as migration and predator avoidance capabilities, while critical swimming speed (Ucrit) provides a useful estimate of maximum swimming performance of fish larvae. Routine and critical swimming speed of larvae of both species increased with ontogeny (size), even though variability at any ontogenetic state was large. Close to settlement size (10 mm TL) swimming behaviour started to decrease. This has to do with the development of a ventral sucking disk, which is an adaptation to the benthic mode of life and allows larvae to glue to the bottom or walls of the chamber and counteract strong currents. These results have the potential to improve our knowledge of larval behavioural capabilities of temperate species, and also advance the capability of biophysical dispersal models to predict the probabilities of dispersal and retention in coastal zones.

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452 Snake Ecology, Pavilion East, Monday 27 July 2009

Terence Farrell, Peter May

Stetson University, DeLand, FL, United States

Patterns of Growth in Dusky Pigmy Rattlesnakes (*Sistrurus miliarius*) in Central Florida

We studied growth in SVL and weight of pigmy rattlesnakes in Volusia Co., FL, using mark-recapture techniques. Between February 1992 and December 2000, we had a total of 665 PIT-tagged individuals of approximately one year of age or greater that were

subsequently recaptured at least once. Because snakes can be definitively aged at one year, this resulted in a large sample of snakes of known age that were subsequently followed for up to 7 years. Seventy-seven of these individuals PIT-tagged at one year were identified from photographs of neonates born in captivity, allowing us to relate adult growth to neonate traits. Snakes were surface-active throughout the year, and snakes with detectable prey in the gut were found in all months. Pigmy rattlesnakes typically increased their weight by 5.6-fold and 9-fold from birth to one and two years of age, respectively. SVL increases by 1.8-fold and 2.2-fold by one and two years of age, respectively. Multiple regressions of SVL and weight on age showed a slight but significant effect of sex on both SVL and weight, though these differences in weight and length are not apparent until snakes are around 4 years old. Growth appears to continue throughout life, with no clear indication of an asymptote in size. Analysis of individual growth records shows much variability in patterns of growth. A year-round activity season may decouple feeding and growth in these snakes from the temporal constraints imposed on more northern snakes, resulting in greater variability in individual growth trajectories.

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824 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Thomas Farrugia[1], Mario Espinoza[1], Dale Webber[2], Frank Smith[2], Chris Lowe[1]

[1]California State University, Long Beach, Long Beach, CA, United States, [2]VEMCO Ltd., Halifax, Nova Scotia, Canada

Testing a New Long-term Fine-scale Positional System for Tracking Multiple Fish Simultaneously

Quantifying the fine-scale movement of coastal elasmobranchs is important in determining life history characteristics, resource utilization and the role of elasmobranchs in coastal communities. However, traditional active tracking requires a large amount of time and effort and yields very short-term data (days). We describe and test a novel acoustic telemetry technique using Vemco VR2W acoustic receivers that will provide long-term fine-scale positional data of elasmobranchs fitted with coded transmitters. The VR2W Positional System (VPS) uses stationary transmitters placed throughout a VR2W array to synchronize the internal clocks of the receivers. Differences in times of arrival from transmitters placed on elasmobranchs to three or more receivers are used to triangulate a position for the animal, potentially every time the transmitter pulses. The VPS was found to estimate the location of a stationary test transmitter with a mean accuracy of 3.18 m and a mean precision of 3.02 m. Ninety percent of the VPS estimates fell within 6.06 m of the actual transmitter location. A shovelnose guitarfish and a gray smooth-hound, were double-tagged and tracked simultaneously using active tracking and the VPS. Movement parameters (including distance and direction traveled) binned in one-hour intervals did not differ significantly between VPS and active tracking for either species. Our results suggest that the VPS provides fine-scale data comparable to active tracking over the entire life of a coded transmitter (years),

providing significantly longer term, fine-scale data for numerous individuals simultaneously.

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176 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Kevin Feldheim[1], Samuel Gruber[2], Joseph DiBattista[3], Demian Chapman[4], Andrew Hendry[3], Elizabeth Babcock[5], Ellen Pikitch[4], Mary Ashley[6]

[1]Field Museum, Chicago, IL, United States, [2]Bimini Biological Field Station, Bimini, Bahamas, [3]McGill University, Montreal, Quebec, Canada, [4]Stony Brook University, Stony Brook, NY, United States, [5]University of Miami, Miami, FL, United States, [6]University of Illinois at Chicago, Chicago, IL, United States

Long-term Philopatry and the First Case of Natal Homing in a Chondrichthyan Fish

Natal homing is an extreme form of philopatric behavior, in which females return to their birthplace to give birth. This phenomenon has been shown in some marine vertebrates including bony fish and reptiles, but not for the most basal jawed vertebrate lineage, the chondrichthyans, that includes sharks and their relatives. Using both physical and genetic tags coupled with pedigree reconstruction, we show long-term (up to 16 years) philopatric behavior by female lemon sharks (*Negaprion brevirostris*) to a tropical nursery lagoon. We also find evidence of males and females mating over several years, indicative of either long-term sperm storage or long-term associations between individuals. Finally, we provide the first evidence of natal homing in a shark. These results provide a potential explanation for why rapid, long-term population collapse is typical of local shark fisheries, which then has important implications for conserving these imperiled apex predators.

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917 Storm Symposium, Pavilion West, Friday 24 July 2009

Chris Feldman[1], Edmund Brodie, Jr.[2], Edmund Brodie, III[3], Michael Pfrender[2]

[1]University of Nevada, Reno, NV, United States, [2]Utah State University, Logan, UT, United States, [3]University of Virginia, Charlottesville, VA, United States

Evolutionary Genetics of Tetrodotoxin (TTX) Resistance in Snakes

Research on the process of adaptive evolution has recently come to focus on details concerning the genetic basis of adaptation as well as theoretical work on the mechanics of adaptive evolution. Nevertheless, key questions regarding the process of adaptive evolution remain. Ultimately, a detailed description of the ecological context,

evolutionary history, and genetic basis of adaptations is required to advance our understanding of adaptive evolution. To address some of the contemporary issues surrounding adaptive evolution, we examine phenotypic and genotypic changes in a snake feeding adaptation. Some populations of the garter snakes *Thamnophis sirtalis*, *T. couchii*, and *T. atratus* possess elevated resistance to tetrodotoxin (TTX), the lethal neurotoxin of their Pacific newt prey (*Taricha* sp.). We demonstrate that TTX resistance has evolved independently through amino acid changes at critical sites in a voltage-gated sodium channel protein ($Na_v1.4$) targeted by TTX. Additionally, we show the contribution of $Na_v1.4$ alleles to whole-animal TTX resistance is substantial, demonstrating that $Na_v1.4$ is a gene of major effect. Finally, we broaden the scope of our work by examining patterns of convergent evolution in parallel arms-races between diverse snakes and amphibians from across the globe. Six snake species that prey on TTX bearing amphibians have independently acquired amino acid changes in $Na_v1.4$. However, the derived mutations are clustered in two portions of the gene, often involving the same sites and substitutions, suggesting protein evolution in this system may be constrained.

1047 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Mark Feldman, Elizabeth Feldman

New Zealand

A More Effective Method to Induce Turtles to Lay Their Eggs

Oxytocin has been in use for decades to induce turtles to lay their eggs. Unfortunately, it often leads to partial clutches or fails to work at all. Oxytocin also has some significant side effects in wild animals; causing delays in producing the next clutch and aberrant nesting behavior days after injection. Both are probably due to a failure of ovulation after induction. For the past two seasons we have been working at one of the world's largest turtle farms, looking for a safer and more effective method to induce oviposition. The huge number of animals available at the farm has made it possible to experiment with a wide variety of techniques and agents. After rejecting oxytocin alone, prostaglandin F2 alpha (Lutalyse) alone, propranolol alone and in combination, prostaglandins E1 and E2 alone and in combination, arachadonic acid alone, and medetomidine (Domitor) in combination, we found that a combination of oxytocin and prostaglandin F2 alpha was more effective, and more physiologic, than any other method. We've refined the dosages and timing of the injections and found that noise, immersion in water, light, and method of injection had no effect on success.

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948 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Alexsis Ferguson, Melissa Pilgrim

University of South Carolina Upstate, Spartanburg, SC, United States

Implementation of the North American Amphibian Monitoring Program in the Upstate Region of South Carolina

The North American Amphibian Monitoring Program (NAAMP) was developed in 1995 as an initiative to monitor amphibian population trends in Canada, Mexico and the United States (see www.pwrc.usgs.gov/naamp). NAAMP uses breeding call surveys to inventory and monitor presence and persistence of amphibian species in a region. South Carolina joined NAAMP in 2008. USC Upstate's research group, Upstate Herpetology, is responsible for collecting NAAMP data for the Upstate region of South Carolina. Specifically, we conduct call surveys along 11 routes that span 7 counties in the Upstate. We follow standard NAAMP protocol (see http://www.pwrc.usgs.gov/NAAMP/protocol/index.html) for data collection along each route. We spent December of 2007 - February of 2008 establishing call survey sites (10 sites/route) along the 11 Upstate routes assigned to us by USGS. We then collected call survey data for NAAMP sampling windows two (March 15 - April 30) and three (May 15 - June 30). Our objectives for the 2008 season were to evaluate the productivity of Upstate calling routes, the species richness of our region and seasonal impacts on breeding phenology. We recorded anuran calling activity at 91 of the 110 potential breeding sites surveyed. We recorded 12 anuran species calling along Upstate routes. The three dominant callers during window two were Spring Peepers, Northern Cricket Frogs and Fowler's Toads. The three dominant callers during Window three were Fowler's Toads, Green Treefrogs, and Northern Cricket Frogs. Number of species calling per site varied from 1-5, with per site species richness increasing during window three.

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213 Poster Session I, Exhibit Hall, Friday 24 July 2009

Fernando Fernandes Mendonça, Diogo Teruo Hashimoto, Claudio Oliveira, Fabio Porto Foresti, Otto Bismarck Fazzano Gadig, Fausto Foresti

Universidade Estadual Paulista - UNESP, São Paulo, Brazil

Genetic Identification of Lamniformes and Carcharhiniformes Sharks: Fishery Monitoring and Conservation

The difficulties of morphological identification of many shark species exploited for fishing associated to the usual practice of removing the heads and fins of the animals prior to going ashore resulted in a general lack of information about the extent of fishing and commercialization and made it nearly impossible to assess its effects. Considering

the growing demand for shark meat and fins and the fact that each species responds differently to exploitation, the creation of practical tools for identification to the lowest possible taxonomic level is essential. In order to fill this lacuna, libraries of mitochondrial DNA sequences were created using the cytochrome oxidase subunit I gene (COI) of several shark species usually fished in the Brazilian coast and from specific genetic characteristics of every taxon species-specific primers were designed, which, in multiplex-PCR reaction produce fragments of varying sizes (variable according to the species), making it possible, by electrophoresis, the simultaneous identification of several samples. According to this methodology, the species *Alopias superciliosus*, *Alopias vulpinus*, *Isurus oxyrinchus*, *Prionace glauca*, *Galeocerdo cuvier*, *Carcharhinus falciformes*, *Rhizoprionodon lalandii*, *Rhizoprionodon porosus* and *Sphyrna lewini* can be easily identified without the need for morphological characters. Besides making it possible to identify shark species from the commercialized meat, this technique is also practical and inexpensive, which makes it suitable for use in the proper management of fishing in the Brazilian coast and in global conservation programs. Financed by FAPESP.

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581 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Joana Fernandez-Carvalho, George Burgess

Florida Program for Shark Research, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

The National Sawfish Encounter Database: Integration, Maintenance and Growth

The smalltooth sawfish (*Pristis pectinata*), the first marine fish to be listed under the U.S. Endangered Species Act (ESA), is currently listed as critically endangered by the IUCN, and is included in the Appendix I of CITES. During the species listing process, the National Sawfish Encounter Database (NSED) was created as a tracking database to gather information regarding smalltooth sawfish encounters and has been maintained ever since to assist recovery managers and researchers. In September 2008, the NSED was transferred from Mote Marine Laboratory to the Florida Program for Shark Research (FPSR), where it was merged with the FPSR database and four additional scientific and private databases. As a result, all information regarding U.S. sawfish is united for the first time in one place. Currently, the NSED has a total of 3368 records and includes data from 1782 to 2009. Preliminary analysis shows a depth-related size distribution, with the larger specimens occurring predominantly in deeper waters and smaller individuals inhabiting shallower waters. While juveniles have been observed throughout Florida waters, the highest frequency of occurrence occurs along the southwest (Gulf of Mexico) coast. Juveniles also are commonly encountered in the Florida Keys, where adults are observed most frequently. Adults also are often found along the east coast (Atlantic Ocean) of Florida, where juveniles are relatively scarce. The newly-augmented NSED provides enhanced information on the U.S. smalltooth sawfish

population, assisting the Sawfish Implementation Team in the evaluation of the species abundance, range and habitat preferences.

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149 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Toni Ferrara[1], Stephen Wroe[1], Daniel Huber[2], Colin McHenry[3], Philip Clausen[3], Victor Peddemors[4], Mason Dean[5], Michael Lowry[4]

[1]University of New South Wales, Sydney, NSW, Australia, [2]University of Tampa, Tampa, FL, United States, [3]University of Newcastle, Newcastle, NSW, Australia, [4]NSW Department of Primary Industries, Cronulla, NSW, Australia, [5]University of California, Irvine, CA, United States

Three Dimensional Computer Analysis of Jaw Mechanics in Great White and Sandtiger Sharks

The relationship between form and function of the elasmobranch feeding apparatus is central to our understanding of their evolution and ecology. Bite force has been utilized as a predictor of this relationship in many vertebrate taxa, and when combined with morphological studies, can provide valuable insight into cranial evolution, dietary limitations, niche segregation, and sexual dimorphism. However, bite force in sharks is poorly understood and accurate estimates are difficult to obtain. Finite Element Analysis (FEA) is a powerful tool used by engineers, and increasingly by biologists, to examine the mechanical behaviour of structures. In FEA, a 3 Dimensional (3D) computer model of a structure is generated and subjected to various loading conditions to evaluate mechanical performance. FEA provides not only a method to quantitatively assess bite force, but also provides a much broader analysis of form and function by demonstrating how a structure responds to the various forces which may be imposed upon it, such as when biting prey. The present study assembled sophisticated 3D Finite Element models based on computerized tomography (CT) scans and dissected specimens of the jaws of two species of shark, *Carcharodon carcharias* (great white) and *Carcharias taurus* (sandtiger). Comparisons of bite force, gape angle and mechanical behaviour in these two species is presented. Of key interest is how jaws constructed of flexible cartilage have evolved into an efficient feeding apparatus. Although the application of FEA to elasmobranch research is still in its infancy, this technique has potential benefit to many aspects of shark research.

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52 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Carl Ferraris

All Catfish Species Inventory, Portland OR, United States

Patterns of Discovery of Siluriformes During the All Catfish Species Inventory

For the past six years, the rate of discovery of new catfishes has been accelerated by the All Catfish Species Inventory (ACSI), which was undertaken with the generous support of NSF. During that period of time, reports of the discovery of more than 475 species of the Siluriformes were published, resulting in an approximately 17% the increase in known catfish species. Patterns of new species discovery were analyzed by time, relationships and broad geographic distribution to search for trends in discovery and gaps in coverage. The sources of specimens that formed the type series were also examined to determine the relative proportion of species discovered from materials that had been deposited in collections prior to ACSI to those collected during the Inventory. New species were discovered from all continents except Antarctica, and included five species known only from the fossil record. New species were reported for 29 of the 36 currently recognized families of catfishes, with most of the families that did not increase in number being amongst the smallest families (< seven species). Nearly one-fourth of all new species are in the Neotropical Loricariidae, an increase of > 20%., and four other families increased by percentages of > 40%. Although many more species of catfishes will undoubtedly be named from recently collected material, trends observed in ACSI might provide valuable insights for efficient strategies that can be implemented for comparable inventories of other, especially freshwater-, fish groups.

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133 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Cristiane de Paula Ferreira, Lilian Casatti

UNESP-São Paulo State University, São José do Rio Preto, São Paulo, Brazil

Fish Assemblage Structure in Streams Associated to Forest Fragments in a Degraded Region of Southeastern Brazil

This study was conducted in streams of the São Paulo state, Brazil, in a region where only 4% of the native vegetation remains, surrounded by pasture, sugarcane and citrus crops. We selected nine streams from the largest forest fragments of the region, being four in sugar cane matrix (S1,S4,S5,S7), two in grassland (S2,S3), and three in citrus (S6,S8,S9). Each of them was sampled three times in the dry period (Jun-Aug/2007) and three in the wet (Jan-Mar/2008). A 75 m reach in each stream was selected, where the abiotic, local, and landscape descriptors were evaluated. Fish were collected with a passage of electric-fishing at each sampled time. Overall fish species richness was 53,

and the multivariate pattern of the community indicates greater similarity between S2/S3, S8/S9, and S4/S5/S6/S7, reflecting the soil use without influence of seasonality. Land use influences was reinforced by Canonical Correspondence Analysis. Ammonia and inorganic carbon were related to pasture (S2) and sugarcane (S1,S4,S5,S7) streams, to which tolerant species *Cichlasoma paranaense*, *Callichthys callichthys*, *Geophagus brasiliensis* were associated; woody debris and water-land ecotonal diversity were related to interior reaches (S4,S5,S6,S9), where the non tolerant species *Pseudopimelodus pulcher*, *Hypostomus nigromaculatus*, *Cetopsorhamdia iheringi* occurred; grass proportion was related to edge reaches (S1,S2,S3,S7,S8), to which the dominant and tolerant species *Serrapinnus notomelas*, *Pyrrhulina australis*, *Hoplias malabaricus* were associated; drainage density was related to larger streams (S4,S5,S6,S7). These results reflect that the ichthyofauna structure in streams is explained by local and regional factors on several scales.

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72 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Lara Ferry-Graham[1], Adam Summers[2]

[1]Moss Landing Marine Laboratories, Moss Landing, CA, United States, [2]University of California, Irvine, CA, United States

Ventilation in Chondrichthyans: A Decade of Research Reveals New Models of Aquatic Vertebrate Respiration

Over the last decade, investigations of the ventilatory mechanics of chondrichthyans have revealed a number of unique findings that seem to defy paradigms commonly invoked to describe aquatic vertebrate respiration. Aquatic vertebrate ventilation is typically represented by a model whereby two alternating pumps operate to generate water flow through the head and over the gills. These two pumps, the suction and pressure pumps respectively, are hypothesized to operate such that they are able to maintain both continuous and unidirectional flow at the level of the gill lamellae. Studies of sharks, skates, and chimaeras, however, reveal that the two pumps operate to varying degrees during routine respiration. Flow visualization techniques have revealed concomitant flow reversals, whereby water flows from posterior to anterior, both at the gross anatomical level (i.e., exterior to the head at the mouth and spiracles), and at the level of the respiratory structures (i.e., gill lamellae). Such flow reversals vary both within and among species, and may be negatively correlated with oxygen demand. The most extreme deviation from the paradigmatic norms are found in the chimaeras, in which a single pump dominates the ventilatory cycle. We postulate that during ventilation, water is drawn into the orobranchial cavity using primarily a very low-pressure suction pump, on the order of 100-1000 Pa. We suggest that chimaeras are utilizing an entirely novel mechanisms of generating flow into the head., whereby a

slight amount of expansion of the orobranchial region is sufficient to pull water into the mouth.

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357 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Daniel Figueroa[1], Paula Rivera[1], Belleggia Mauro[3], Delpiani Gabriela[2], Shimabukuro Valeria[1], Scenna Lorena[2], Barbini Santiago[4], Bovcon Nelson[5]

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Teeth of Skates in the Southwest Atlantic

Dentition in skates are used not only for feeding but also for reproduction, both are influential factors on tooth morphology. Despite teeth of elasmobranchs are very abundant skeleton elements in fossil records, the study of dentition of skates has not reached the development achieved in sharks. Southwest Atlantic appears to be a great radiation center of skates, probably due to its large continental shelf, and its transitional waters. Fossil teeth of skates in this region were recorded since the Cretaceous. A total of 23 species of skates inhabit Argentinean continental shelf. Their feeding habits are very diverse. Adult individuals of some species have specialized diet in fishes and large sharp tooth cusps, showing no sexual dimorphism (e.g. *Bathyraja brachyurops* and *Bathyraja magellanica*). On the other hand, some species have a specialized diet in polychaetes (e.g. *Bathyraja albomaculata* and *Bathyraja macloviana*) and evidence a very clear sexual dimorphism, with males presenting larger and sharper tooth cusps than females. In both groups tooth rows of males are well spaced which allows their proper differentiation. An extreme case is *Bathyraja multispinis*, with teeth without cusps and a quincunx pattern, its diet is based on crabs. In *Amblyraja doellojuradoi* have appeared curious dental anomalies, such as bicuspid teeth and row duplication. Given the fact that the dentition of many species has not been studied yet and considerable variations in tooth morphology were shown between the species of skates studied, future research is necessary for intra and interspecific comparations.

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647 Herp Biogeography, Galleria North, Saturday 25 July 2009

Robert Fisher[1], Peter Harlow[2], Heidi Davis[3], Leona Chemnick[3], Oliver Ryder[3], Scott Keogh[4]

[1]USGS, WERC, San Diego, CA, United States, [2]Macquarie University, Sydney, NWS, Australia, [3]San Diego Zoo's Institute for Conservation Research, Escondido, CA, United States, [4]Australian National University, Canberra, ACT, Australia

Another New *Brachylophus iguana* from Fiji? New Genetic Evidence and Further Use of Morphology to Discriminate Among the Described Living Species

The enigmatic monotypic iguanid genus *Brachylophus* was known from the south Pacific for 170 years before there was suggestion of species diversity in the genus. Over the last 40 years several species were described and currently the iguanids from the south Pacific are now represented by two genera and a total of five species, although two of the species are extinct. Recent published analysis of a molecular dataset indicated that there were three clear genetic units within the *Brachylophus* populations sampled. We recently added 14 haplotypes to this dataset that were generated from samples collected over a 15 year period from captive zoo animals, most of which were imported from Fiji in the mid to late 1980's. We recovered two of the living species within these haplotypes, furthering morphological evidence of hybridization in Fiji prior to exportation to San Diego. We also recovered a unique haplotype represented by three zoo animals and not previously sampled in the recent study. This sample could represent a fourth living species within the genus *Brachylophus* although the location of the collection of these animals remains unknown. Further morphological assessment of museum specimens, combined with data for captive and wild animals, indicates that there is a suite of external characteristics that are useful for defining the living species. Lastly, we discuss the priority outstanding issues involved in conserving these species, including a need for sampling of populations not included in our genetic study or represented in museums.

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842 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kevin Floyd[1], Victoria Milne[2]

[1]University of Texas at El Paso, El Paso, TX, United States, [2]El Paso Zoo, El Paso, TX, United States

Lack of *Batrachochytrium dendrobatidis* Detected in Amphibian Populations Around El Paso, Texas

Batrachochytrium dendrobatidis (hereafter *Bd*) is a fungal pathogen linked to global amphibian declines. *Bd* has been found in amphibian populations in the southwestern United States, including Arizona, New Mexico, and Texas. To our knowledge, however, no studies have looked for *Bd* in El Paso, Texas, and the surrounding region. Here we

report initial findings of a survey begun in the summer of 2008. We sampled eight locations, most of which are temporary ponds which fill only during the summer rainy season. Samples from the skin were collected using cotton swabs. We sampled a total of 121 individuals from seven species of toads and a single *Rana catesbeiana*. Of these, 54 samples representing all eight sites and all eight species were pooled by location and tested for the presence of *Bd* DNA. All of the pooled samples tested negative for the presence of *Bd* DNA. This suggests that the seasonal drying of the temporary ponds found in this region do not support the fungal life cycle of *Bd*. Although some of the areas sampled are close to the Rio Grande, we did not sample any frogs or toads from the river, where *Bd* is most likely to survive. Future work will include sampling from the Rio Grande, as well as re-sampling some of the initial ponds. If these samples confirm a lack of *Bd*, the El Paso region might be one of the few remaining areas of the southwest free of *Bd*.

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921 Fish Conservation I, Parlor ABC, Sunday 26 July 2009; ASIH STOYE AWARD CONSERVATION

Brook L. Fluker

The University of Alabama, Tuscaloosa, AL, United States

Molecular Divergence in the Highly Imperiled Rush Darter, *Etheostoma phytophilum*, Relative to its Widespread Congener *E. parvipinne*

Populations of spring dependent species typically share characteristics with island populations, often displaying molecular divergence and lower levels of genetic variation relative to their widespread congeners. The Rush Darter, *Etheostoma phytophilum*, is a spring dependent species endemic to upland portions of the Black Warrior River drainage in Alabama. The species is known from only three disjunct populations, two of which are found in the Locust Fork and one in the Sipsey Fork. Using a combination of mitochondrial and nuclear DNA, molecular diversity and the evolutionary history of *E. phytophilum* were examined with respect the Goldstripe Darter (*E. parvipinne*), its widespread lowland sister species. Haplotype diversity was low in all populations of *E. phytophilum*; each Locust Fork population had a single unique mtDNA haplotype and the Sipsey Fork population housed two haplotypes. Despite low within population diversity, mtDNA sequence divergence was substantial among Locust Fork populations (1.41%) and greater between Sipsey and Locust forks (1.86%). Phylogenetic analyses revealed that Locust Fork populations were reciprocally monophyletic, and although resolution among Locust Fork *E. phytophilum* and other Mobile Basin *E. parvipinne* was poor, the Sipsey Fork population shared a closer relationship with Black Warrior and Tombigbee River *E. parvipinne*. These results suggest that Sipsey and Locust Fork populations of *E. phytophilum* possibly had independent evolutionary origins and all populations are highly differentiated. The patterns of molecular divergence in *E. phytophilum*, as with other Mobile Basin spring endemics, suggest that spring specific management plans are necessary to properly conserve these unique species.

256 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Joel Fodrie[1], Sean Powers[1], Matthew Ajemian[1], Gregory Stunz[2], Robert Shipp[1]

[1]University of South Alabama & Dauphin Island Sea Lab, Dauphin Island, AL, United States, [2]Harte Research Institute for Gulf of Mexico Studies, Texas A&M University, Corpus Cristi, TX, United States

Basin-Wide Decrease in Large Sharks Documented by a Unique Eight-Decade Dataset from the Gulf of Mexico

Apex predators are known to have important regulatory roles within coastal food webs. For sharks, which are apex predators in many coastal systems, decreases in populations are evident in some analyses of commercial landings, and this could have cascading effects throughout the coastal ocean. Unfortunately, analyses of shark population trends have proven controversial and are often of very limited temporal scope (e.g., stock assessments for sharks in the Gulf of Mexico began in the early 1990s). We utilized a unique, eight-decade dataset from three deep-sea fishing rodeos (in Alabama, Mississippi and Texas) to examine long-term trends in the size of sharks that claimed top prizes in these rodeos. The dataset has several biases, but many of these biases are acceptable, even favorable, for estimating the basin-scale availability of large sharks. All three fishing tournaments demonstrated significant increases in the size of prize sharks from 1929-1985, coinciding with increases in effort and technology. In all three rodeos, sizes peaked during the early 1980s, with the largest fish weighing in at nearly 400 kg. Since then, the sizes of prize sharks have decreased dramatically. Subsequently, winning sharks weighed in at ~ 100 kg by the mid 1990s (with no apparent recovery in recent years). Furthermore, large tiger and bull sharks dominated the rodeos from 1929 until 1989, but now appear to have been expatriated from the region. The loss of these large predators may have dramatic ecosystem effects.

490 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Dan Foley[1], Jennifer Sunderland[1], Gary Garrett[2]

[1]Sul Ross State University-Rio Grande College, Del Rio, TX, United States, [2]Texas Parks & Wildlife Department, HOH Fisheries Science Center, Mountain Home, TX, United States

Diet of an Invasive Suckermouth Catfish (*Hypostomus* sp.) and Examination of Possible Dietary Overlap with Indigenous Fishes in San Felipe Creek, Texas

Introductions of exotic fish species into desert ecosystems can have detrimental effects on endemic fauna. The federally threatened Devils River minnow (*Dionda diaboli*) is presently limited to the Devils River, and three small creeks within Texas. A noticeable decline in Devils River minnows from San Felipe Creek concurrent with the expansion of an exotic suckermouth catfish, armadillo del rio (*Hypostomus* sp.) led to the speculation that this introduced species was negatively impacting *D. diaboli* minnow populations. We hypothesized that the observed reduction in *D. diaboli* was at least in part due to competition for available food sources. Both *D. diaboli* and *Hypostomus* are almost exclusively algivorous. At monthly intervals *Hypostomus* were collected from the same location within San Felipe Creek. The contents of each catfish stomach were removed and permanent slides prepared. Among the 120 catfish sampled, 37 genera of algae were identified representing four algae divisions. Overall, rhodophytans comprise 87% of the algae consumed by catfish. *Rhodophytans* represented a minimum 63% of the diet each month. Chlorophytan consumption was generally low throughout the year, peaking in October at 11.5%. Consumption of Cyanophyta was also generally low except during August (20.3 %), September (24.7%) and October (17.4%). Maximum Bacillariophyta consumption occurred during August (15.0%). The gut contents of several *D. diaboli* and its congener *D. argentosa* were also analyzed. The diet of *D. diaboli* contained 11 genera of algae with Bacillariophyta representing 55.5%. The diet of *D. argentosa* contained 15 genera with Cyanophyta and Rhodophyta representing 39.2% and 40.8% respectively.

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134 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Neil Ford[1], Richard Seigel[2]

[1]University of Texas at Tyler, Tyler, TX, United States, [2]Towson University, Towson, MD, United States

Factors influencing Offspring Size in Snakes

Selection pressure on offspring size occurs not only on individual offspring but also on the female that produces the eggs or neonates. In an optimal model, offspring should be large enough to eat available prey and escape predators while maximizing maternal fitness. The ability of the female to maximize number of optimal sized offspring is often an assumption of models of life-history evolution. However, empirical examinations of offspring size and trade-offs associated with reproductive traits such as clutch size, reproductive mass, and other characteristics in a variety of species of snakes have given mixed results. This presentation attempts to clarify some of those issues. Longer female snakes usually have more offspring, but in several species from different families, they also have larger offspring. Energy intake also impacts reproductive traits with the strongest effects on clutch size. Interestingly, smaller females in several species show stronger trade-offs of clutch size on offspring size as it relates to energy intake. In one species with large eggs, energy intake appears to influence offspring size and not clutch size. Timing of energy acquisition relative to ovulation is likely the most important factor influencing the ability of snakes to regulate offspring size. Capital breeders may buffer the effects of environmental extremes by waiting to reproduce, whereas income breeders have the flexibility to reproduce at high rates whenever favorable conditions are encountered but may have some degree of unpredictability superimposed on the reproductive system.

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453 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Travis Ford, Jeff Kneebone, Dean Elder, Hunt Howell

University of New Hampshire, Durham, NH, United States

Reducing Sampling-Induced Stress in Atlantic Cod

Atlantic cod, *Gadus morhua*, have historically been regarded as one of the most commercially important fish in New England waters. Their significance in fisheries and aquaculture calls for in depth study of their physiology, in particular, to the stress response due to interactions with fishing gear and/or aquaculture procedures. Examining plasma cortisol levels is a common method of measuring stress in fishes. However, the stress induced by sampling blood can cause significant differences in

plasma cortisol levels and distort results of stress related experiments. Thus, reducing sampling-induced stress is crucial to these experiments, specifically when taking repeated samples from an individual. This study evaluated three different sampling techniques, including cannulation and two different handling methods of vessel puncture, and compared the stress induced by each sampling method. Cod were in kept in flow through seawater tanks at the University of New Hampshire's Coastal Marine Lab (New Castle, NH) from 2008 to 2009. One group of fish was cannulated by surgically inserting a piece of PE-50 tubing into the second afferent branchial artery and was sampled once daily for a week. Blood was sampled from other groups through a caudal vessel puncture 3 times weekly. Plasma cortisol levels were analyzed by radioimmunoassay and compared statistically using an ANOVA and a Tukey's test. Baseline plasma cortisol levels and plasma cortisol profiles for each of the blood sampling methods will be reported.

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255 Poster Session I, Exhibit Hall, Friday 24 July 2009

Don Forester, Penny Mae Forester

Towson University, Towson, MD, United States

The Use of Montage Photography to Document Embryonic Development in the Northern Dusky Salamander (*Desmognathus fuscus*)

The Northern Dusky Salamander (*Desmognathus fuscus*) is a widely distributed streamside plethodontid indigenous to North America east of the Mississippi River, from northeastern Georgia and Tennessee in the United States to New Brunswick, Canada. In Maryland, females oviposit beneath natural debris adjacent to the headwaters and seeps of first order streams. Nesting begins in late May and peaks in early July. Females remain with their eggs throughout development (50-65 days) and hatchlings spend 9-12 months as gilled larvae prior to metamorphosis. We collected 10 clutches of eggs from the field immediately following oviposition. The eggs were maintained in a darkened controlled environmental room (to simulate a subterranean nesting cavity) at 19±1 C. One to three eggs were preserved in 70% ETOH every other day throughout the developmental period until the onset of hatching. Prior to a photographic session, we removed the outer mucopolysaccharide membranes from the eggs to enhance photographic clarity. We created each composite color photograph from an average of 21 digital slices using a Q-Imaging digital camera and Syncroscopy Auto-Montage software. Images were taken at various powers with a Leica MZ16 microscope using a micrometer stage with a digital readout. We assigned each embryo to 1 of 33 embryonic stages conforming to a developmental table published by Marks and Collazo (1998) for the direct developing Seepage Salamander (*Desmognathus aeneus*). In contrast to *D. aeneus*, *D. fuscus* hatchlings lack eyelids, retain fully-functioning filamentous gills, possess a distinct tail fin, and exhibit dorsal pigmentation replete with larval spots.

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753 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Angela Fornell

University of Texas, Arlington, Arlington, TX, United States

Working in Reverse: When Snakes Are Prey

Snakes are often considered predators and very rarely prey within the context of predator-prey relationships. I address what carnivores are likely predators of snakes and investigated tail breakage as a proxy of attempted predation. I performed a literature search to identify potential and known predators of various snake species. The number of predators per snake species and predator class (i.e., avian vs. mammalian) were compared against snake size class and habitat type. I predicted overlap in predator class of each snake species and that larger snake species would have fewer predator species. Additionally, I inspected museum specimens of snakes for evidence of a predation attempt as a result of the presence of tail breakage. Sex, size and age classes were also examined to determine a correlation with tail breakage. For intraspecific comparisons, I predicted a lesser incidence of tail breakage in juveniles than in adults, as such injuries would be retained into adulthood.

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821 Herp Genetics, Galleria North, Saturday 25 July 2009

Alicia Fox, Aaron Schrey, Henry Mushinsky, Earl McCoy

University of South Florida, Tampa, FL, United States

Genetic Relatedness in the Sand Skink, *Plestiodon reynoldsi*, in the Scrub of Central Florida

Information about mating systems and fine-scale dispersal is important when conducting studies for conservation and management. The Florida Sand Skink, *Plestiodon reynoldsi*, is a fossorial lizard currently listed as threatened throughout its range along the scrub habitat of the central ridges in Florida. Genetic differentiation is known to exist among distinct geographic samples across its distribution, and mark-recapture evidence suggests that the Florida Sand Skink travels distance of 140m at most; however, little information is available about within-population properties. The goal of this study is to investigate the mating system and dispersal of the Florida Sand Skink. Multiple microsatellite loci were screened in individuals sampled from a large homogeneous scrub location near Davenport, Florida. Samples were collected from four sites (less than 2 km apart), each with multiple transects of pitfall arrays. Parentage, reproductive success, and genetic relatedness were estimated among individuals and sites. Significant genetic differentiation, of low magnitude, was observed among four

Davenport sites, suggesting restricted gene flow; however, average relatedness values among individuals were low in magnitude. Low relatedness values indicate that individuals may be moving more than previously thought. Results from Davenport were compared to a geographically distinct population of Sand Skinks collected at Archbold Biological Station. These sites differ in overall continuity of habitat, with Archbold containing numerous small wetlands throughout the scrub, which may act as barriers within the local population. If wetlands at Archbold impact dispersal, we expect that average relatedness will be higher for fragments at Archbold when compared to Davenport sites.

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974 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Dewayne Fox[1], Bradley Wetherbee[2], Lori Brown[1], Mahmood Shivji[3], Kenneth Sulak[4], Johnny Moore[1]

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Coastal Movements of Sand Tiger Sharks (*Carcharias taurus*) in the Northwest Atlantic as Determined by Acoustic and Satellite Telemetry

Prior to a recent harvest moratorium, sand tiger sharks (*Carcharias taurus*) were the focus of both directed and non-directed fisheries in the northwest Atlantic. Sand tigers occupy a high public profile due to their size and relative ease of public display. In contrast with many other large coastal sharks, limited information is available on the coastal movements of sand tigers including locations of overwintering areas. In 2008 we outfitted 13 sand tigers (1.4-3.3m FL) with acoustic (VEMCO Ltd. V-16-6H) and satellite (Microwave Telemetry Inc.) transmitters in Delaware Bay. Twelve of the thirteen acoustic transmitters were detected a total of 8,030 times prior to departing Delaware waters in September and October. Similarly, twelve of the satellite transmitters were detected within scheduled pop-off times (4-6 months post-deployment). Most sand tigers made relatively direct movements to overwintering areas in the Hatteras Bight Region, arriving within weeks of departing Delaware waters. An additional male sand tiger (1.09m FL) outfitted with an acoustic transmitter was detected off Cape Canaveral, FL in January-February, 2009 after departing Delaware Bay in September. Female sand tigers occupied significantly ($p < .0001$) warmer waters compared to males although occupied depths did not vary significantly ($p = .1054$). Although perceived as a relatively sluggish species, telemetered sand tigers were documented making rapid movements in the water column from surface waters to depths of 188m. Our results underscore the need for coast-wide approaches to recover sand tigers as this charismatic shark is particularly vulnerable to anthropogenic impacts.

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762 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Carmen Franco-Gordo, Salvador Hernández-Vázquez, Angel Hinojosa, Arturo Amezcua, Enrique Godínez-Domínguez, Jorge A. Rojo-Vázquez

Universidad de Guadalajara, Jalisco, Mexico

Fish Larvae Assemblages of the Revillagigedo Islands During Summer 2008

The Revillagigedo Islands are an archipelago of volcanic oceanic islands rising independently from the ocean floor along the Clarion Fracture Zone. Since 1994 the archipelago has been protected under the Biosphere Reserve status due the high biodiversity, both terrestrial and marine. During May and June 2008, a zooplankton survey was carried out around the Socorro and Clarión islands. Sampling were taken using a zooplankton net (250 μm mesh) by means of horizontal hauls. The presence of Coryphaena hippurus and Scombrids small larvae show the reproductive activity of middle and major pelagic fish species in the area. The demersal hard bottom assemblage was typified by *Labrisomus multiporosus*.

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967 AES Ecology I, Pavilion West, Saturday 25 July 2009

Bryan Franks[1], Eric Reyier[2], Samuel Gruber[3], Steven Kessel[1], Demian Chapman[4]

[1]Bimini Biological Field Station, Miami, FL, United States, [2]Dynamac Corporation, Kennedy Space Center, FL, United States, [3]University of Miami, Miami, FL, United States, [4]Stony Brook University, Stony Brook, NY, United States

Lemon Sharks (*Negaprion brevirostris*) on the Beach: An Update from a Winter, Surf-zone Nursery at Cape Canaveral, Florida

The lemon shark (*Negaprion brevirostris*) utilizes nursery areas mostly found around shallow, mangrove fringed coastlines from Florida to Brazil. Recently a large population (>500 individuals) of juvenile lemon sharks was found in the surf zone along Cape Canaveral, Florida. This presents a unique opportunity to study a population of juvenile sharks utilizing a nursery habitat that differs greatly from most of the known nurseries for this species. A majority of young individuals in this population suffer from an extremely heavy parasite load. To date, we have tagged 390 individuals with tag returns suggesting a northward migration in early spring. Some sharks moved at least 640 km from Cape Canaveral to Buzzard Bay, NC. In December 2008, we implanted Vemco transmitters in 4 male and 5 female lemon sharks (59 - 97 cm PCL) to obtain data on the seasonal movements around the Cape and to gauge the timing of their northward migration. We are monitoring local movements using Vemco monitors placed just off the beach. Large scale movements are being monitored through the FACT and ACT arrays along the eastern seaboard and through tag returns. Finally we are examining a

possible connection between the Cape Canaveral juvenile sharks and a large, seasonal aggregation of mature sharks off Jupiter, Florida. Future directions for this project include assessing the population genetics of these juvenile sharks, expanding the tracking study to further evaluate local movements and migration patterns, and examining the health of the sharks with specific regard to their high parasite burden.

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272 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

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Diel Movements Of A Scalloped Hammerhead Shark (*Sphyrna lewini*) In The Northern Gulf of Mexico As Determined By High-Rate Pop-Up Satellite Archival Tagging

Diel behavior and essential habitat of scalloped hammerhead sharks (*Sphyrna lewini*) in the Gulf of Mexico are poorly understood. A high-rate pop-up satellite archival tag (PSAT; Microwave Telemetry, PTT-100 HR) affixed to a mature female caught at a deep water petroleum platform in the northern Gulf of Mexico in June 2008 recorded data on the shark's diel behavior and use of vertical habitat as related to temperature and depth for a period of 27 days. Data recovered from the tag were used to document fine-scale, diel vertical movements previously unreported for S. lewini in the Gulf region. The shark spent ~85% of daylight hours at depths and temperatures between 20-100m and 24-29^{o}C, respectively, with no deep dives. The shark spent ~70% of night time hours between the surface and a depth of 50 meters, with the remainder of night time spent in repetitive vertical excursions >700m, the deepest being 964m at a temperature of 5.8^{o}C. Deep dive rates of descent were significantly faster than ascent rates. It is presumed that throughout the entire 27-day period of PSAT attachment the shark remained at or near the petroleum platform during daytime hours and made repetitive, deep water forays into the adjacent Mississippi Canyon at night.

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449 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Layla Freeborn, David Sever

Southeastern Louisiana University, Hammond, LA, United States

Reproductive Morphology of Colubroid Snakes

Past studies indicate that interspecific and seasonal variations occur within the accessory ducts and glands of male snakes. These accessory ducts and glands include the proximal efferent ducts, the ductus deferentis, ampulla ductus deferentis, and the renal sexual segment. While many past studies have been conducted at the light microscopy level, far fewer have been completed at the ultrastructural level. However, more recent ultrastrucural studies have revealed new and surprising variations. Using both light and electron microscopy, we examined the male accessory ducts and glands of snakes within the group Colubroidea. Variations found within this group may reveal morphological characters that can be mapped over existing phylogenetic hypotheses of Colubroidea. This in turn will useful in elucidating the evolution of reproductive characters in colubroid snakes.

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319 Fish Ecology I, Pavilion East, Friday 24 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Nathan Franssen

University of Oklahoma, Norman, OK, United States

Biodiversity and Community Biomass Stability of Stream Fishes in the Great Plains

Anthropogenic influences have disproportionally affected freshwater ecosystems, and loss of biodiversity is forecasted to greatly reduce ecosystem function and services. Reduced species richness may destabilize community aggregate properties through a loss of compensatory dynamics or statistical averaging, which buffer variation in community attributes in the naturally dynamic environment. Currently, support for positive diversity-stability relationships stem from experiments with simple communities at small spatial and temporal scales, and application to natural communities is limited. Using a 28-year dataset of 35 stream fish communities I show that higher species richness was associated with more stable annual standing biomass of fishes after controlling for variability in river discharge. Both the portfolio and covariance models of community stability were consistent with observed patterns of lower biomass variation in more species rich communities. My findings suggest the 'insurance value' of vertebrate consumer diversity has important implications for stabilizing trophic linkages and subsequent ecosystem services in complex ecosystems.

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627 Fish Ecology I, Pavilion East, Friday 24 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Jonathan Freedman

The Pennsylvania State University, University Park, PA, United States

Interaction of competition and nutrient pathways in shaping the trophic structure of benthic fish communities

Interspecific competition has profound effects in shaping the realized trophic structures of fish communities, yet these effects are confounded by variation in source and availability of exploitable nutrient pathways. Although bounded by variation in fish community structure, nutrient availability plays a vital role in determining the trophic positions of fishes within these communities. To better understand the interactions between competition and nutrient flow in the structure and function of benthic fish communities in large rivers, we sampled six sites in the Allegheny River of Pennsylvania encompassing a variety of habitats: shallow (2) and deep (2) sites in navigation pools, and sites with limited anthropogenic disturbance in the free-flowing portion of the river (2). We then used ecological metrics and stable isotope analysis of $\delta^{13}C$ and $\delta^{15}N$ to characterize trophic structure in the benthic fish community, and to detect differences in energy flow through these systems. The overall range of $\delta^{13}C$ at deeper sites indicated a shift towards increased reliance on pelagic-derived nutrients relative to the shallow sites, while increased variation in $\delta^{13}C$ and $\delta^{15}N$ of common species was associated with trophic generalization at deep sites. Free-flowing sites had less variation in $\delta^{15}N$ than the pool-influenced sites, while low variation in the stable isotope signatures of species at these sites implied increased trophic specialization. Realized trophic niche width and the trophic energy pathways utilized by some species were altered by the presence or absence of certain competitors, indicating competitive niche exclusion and release across sites.

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692 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Santiago P Fregoso, James R Stewart, Tom W Ecay

East Tennessee State University, Johnson City, TN, United States

Timing of Calcium Mobilization in a Predominantly Lecithotrophic Viviparous Snake, *Virginia striatula*

Patterns of embryonic calcium uptake vary among squamate reptiles, and are poorly understood in snakes. Only three oviparous snakes have been studied to determine

patterns of calcium provision. Oviparous snakes produce calcium-rich yolk, which supplies the majority of calcium during the growth phase of development. They receive supplemental calcium via eggshell exploitation just prior to hatching. However, the timing and patterns of calcium mobilization for viviparous species are unknown. *Virginia striatula*, a viviparous snake, was studied to determine calcium mobilization patterns during embryonic development. We tested the hypothesis that viviparous snake embryos do not differ from their oviparous counterparts in the patterns of calcium mobilization. Yolk and embryos were analyzed for calcium content using atomic absorption spectrophotometry. We conclude that embryos of *Virginia striatula* do not begin mobilizing calcium until the late stages of development. Yolk supplies 62% of embryonic calcium, while the remaining proportion is provisioned via a placenta. Eggs lack a calcareous eggshell and uterine calcium secretion is timed to coincide with the embryonic growth phase. While embryonic patterns of calcium uptake are similar between viviparous and oviparous snake species, the timing of calcium secretion by the uterus in this viviparous species is delayed relative to the reproductive cycle compared to oviparous species. (Supported by a grant from NSF-IOB 0615695)

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778 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Sarah Friedl[1], Jeffrey Buckel[1], Joseph Hightower[2], Frederick Scharf[3], Kenneth Pollock[2]

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Effects of Implanting a Relatively Large Sonic Telemetry Tag on Growth, Survival, and Tag Retention in Age-1 Spot

We are conducting a study to estimate natural mortality rates of spot using sonic telemetry tags. Prior to our field study, we conducted laboratory experiments to determine if a relatively large sonic telemetry tag adversely affected age-1 spot. It has been suggested that internally implanted sonic telemetry tag weight should represent no more than 2.0% of fish weight (Winter 1983). At a relative weight of 4-7%, the tag chosen for our field study exceeded the suggested 2.0%. We compared growth, survival, and tag retention in age-1 spot between control and surgery groups. The surgery group was implanted with VEMCO V9-6L (2.9g in air) sonic tags and incisions were closed with a simple continuous suture. Over an 80 day experimental period, there were no mortalities and growth rates were not significantly different between groups; thus, the relatively large tag had no obvious negative effects on growth or survival. However, the tags were expelled from two of the eight surgery fish. If this tag loss was unaccounted for in our field study, it would cause positive bias in estimates of natural mortality rate. As a follow up to this experiment, we are holding age-1 spot implanted with V9 tags but

whose incisions were closed with simple interrupted sutures. To date (60 days), there has been no mortality and no tag loss in this group. Although this suture takes more time to perform, our preliminary observations indicate that it provides a stronger wound closure that may result in a higher tag retention rate.

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616 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Sam Friederichs[1], Stephen Morreale[2], Frank Paladino[1]

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[2]*Department of Natural Resources, Cornell University, Ithica, NY, United States*

Measuring Temporal, Spatial and Vertical Movements of Pacific Sailfish (*Istiophorus platypterus*) in the Eastern Tropical Pacific Using Pop-up Archival Tags

Overfishing has become an important issue and migratory species such as the Pacific sailfish (*Istiophorus platypterus*) are one of the species at risk. Migrations spanning multiple exclusive economic zones within the Eastern Tropical Pacific make these fish a multi-national resource. As a result, a better understanding of their temporal, spatial and vertical movements is necessary for effective management throughout their range. In this study, 8 Pacific sailfish were tagged with pop-up archival tags. The fish were collected from sportfishing vessels from Guanacaste, Costa Rica. They were captured using conventional gear with dead bait and a circle hook. Once subdued, the tag was inserted into the dorsal muscle of the fish posterior to the head. The fish was then revived and released. The deployment interval of the tags ranged from 100-250 days. The tags were programmed to record dive depth (1-500m), dive duration (<1->90 min) and time-at-depth. The MK-10 tags were also programmed for opportunistic transmission allowing for near-real time location data when the fish surfaced to bask. The results of this tagging show Pacific sailfish tagged off Costa Rica range over the entire Central American coast and do so in as little as 20 days. They dive as deep as 200 meters but live primarily within 15 meters of the surface. As a result, commercial fishing gear set below 15 meters in the Eastern Tropical Pacific may help reduce sailfish bycatch.

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451 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

John Friel[1], John Sullivan[2], Thomas Vigliotta[1]

[1]Cornell University, Ithaca, NY, United States, [2]Academy of Natural Sciences, Philadelphia, PA, United States

Conflicting Phylogenies for Mochokid Catfishes: A Rag-gene to Morphological Riches Story

Recent ACSI-sponsored studies have produced two independent phylogenetic hypotheses for relationships among mochokid catfishes (one based on morphology and another on sequence data). While monophyly of the Mochokidae is firmly supported by both studies, there are several areas of incongruence. Most significant is the placement of the sucker-mouth taxa (Subfamily Chiloglanidinae) relative to the rest of the family. Morphology suggests the Chiloglanidinae is nested well within the Mochokidae; while molecular data suggest the Chiloglanidinae is the sister group to a clade containing all other mochokids. Another area of contention is the placement of *Microsynodontis* relative to other mochokid taxa. Here, we will discuss our efforts to investigate the potential sources of these conflicts, as well as our efforts to reanalyze and reconcile these competing phylogenies.

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344 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Chris Friesen, Amelia Kerns, Robert Mason

Oregon State University, Corvallis, OR, United States

Sperm Precedence in a Snake: *Thamnophis sirtalis parietalis*

The first observation of multiple paternity in any 'reptile' was documented in captive common garter snakes, *Thamnophis sirtalis sirtalis*, in 1941 by Frieda and Frank Blanchard. Since then many other investigators have found evidence of multiple paternity genus Thamnophis. As informative as these studies have been, they conducted paternity analysis on litters from wild-caught females without knowledge of the identities and/or mate order of potential fathers. Therefore, these studies could not establish patterns of precedence. In the Interlake region of Manitoba, spring of 2007, we obtained 53 doubly mated females *Thamnophis sirtalis parietalis* for whom we know with certainty the mate order of their last two mates. These females were taken back to Oregon State University where 32 gave birth the following summer. We have genotyped a subset of these litters for paternity analysis. Our data show a trend toward 2nd male precedence, if the 1st known male had mated previously. Thus sperm depletion may be a significant factor in this mating system. In addition, and perhaps most interestingly, we

found significant usage of stored sperm and evidence that more than one male is needed to explain the patterns of stored sperm usage in some litters. In fact, stored sperm accounted for the majority of paternity in some litters. To our knowledge this study is the first that measures sperm precedence in a non-avian sauropsid.

348 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Chris Friesen[1], Don Powers[2], Robert Mason[1]

[1]Oregon State University, Corvallis, OR, United States, [2]George Fox University, Newberg, OR, United States

Cost of Male Courtship: Using Group Metabolic Rates to Assess Individual Courtship Costs

Reproductive effort is an important aspect of life history, as reproductive success is arguably the most important component of fitness. Females of most sexually reproducing organisms invest more in the production of offspring than do males. Red-sided garter snakes (*Thamnophis sirtalis parietalis*) are an exceptional model for study of energetic costs of courtship and mating as they fast during the spring mating season segregating the cost of energy acquisition from the cost of courtship and mating. However, measuring an individual male's metabolic rate during courtship is complicated by the fact that male courtship behavior in red-sided garter snakes is dependent on the detection of female sexual attractiveness pheromone, and facilitated courtship, i.e., vigorous courtship is only exhibited in the presence of other males. Thus, traditional techniques of masking individuals would prevent male courtship behavior, and single animals placed in a flow-through chamber would not yield ecologically realistic levels of courtship, which are only seen in the context of a group or mating ball. Because of these difficulties, we placed groups of males in a flow-through metabolic chamber together with a single female whose respiratory gases were vented outside the chamber to yield a whole group metabolic rate during competitive courtship. Conservative estimates of peak group metabolic rates during courtship are 10-20 times higher than resting group metabolic rate. These measurements indicate that costs of male courtship are high for males and may have implications for the evolution of alternative male mating strategies in this system.

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932 General Ichthyology, Parlor ABC, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Bridgette Froeschke

Texas A&M University-Corpus Christi, Corpus Christi, TX, United States

Future Fishery? Is There Still Hope for the Future Status of the Southern Flounder (*Paralichthys lethostigma*) Fishery?

Southern flounder, *Paralichthys lethostigma*, represent an important multi-million dollar commercial and recreational fishery and are distributed from North Carolina to Florida and from Florida to northern Mexico. Despite the economic and ecological importance of this species, flounder populations in Texas' coastal waters have declined precipitously in recent years. To address the decline and support sustainable use of southern flounder, time series analysis and forecast models were developed using data from the Resource and Sport Harvest Monitoring Program in Texas' major bay systems, conducted by Texas Parks and Wildlife since 1977. Time-series models were constructed to address: 1) sustainability of juvenile and adult populations; 2) patterns in CPUE among bays, and; 3) the potential to use abiotic factors to predict future status of southern flounder. Primarily the model focused on predicting future distribution patterns of southern flounder populations based on projected changes in abiotic factors and relationship of those abiotic factors to habitat quality. During this study juvenile southern flounder catch rates have declined slightly ($y = -0.0884x + 185.25$), whereas adults have declined more rapidly ($y = -0.0021x + 4.2975$). Additionally, catch per unit effort (CPUE) patterns differed among bays between juveniles and adults. Juvenile catch rates were highest in Galveston Bay and Matagorda Bays whereas San Antonio Bay and Aransas Bays supported highest CPUE for adults. Time series analysis provides crucial information for ecosystem-based management and natural resource managers, in that it provides the information needed to identify sensitive life stages that can aid in sustainable management.

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913 AES Ecology II, Galleria South, Sunday 26 July 2009

John Froeschke

Harte Research Institute Texas A&M University-Corpus Christi, Corpus Christi, TX, United States

Habitat Selection Patterns of Sharks in Northwestern Gulf of Mexico

Dramatic declines in shark populations worldwide have occurred from overfishing and habitat loss, and designation of Essential Fish Habitat has been congressionally mandated to sustain shark populations. However, this requires detailed knowledge of

habitat selection and use that is currently unknown for coastal sharks in northwestern Gulf of Mexico. This study examined habitat selection patterns of five coastal shark species using fisheries-independent gill-net monitoring data from Texas Parks and Wildlife Department (1975-2006). The goals of this study were: 1) describe shark distribution patterns in Texas Bays and 2) relate patterns to environmental and spatial ecosystem attributes. Fifteen species of sharks were collected although only 5 species: Bull, blacktip, bonnethead, Atlantic sharpnose, and finetooth sharks were common enough for analyses. The relative influence of environmental and spatial variables was examined using Boosted Regression Trees, a novel and flexible approach for characterizing fish habitat. The relative influence of environmental attributes varied among species and spatial scales. Large-scale (coast wide) patterns were linked most closely with salinity while small scale (within-bay) patterns were associated with temperature. This study provides an example of a flexible method for identifying essential habitat that can be used for inference or prediction of habitat value for rare species.

1046 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Bryan Fry

University of Melbourne, Melbourne, Australia

A Central Role for Venom in Predation by *Varanus komodoensis* (Komodo Dragon) and the Extinct Giant *Varanus* (*Megalania*) *prisca*

The predatory ecology of *Varanus komodoensis* (Komodo Dragon) has been of long-standing interest and considerable conjecture. We investigated the roles and potential interplay between cranial mechanics, toxic bacteria, and venom. Our analyses pointed to the presence of a sophisticated combined-arsenal killing apparatus. We found that the lightweight skull was relatively poorly adapted to generate high bite forces, but better adapted to resist high pulling loads. We rejected the popular notion regarding the utilisation toxic bacteria. Instead, we demonstrated that the effects of deep wounds inflicted are potentiated through venom with toxic activities including anticoagulation and shock induction. Anatomical comparisons of *V. komodoensis* with *Varanus* (*Megalania*) *prisca* fossils suggested that the closely-related extinct giant was the largest venomous animal to have lived.

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547 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Vivian Wing Kan Fu, David Dudgeon, Nancy Karraker

The University of Hong Kong, Hong Kong SAR, China

Seasonality, Diet, and Habitat Use of the Hong Kong Newt (*Paramesotriton hongkongensis*), and their Implications for Conservation

Paramesotriton hongkongensis has a highly restricted distribution in southern China. Field-based ecological studies of this species are scarce, and the terrestrial phase of the life cycle has not been investigated. Seasonal patterns of the breeding populations of newts in four stony hill streams (two impounded, two free-flowing) were assessed every three weeks over a 17-month period. Newt diets were investigated by stomach-flushing. Breeding sites in streams (deep pools) and the surrounding terrestrial habitats were characterized. Transects radiating outward from breeding sites were surveyed to determine the migratory distance travelled by the newts on land. Breeding began in September and ended in April when most newts had departed from pools. Male newts outnumbered females early in the breeding season while females dominated at the end. Among the 32 identified prey types (n = 532 stomachs), aquatic insect larvae were the main component (37%) of the breeding adults' diet with the remainder consisting of shrimps (22%) and snails (11%); egg and larval cannibalism were detected also (21%). There was no systematic difference in diet or adult body condition (size-weight relationships) among streams, but a higher frequency of injuries and deformities was noted in impounded streams (33-67%) compared to free-flowing streams (2-7%). The reasons for this difference were unclear. Thirteen newts (including 6 metamorphs) were found along transects. The mean distance travelled from breeding sites was 110 m (range: 18-228m). Extensive terrestrial habitat use by *P. hongkongensis* mandates protection of substantial areas of forest around newt breeding sites.

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160 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Lee A. Fuiman[1], Mark Meekan[2], Mark McCormick[3]

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Behavioral Traits that Determine Mortality of Newly Settled Reef Fish Larvae

Settlement from the plankton ends the major dispersive stage of life of reef fishes and exposes them to intense predation pressure on densely populated coral reefs. This predation mortality, which is about 55% within 1-2 days of settlement, can determine recruitment success. At the level of individual predation interactions, survivorship depends upon prey behavior through its effects on conspicuousness and evasive ability. We conducted an experiment to identify the behavioral traits and

performance levels that are most important determinants of which larvae survive or die soon after settlement. We collected late stage, presettlement *Pomacentrus* sp. larvae using light traps and measured 12 behavior traits on each of 104 larvae. These traits included two measures of routine swimming (indicators of conspicuousness) and nine measures of evasive performance to a visual startle stimulus measured in the laboratory. Larvae were then forced to settle onto individual patch reefs, where a single additional behavioral trait (boldness) was measured. Divers censused each patch reef until approximately 50% of the larvae were missing (~24 h), which we assumed to be a result of predation. Classification tree analysis was unable to describe a set of traits that reliably predicted surviving individuals, but it revealed that a combination of low escape response speed, low boldness, and high routine swimming speed reliably identified 55% of the larvae that died. Larvae with fast evasive responses to the visual stimulus were most likely to survive, but there was a large amount of uncertainty about that prediction.

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653 ELHS/LFC Ecology I, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

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Comparison of UV-B Tolerance among Wild and Hatchery-reared Juveniles in Black Sea Bream (*Acanthopagrus schlegeli*) and Red Sea Bream (*Pagrus major*)

Because the level of UV-B radiation reaching the sea surface increased due to ozone layer depletion, it is important to quantify the adaptation potential of marine fish to this changing environment. In a previous rearing study, we concluded that juvenile black sea bream, a fish species inhabiting the surf zone, was more tolerant to UV-B radiation than red sea bream, usually distributed in deeper waters (~10m). Here we compared UV-B tolerance between hatchery-reared and wild juveniles of these two species. Reared and wild juvenile sea breams were exposed to one of four different UV-B radiation levels (1.8; 1.1; 0.4; 0W/m2) for 4 hours. Following exposure, survival rate was measured every 2 hours for a period of 24 hours (red sea bream) or 48 hours (black sea bream). Reared and wild juvenile red sea bream were characterized by similar survival rate with mortality reaching 100% 24 hours after exposure at the 1.1 and 1.8W/m2 levels. In black sea bream, wild individuals showed higher UV-B tolerance than the reared ones. Survival rate of reared juveniles declined earlier, and their survival after 48 hours was significantly lower relative to wild individuals at the 1.1and 1.8W/m2 radiation levels. The present results indicate that in black sea bream, physiological characteristics accounting for UV tolerance are at least partly acquired during development in the natural environment.

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171 Poster Session I, Exhibit Hall, Friday 24 July 2009

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[1]Utah State University, Logan, UT, United States, [2]Missouri State University, Springfield, MO, United States

Innate Predator Recognition in Larval Hellbenders (*Cryptobranchus alleganiensis*) and the Problem of Introduced Trout

Prey commonly use chemical cues to assess the current level of predation risk. Innate predator recognition can only occur when there is evolutionary history between predator and prey. Predator introductions pose a unique threat to prey in permanent aquatic habitats because predation is part of predator-prey evolutionary history, but innate predator recognition may make them incapable of recognizing the recently introduced predator. Here we present a study evaluating the ability of a fully aquatic salamander to chemically recognize native and introduced fish predators. We presented two subspecies of larval hellbenders (*Cryptobranchus alleganiensis*) with chemical stimuli from native and nonnative predatory fishes and compared them with a nonpredatory fish and a blank control. Compared to a nonpredatory fish (redhorse sucker, *Moxostoma* spp.), eastern hellbender larvae (*C. a. alleganiensis*) significantly reduced activity in response to chemical stimuli from native predators but did not in response to nonnative trout chemical stimuli. Responses of Ozark hellbender larvae to brown trout (*Salmo trutta*) were similar to that of the native fishes and different from the blank control, but responses to rainbow trout (*Oncorhynchus mykiss*) did not differ from the blank control. The general inability of larval hellbenders to recognize introduced predatory trout could lead to increased predation in the wild.

1016 Poster Session I, Exhibit Hall, Friday 24 July 2009

Felipe Galvan Magaña[1], Zullette del Socorro Andrade González[1]

[1]Cicimar, La Paz, BCS, Mexico, [2]University of Guadalajara, Guadalajara, Jalisco, Mexico

Feeding Habits of *Cacharhinus falciformis* in the Oceanic Zone of the Eastern Pacific Ocean

The diet of silky shark *Carcharhinus falciformis* from the eastern Pacific Ocean was analyzed during 1992 to 1994. From a total of 324 silky shark stomachs, 258 showed stomach contents (79.6%) and 66 were empty (20.3%). Four principal trophic groups were found in the eastern Pacific Ocean: cephalopods, crustaceans, marine mammals, and fishes. Applying the index of relative importance (IRI) it was found that silky shark fed preferentially on yellowfin tuna *Thunnus albacares* (66.7% IRI) in the entire study area consisting of 6 sub-areas A-F. The most important prey species by area were: in area A,

fishes of the family Carangidae (59.8%) , in area B, *Thunnus albacares* (38.3%), in area C, *Cubiceps pauciradiatus* (59.2%), in area D *Thunnus albacares* (72.8%), in area E, *Dosidicus gigas* (21%), and in area F, *Katsuwonus pelamis* (65.1%). Applying the ecological index of trophic niche breadth, low values were observed in the total area by sex and stage of maturity (juvenile or adult, 0.05-.49), meaning that sharks select their prey. Analyzing by area, however, showed that areas A,C, E, and F had high values (generalists); whereas areas B and D were low (specialists). Higher values of prey diversity index were registered in areas D and E (2.30-2.38), than in the other areas A (0.189), B (2.18), C (1.17), and F (1.98).

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496 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Jin Gao, Stephan Munch

Stony Brook University, Stony Brook, NY, United States

Parental Contributions to Larval Growth in Atlantic Silversides: A Heritability Study

Many studies have shown that mortality during the early life history of fishes is extremely size selective. However, despite strong directional selection on size, local adaptation in growth rates is quite common. One explanation for these conflicting observations is that there is little genetic variation in growth in the early life history. To test this hypothesis, we used Atlantic silversides as a model species to examine genetic variance in, and heritability of, size at age through the first two weeks of life. We used a full-factorial mating design in which a total of 288 full- and half-sib families were raised in a common environment and body lengths were recorded by photographing fish at 1, 5, 10, and 15 days post-hatch. We found that the heritability was low at all ages but increased with age. Differences in heritability estimates from sires and dams indicate evidence of maternal effects on growth.

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469 Herp Conservation II, Grand Ballroom II, Monday 27 July 2009

Tiffany Garcia, Rebbecca Hill, Benjamin Emmert, Megan Cook

Oregon State University, Corvallis, OR, United States

Mechanisms Behind the Successful Invasion of Bullfrogs (*Rana catesbeiana*) in the Northwest United States

Understanding the mechanisms that allow populations of some species to successfully expand in novel environments is essential for developing management strategies to limit

the spread and ecological impact of biological invasions. Bullfrogs (*Rana catesbeiana*) are one of the 100 worst invasive species in the world. These frogs are native to eastern North America, but have become established in 25 additional countries on three continents and are involved in declines of many native species, particularly other amphibians, via predation and/or competition. We hypothesize that larval phenotypes of invasive bullfrogs in the Pacific Northwest have diverged from the native range, and that local adaptation and/or phenotypic plasticity are the mechanisms facilitating this bullfrog invasion. Preliminary studies conclude that bullfrog populations at the southern extreme of the Pacific Northwest invasion range are capable of metamorphosing at an accelerated rate. The consequences of this phenotypic divergence are dependent on the mechanism of change. We propose using molecular genetic techniques to estimate genetic divergence in Pacific Northwest populations across the invasion range, common garden experiments to determine if larval developmental rates are genetically bases, and species distribution models to estimate potential invasion range in the Pacific Northwest. This integrated method of investigation is a powerful and unique approach for understanding invasion mechanisms and will serve as a useful model for future studies of invasive species. We will present our preliminary findings and initial experimental designs.

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969 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Francisco J. García de León[1], Angélica Daza Zepeda[2], Héctor Espinosa Pérez[2]

[1]1Centro de Investigaciones Biológicas del Noroeste, S.C. (CIBNOR), La Paz, BCS, Mexico, [2]Instituto de Biología, Universidad Nacional Autónoma de México, México, DF, Mexico

Morphological Variation of *Poecilia mexicana* in Mexican Populations

The Atlantic Molly *Poecilia mexicana* is a livebearer, which ranges from the San Juan River (a tributary to the Bravo River in Tamaulipas, Northeastern Mexico) to the Southern Atlantic slope of Mexico, and to Belize and Guatemala in the Polochic and Motagua rivers, and is probably also present in Northeastern Honduras. Atlantic mollies are a plastic species adaptated to different ecosystems along its range. Since its description, this species had presented taxonomic problems due to phenotypic similarity with other species with which they frequently co-habit. This present study integrated the taxonomic revision of 153 individuals, from 16 localities in nine States of Mexico from the National Fish Collection at the Instituto de Biología UNAM. The fish were identified using diagnostic traits according to the literature. Nineteen morphometric traits were measured. We used the Truss network model to standardize the different measures, and a Principal Component and Graphical Analysis were conducted. Three different groups of populations were obtained, one ranged along to Atlantic slope, and showed a morphological North - South gradient and is highly variable. The other one is found in Quintana Roo, and finally one more group is found on the Pacific slope

(Guerrero and Chiapas). We concluded that this species is highly polymorphic and due to its broad range we hypothesize it to show incipient allopatric or parapatric speciation.

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878 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Jayne Gardiner[1], Jelle Atema[2], Robert Hueter[3], Philip Motta[1]

[1]University of South Florida, Tampa, FL, United States, [2]Boston University/Marine Biological Laboratory, Woods Hole, MA, United States, [3]Mote Marine Laboratory, Sarasota, FL, United States

Odor Orientation Behavior in Sharks

Sharks are hypothesized to orient to odors by performing bilateral comparisons between the nares, turning towards the side receiving the highest concentration. Results from previous experiments have left unclear the question of whether animals respond to differences in concentration or in the timing of odor arrival at the nares. We fitted smooth dogfish, *Mustelus canis*, with headsets made of tubing to deliver odor to the two inflow nares, connected to computer-controlled programmable syringe pumps to precisely control the timing of odor delivery. First, the nares were presented with squid rinse of identical concentration with the timing varied such that one naris received the pulse ahead of the other with 0.1, 0.2, 0.5, and 1s delays. Secondly, both nares were simultaneously stimulated, one with full strength squid rinse, the other with a 100 fold dilution. Finally, the nares were stimulated with these concentration differences but with a 0.5s delay such that the weather odor was received before the stronger odor. For delays of less than 1s, animals displayed turns towards the side receiving the first odor pulse, regardless of concentration differences. Simultaneous pulses of different concentrations and pulses of equal concentration with a 1s delay resulted in turns towards either side with equal frequency. These results suggest that the temporal pattern of odor patches presents the most salient information for orientation in this species and the decision to turn is made within 0.5 seconds, regardless of subsequent, stronger odor pulses.

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620 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Gabriele Gerlach, Jelle Atema, Michael Kingsford

University of Oldenburg, Oldenburg, Germany

Dynamic of the Genetic Structure Indicates Post-Settlement Selection

While ocean currents are a major force in larval dispersal, retention to natal reefs is far greater than predicted by advection models. Previous mark-recapture studies and

assignment tests show for different species that up to 60 % of larvae return to natal reefs. Considerable effort has focused on understanding retention mechanisms and sensory based orientation. While self recruitment is evident such recruitment rates can not explain genetic differences among reef fish populations. 40 % of "misdirected" larvae should result in genetic panmixia of populations at different reefs. For 6 consecutive years, we compared with microsatellite markers the genetic structure of different developmental stages of cardinalfish, *Ostorhynchus doederleini*, at 5 different reefs of the Capricorn Bunker Group (Great Barrier Reef, Australia) at a geographical scale from 3 to 23 km We used new calculations of genetic diversity to account for highly polymorphic microsatellite markers. The results show that genetic structure can change significantly between years disappearing in one year and emerging again in the following year. Such a rapid reconstitution of the former genetic structure can be explained by post settlement selection leading to different mortality of larvae and subadults. In order to test this, we collected *O. doederleini* of different age stages at 4 different reefs and conducted different behavioral experiments. Our results indicate that differential aggressive behavior of adults might select against foreign, genetically dissimilar larvae and result in differential mortality of settling larvae from different origin.

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97 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Eric Gangloff, Jennifer Gagliardi-Seeley

Metropolitan State College of Denver, Denver, CO, United States

Variation in Body Mass Index in a Colorado Population of Ornate Box Turtles (*Terrapene ornata ornata*)

The demographics and life history of the ornate box turtle (*T. o. ornata*) have yet to be studied in Colorado. To provide comparison with other populations and to inform land management questions, morphometric data were collected for two seasons in a population of *T. o. ornata* on the sandhills of eastern Colorado (n = 84). Ratios of mass to calculated volume, or body mass index, were compared between males and females and between years. A significant difference was found between mean body mass index for females in 2007 and females in 2008, while males did not demonstrate such a difference. This difference is most likely due to variation in egg development and reproductive output in females, possibly as a result of environmental factors and resource availability. Continued studies will provide more data to address these and other questions of box turtle ecology.

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380 General Ichthyology I, Pavilion East, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Aaron Geheber

Southeastern Louisiana University, Hammond, LA, United States

The Fish Community of the Pearl River: A Historical Test of Community Persistence and Stability

The Pearl River is a Gulf Coastal drainage located in Mississippi and Louisiana, harboring approximately 119 species of freshwater fishes. Multiple environmental perturbations have occurred throughout the basin including river impoundments, stream channelization events, and poor land-use practices. Historically, quarterly surveys were conducted by Royal Suttkus at selected historically sampled sites from Monticello, Mississippi (Upper Pearl River survey: 8 sites) southward to Bogalusa, Louisiana (Lower Pearl River survey: 8 sites). Since 2006, I have continued gathering data from these historic sites using the same methodologies employed during the historical surveys. The combination of these data sets (contemporary and historical) allows for a thorough examination of fish community changes in the Pearl River, as related to temporal and spatial variation. Therefore, the objective of this study was to assess persistence and community stability of fish assemblages of the Pearl River over the past 20 years (1988-2009). This data was analyzed using univariate and multivariate statistical analyses, including multi-dimensional scaling and regression models. A decline in species abundances as well as species richness was detected over the 20 year period, specifically due to a decrease in the presence of benthic species. It is speculated that this lack of stability and persistence in the fish community may be due to the instability of the river channel.

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406 AES Physiology, Galleria South, Sunday 26 July 2009

James Gelsleichter[1], Nancy Szabo[2], Chris Fulcher[1]

[1]University of North Florida, Jacksonville, FL, United States, [2]University of Florida, Gainesville, FL, United States

Toxicity of Polychlorinated Biphenyls in Atlantic and Gulf Populations of Juvenile Sharks

Polychlorinated biphenyls (PCBs) are persistent organic compounds used as coolants in various products including electrical transformers, but have been banned since the 1970s due to toxic effects. PCBs tend to persist in marine environments, and recent studies have demonstrated elevated concentrations of total PCBs in juvenile sandbar and blacktip sharks from the U.S. Atlantic coast. Since some PCBs are far more toxic than

others, the purpose of this study was to compare the toxicity of PCB congeners in sharks from these locations and less contaminated sites on the U.S. Gulf coast. Emphasis was placed on six of the most toxic PCB congeners, for which health effects have been well characterized. Liver concentrations of these compounds were used to calculate the Toxic Equivalence Quotient, a standard measure of pollutant toxicity. TEQ values indicated that Atlantic sharks are exposed to higher amounts of toxic pollutants, but the levels observed are low compared to earlier studies.

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164 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Gary Gerald[1], Jennifer Purrenhage[2]

[1]Nebraska Wesleyan University, Lincoln, NE, United States, [2]University of New Hampshire, Durham, NH, United States

Phenotypic Plasticity in Pond-breeding Amphibians Resulting from Differences in Larval Habitats

Phenotypic plasticity in metamorphic traits has been observed in several species of amphibians. Plastic metamorphic responses have been shown to be due to both biotic (e.g., predator cues) and abiotic factors (e.g., pond hydroperiod, canopy cover). Physical attributes of the larval environment may also have latent effects on plastic phenotypes in subsequent life stages. For juvenile pond-breeding amphibians, terrestrial locomotor ability is an important trait because juveniles must typically disperse overland from their natal pond to suitable terrestrial habitat. Differences in the larval environment could alter the developing physiological capabilities that underlie locomotor ability. We raised toad (*Bufo americanus*) and salamander (*Ambystoma maculatum*) larvae in outdoor pond mesocosms designed to simulate open- and closed-canopy pond habitats, and examined both metamorphic traits and post metamorphic locomotor performance. Toads raised in closed-canopy ponds were larger at metamorphosis and had a greater probability of survival to metamorphosis than those raised in open-canopy ponds. Toads exhibited a size-mediated trade-off between speed and endurance, such that small toads were slower but had better endurance relative to large toads. Moreover, after correcting for the influence of body size, toads from open-canopy ponds still exhibited better endurance ability than those from closed-canopy ponds. Though salamanders from open-canopy habitats were larger than those from closed-canopy habitats, they did not exhibit a trade-off between speed and endurance. Our results suggest that pond habitat type can affect not only fitness-related metamorphic traits of pond-breeding amphibians, but also the potential ability of juveniles to disperse to suitable terrestrial habitat.

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113 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

David J. Germano[1], R. Bruce Bury[2]

[1]California State University, Bakersfield, Bakersfield, CA, United States, [2]U.S. Geological Survey, Corvallis, OR, United States

Growth, Population Structure, and Reproduction of the Western Pond Turtle Across Its Range

Western pond turtles (*Actinemys marmorata*) occur from Washington to Baja California in virtually all aquatic habitats from sea level to about 5500 feet in elevation. Since 1993, we have caught approximately 2,500 turtles at 24 sites across the species range from the mountains just south of the San Joaquin Valley in California through southern Oregon. We found that large turtles dominate at most sites, but that this is not indicative of old adults. At most sites, 50-60% of turtles are < 10 years old and, at some sites, 20-30% of turtles are ≤ 3 years old. Proportions of large, yet young, turtles are greater in the southern part of the range than in the north. Whereas it can take 6-10 years to reach 120 mm carapace length in the northern part of the range, turtles at several sites in the San Joaquin Valley can reach this size in 2-3 years. However, habitat can modify these growth rates with turtles generally growing faster in shallow, still waters than flowing waters. The smallest clutch sizes (4.5-6.5 eggs) are in central coastal and southern California and higher towards the north. The highest average clutch sizes appear to be in the San Joaquin Valley (7.0-8.5 eggs), but additional data are needed from the northern part of the range. Females can have multiple clutches per year, but is currently not well defined rangewide. Much of the population ecology of western pond turtles is influenced by latitudinal variation, but habitat differences affect these trends.

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29 General Herpetology, Galleria South, Sunday 26 July 2009

Marina Gerson

California State University, Stanislaus, Turlock, CA, United States

Different Strokes for Different Folks: Signaling Behavior and Caudal Traits in Two Populations of Zebra-tailed Lizards (*Callisaurus draconoides*)

Lizards use visual signals in diverse circumstances, including conspecific interactions and antipredator defense. At least four hypotheses have been proposed to explain the tail-wagging display of the zebra-tailed lizard (*Callisaurus draconoides*). I performed behavioral trials and collected morphological data from populations in Turtle Mountains, California and at Pyramid Lake, Nevada. The data reveal differences in the two populations: compared to Pyramid Lake lizards, Turtle Mountains lizards showed a) greater likelihood of display at the approach of an observer ($\chi^2 = 17.14$, $p<0.001$), b)

greater likelihood of display after flight (χ^2 = 10.10, $p<0.006$), c) quicker response to the approach ($t_{stat(1,43)}$ = 6.68, $p<0.001$), and d) longer tails relative to body length ($t_{stat(1, 180)}$ = 15.69, $p<0.001$). These differences suggest that tail traits are related to different selective pressures in the two populations. I propose that the function of the tail-wagging display may be one of pursuit deterrence in the Turtle Mountains population, or at the very least an antipredator response, as has been suggested in the literature. At Pyramid Lake, the tail-wagging display was frequently observed but only rarely in response to the observer's approach; this suggests that tail-wagging serves a different function in this population. As lizard density varies dramatically between the two sites (1.3/1000 m^2 at Turtle Mountains versus 32.7/1000 m^2 at Pyramid Lake), the selective pressures of predation risk and competition may well vary in relative importance for the two populations. Further study may elucidate the function of the display at Pyramid Lake.

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28 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Marina Gerson, Nelson Membreno

California State University, Stanislaus, Turlock, CA, United States

Protected and Managed: a Viable Population of Blainville's Coast Horned Lizard (*Phrynosoma blainvillii*) in the Great Central Valley of California

Horned lizards (*Phrynosoma* spp.) are in decline throughout their ranges, as a result of habitat loss, human encroachment, and the introduction of non-native ant species. There is little documentation of the historic ranges of these lizards in the Great Central Valley of California. Over the course of 17 visits in 2009, we found a viable, age-structured population of *Phrynosoma blainvillii* on the Arena Plains Unit of U.S. Fish and Wildlife Service's Merced Wildlife Area. The lizards were found exclusively on sand dune habitats where grasses were limited or absent, and the primary months for surface activity were March (adults) and October (neonates). Of the 46 individuals observed, 15 were fitted with RFID tags for future monitoring. As a result of this work, refuge managers plan a managed burn on an additional dune in March 2009, with the aim of removing non-native grasses and opening up further habitat for horned lizards. This project continues through 2009, with an additional monitoring component.

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401 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Cameron Ghalambor[1], Jeffrey Walker[2], Corey Handelsman[1], Julian Torres-Dowdall[1], Meribeth Huizinga[1], Brian Langerhans[3], David Reznick[4]

[1]Colorado State University, Fort Collins, CO, United States, [2]University of Southern Maine, Portland, ME, United States, [3]University of Oklahoma, Kingston, OK, United States, [4]University of California, Riverside, CA, United States

Patterns of Divergence in Body Shape and Swimming Performance in Live-bearing Fish: A Model for Investigating Trade-offs in Adaptive Evolution

Understanding the relationship between form and function is a general problem in biology. Divergent selection pressures that favor different forms or functions in different environments can lead to local adaptation and specialization because of functional trade-offs in performance. The evolution of body shape and swimming performance in livebearers provides a model system for investigating such trade-offs because of the diversity of environments livebearers occupy and some of the unique challenges they face. In addition to the same challenges faced by egg-layers, female livebearers must cope with the hydrodynamic burdens of pregnancy, while males must cope with an exaggerated anal fin (the gonopodium) that is a requisite for sperm transfer. Here we review patterns of divergence in body shape and swimming performance in response to different predator communities and flow regimes. In addition, we show how these patterns of divergence are potentially constrained in females by differences in reproductive allocation, and in males by gonopodial length. While such trade-offs have been suspected of playing an important role in adaptive evolution, the growing body of empirical work on livebearers has the potential to quantify such constraints in nature.

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398 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Megan Gibbons[1], Karen Warkentin[1], Jennifer Stynoski[1]

[1]Birmingham-Southern College, Birmingham, AL, United States, [2]Boston University, Boston, MA, United States, [3]University of Miami, Miami, FL, United States

Hatching Time and Genetics Affect Behavior and Development in the Red-eyed Treefrog (*Agalychnis callidryas*)

For species with complex life cycles, transitions between life stages result in niche shifts that are often associated with fitness trade-offs. When conditions across life stages are unpredictable, plasticity in niche shift timing may be adaptive. The red-eyed treefrog (*Agalychnis callidryas*) exhibits natural flexibility in the hatching time of embryos. Short term fitness trade-offs in this species are well-studied; however, how genetic variation impacts these trade-offs is unclear. We evaluated the effects of hatching time, and

maternal and paternal (i.e., genetic) effects on behavioral responses of tadpoles to chemical cues from an odonate predator (activity level and depth in the water column at 21 d after oviposition). We also investigated how these factors influenced total length of tadpoles at 21 d, larval period, and mass and jumping ability of metamorphs. At 21 d, early-hatched tadpoles were slightly but significantly larger than late-hatched tadpoles. In the behavioral test, although tadpoles were less active in the predator condition, early-hatched tadpoles were more often found closer to the bottom than late-hatched tadpoles, and varied more in their depth in the water column. Hatching age did not influence larval period, mass at metamorphosis, or jumping ability. Behavioral and developmental traits were strongly influenced by both maternal and paternal identity, with a significant maternal x paternal interaction for tadpole total length and for jumping ability of metamorphs. Partitioning the relative contributions of environmental, maternal, and genetic factors to variation in phenotypes and fitness components is an important step in understanding the evolution of life-history strategies.

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666 Fish Ecology I, Pavilion East, Friday 24 July 2009

Melissa Gibbs, Mary Sheldon Boney, Kirsten Work

Stetson University, DeLand, FL, United States

The Effects of Herbivory by *Pterygoplichthys disjunctivus* on the Ecology of a Freshwater Spring

Pterygoplichthys disjunctivus (*Loricariidae*) is an exotic, invasive species that has populated Volusia Blue Spring for ten years, during which time its population density has skyrocketed. We explored the impact that *P. disjunctivus* has on the overall ecology of the spring by performing a diet analysis, measuring nutrient leaching from fecal material, and monitoring interactions with the endangered Florida Manatee. We found that although catfish diet varies throughout the year with changes in available agal species, one species (*Eunotia*) consistently predominates. The large amount of fecal material catfish egest daily is only slightly processed, and leaches nutrients into a spring run that already has elevated nitrate levels from anthropogenic sources. Finally, catfish grazing on algae growing on manatees has significantly elevated manatee activity levels and changed their behavior during a time when manatees are using the spring run as a wintertime thermal refuge.

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434 Herp Ecology, Galleria North, Monday 27 July 2009

Matthew E. Gifford, Kenneth H. Kozak

University of Minnesota, St. Paul, MN, United States

Competition, Physiological Limitation, and the Impact of Climate Change on the Distribution and Abundance of Montane Salamanders

Species' responses to climate change will depend on both the ability of organisms to physiologically tolerate warming temperatures and on the competitive environment of local communities. Appalachian salamanders in the *Plethodon glutinosus* and *P. jordani* species complexes have served as textbook examples of the influence of interspecific competition on the elevational zonation of species distributions. However, relatively little attention has been focused on understanding how physiological limitations might contribute to species turnover along elevational gradients. This study combines laboratory measures thermal physiology with bioenergetic models to predict the abundance of two salamander species (*Plethodon jordani* and *P. teyahalee*) along elevation gradients in the southern Appalachian Mountains. The extent to which interspecific competition and physiological limitation influence the elevational distributions of *P. jordani* and *P. teyahalee* are evaluated by fitting nested bioenergetic models to observed field estimates of salamander abundance (one model assumes no interspecific competition and a second model incorporates published estimates of competition coefficients). Our results suggest that both interspecific competition and physiological limitations contribute the elevational replacement of these species. We also evaluate the potential impact of climate change on this parapatric species pair using the best-fit bioenergetic model identified above. This approach allows us to consider the potential joint impact of both direct and indirect effects of climate change on species distributions.

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294 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Jenny Giles[1], Jennifer Ovenden[2], Cynthia Riginos[1]

[1]School of Integrative Biology, University of Queensland, Brisbane, Queensland, Australia, [2]Queensland Department of Primary Industries and Fisheries, Brisbane, Queensland, Australia

Phylogeography of Indo-West Pacific Sharks and Rays, with Applications to Monitoring the International Shark Fin Trade

The Indo-West Pacific region has the most diverse shark and ray fauna and highest shark and ray harvest globally, yet phylogeographic studies of species exploited across this region are lacking. This study describes mtDNA population structure for a number

of phylogenetically representative, co-distributed tropical Indo-West Pacific shark and ray species. This multispecies approach will allow us to identify shared barriers to dispersal and compare patterns of population structure among species with differing dispersal potentials. In the second part of this study, these phylogeographic data will be used as the basis for a method to assign likely Indo-West Pacific population origin to dried shark and ray fins for selected species. Identifying the population origin of dried fins in international trade has the potential to provide much-needed species-specific and population-specific data for managing shark and ray species with marketable fins. This study aims to contribute both important regional-scale data on the connectivity of selected species of sharks and large batoids, and viable forensic tools for on-going shark fin trade monitoring in the region.

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441 Poster Session I, Exhibit Hall, Friday 24 July 2009

James Gillingham[1], David Clark[2]

[1]Central Michigan University, Mt. Pleasant, MI, United States, [2]Alma College, Alma, MI, United States

Studs and Duds - Mating Success and Dorsal Spine Reflectance in the Tuatara, *Sphenodon punctatus*

The Tuatara (*Sphenodon punctatus*) has been the subject of recent natural field studies on its reproductive biology and fitness. Detailed observations of courting males in the field allow for individuals to be categorized as either successful or unsuccessful. Successful (stud) males were those showing 2 or more matings per season while unsuccessful (dud) males were those showing 0-1 matings per season. Although previous studies have shown that size and mass seem to be correlated with male mating success, other possible morphological correlates have not been made. Male tuatara tend to exhibit sexual dimorphism in several ways, including larger and more numerous dorsal and nuchal spines than seen in females. We measured total reflectivity (320 - 700 nm) of the dorsal and nuchal spines, as well as number and total spine area in males from both categories of mating success. Additionally, reflectivity, including the ultraviolet, was measured at several other sites on the bodies of these same males. Males showing higher mating success showed both greater spine reflectivity and area when compared to less successful males. Successful males also showed significantly greater ultraviolet reflectivity at other points on their bodies as well. Female tuatara may be able to evaluate male fitness based in part on these characters.

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43 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Xavier Glaudas[1], Stephen Goldberg[2], Bryan Hamilton[3]

[1]University of Nevada, Las Vegas, NV, United States, [2]Whittier College, Whittier, CA, United States, [3]Brigham Young University, Provo, UT, United States

Timing of Reproduction of a Cold Desert Viperid Snake from North America, the Great Basin Rattlesnake (*Crotalus lutosus*)

The reliance of reptiles on the physical environment to regulate body temperature has important implications for the ecology and evolution of these organisms, because most developmental, physiological, and behavioral processes are temperature-dependent. For example, variation in environmental temperatures can affect many reproductive traits, including the timing and frequency of reproduction. Exposure to varying environmental conditions has consequently favored the evolution of a broad array of reproductive strategies in reptiles. The Great Basin rattlesnake (*Crotalus lutosus*) is the only rattlesnake that widely occurs in a cold desert, the Great Basin Desert. As a high elevation desert, this region is arid, cold, and experiences a short growing season. In this study, we examined preserved specimens of the Great Basin rattlesnake (*Crotalus lutosus*) to characterize the reproductive ecology of this rattlesnake. Females started vitellogenesis in late spring/early summer, and ovulated in the summer of the next year. This contrasts with the female reproductive cycle of other rattlesnake species from warmer regions of North America, which typically initiate vitellogenesis in summer/fall, and ovulate in late spring of the next year. On the other hand, the reproductive cycle of male *C. lutosus* conformed well to those described for other rattlesnakes; that is, testes were active in summer. The sexual segments of the kidneys of males were hypertrophied in summer, suggesting a unimodal summer mating season. Our findings suggests that the relatively short active season (i.e. 4-5 months) experienced by these snakes in the Great Basin translates into a lengthened reproductive cycle in female *C. lutosus*.

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42 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Brad M. Glorioso[1], J. Hardin Waddle[2], Stephen P. Faulkner[2]

[1]IAP World Services, Inc., U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, United States, [2]U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, United States

Anuran Site Occupancy as an Indicator of Conservation Benefits of the Wetlands Reserve Program

The Conservation Effects Assessment Project for wetlands (CEAP-Wetlands) is one of several assessments evaluating the conservation benefits of the USDA Wetlands Reserve

Program (WRP). The WRP is a voluntary program that encourages landowners to restore and protect wetlands on private property previously used for agriculture. We used anurans as an indicator to assess the conservation benefits of the WRP. Amphibians are excellent ecological indicators in wetlands as they have a life-history tied to water and permeable skin sensitive to environmental contaminants. Anurans were sampled from 30 WRP sites and 20 nearby agricultural sites in the Lower Mississippi Valley. Although the two land use categories had the same species richness, there were clear differences in the count of individual anurans observed by land use. Site occupancy modeling indicated that six species had a higher probability of occurrence in WRPs relative to agricultural sites. Some of the largest differences in probability of occurrences were seen in highly aquatic species such as *Acris crepitans*, *Lithobates catesbeianus* and *L. clamitans*. Two species, *Anaxyrus fowleri* and *Gastrophryne carolinensis*, showed no difference in probability of occurrence in WRP and agriculture sites. Anuran occupancy is suited as an indicator of the conservation benefits of WRP because it is robust to variation in the observation process (i.e. imperfect detection) and provides a useful metric for comparison across sites.

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621 Poster Session I, Exhibit Hall, Friday 24 July 2009

Enrique Godinez-Dominguez[1], Carmen Franco-Gordo[1], Jorge A. Rojo-Vazquez[1], Beatriz Garcia-Calvo[2], Cristina Bernardez[1], Anatoly Filonov[1], Irina Tereshchenko[1], Daniel Kosonoy[1], Angel Hinojosa[1], Juan Freire[2]

[1]Universidad de Guadalajara, Jalisco, Mexico, [2]Universidade da Coruña, Galicia, Spain

Tidal Transport and Moon Phase Effect in the Spatial Distribution of the Fish Larvae Assemblage in a Tropical Estuary of Mexican Central Pacific

Estuaries and shallow marine areas in tropical latitudes are important nursery habitats for many species which spawn at the open waters and also for resident species which complete their entire life cycle within estuarine habitats. Tidal currents are the mayor mean of entry for young larvae. The main goal of this survey is determine the spatial distribution of fish larvae assemblage during the moon phase and tide in the two main hydroclimatic seasons (North equatorial Countercurrent -rain season-, and California Current influence) of the year. A 3-D circulation model (Hamsom-model) of the estuary was fitted to determine the influence of the transport in the spatial larvae distribution. The biological-physical coupling that control de biological productivity in marine and coastal ecosystem, produce an increase of the primary and secondary production when upwelling processes (California Current period) transport nutrients to surface waters, and most of the marine fish species has coupled their spawning periods to this season. Other estuarine affinity species have coupled their spawning season with freshwater inputs during the rain season, and these both patterns were observed in the larval assemblages surveyed. During the NECC period, the fish larvae abundance was related to moon phase and tide, and showed a clear spatial pattern, where the highest abundances were located in the sampling sites nearest to the mouth. During the CC

period, the tide and the moon phase were related to the fish larvae abundance. No spatial pattern was found.

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792 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Steven Godwin[1], Robert Hogg[2]

[1]Bureau of Land Management (BLM), Medford, OR, United States, [2]Southern Oregon University, Ashland, OR, United States

2008 Northwestern Pond Turtle Census, Capture and Marking in Southwestern Oregon

The Western pond turtle *Clemmys marmorata* is currently listed as a species of concern by the U.S. Fish and Wildlife Service, and the species is classified as Bureau Sensitive by the Bureau of Land Management (BLM). The BLM manages the Cascade-Siskiyou National Monument and has identified habitat with confirmed populations residing within the Jenny Creek Watershed. Visual surveys and mark-recapture efforts were last conducted in 1998, and to assess the current status of the sensitive species, three historic sites were revisited during a seven-week study through the summer of 2008. The "Jenny Power" site revealed a robust population with a strongly biased 3F:1M sex ratio. A majority of the sampled population was estimated to have recently attained sexual maturity, with a few juveniles approaching maturity, and the oldest adults estimated to be in the prime of their reproductive capabilities. Turtles were sparingly observed at the other two sites and trapping efforts produced no captures at these sites for continued mark-recapture monitoring. Low capture rates and the observed presence of the highly predacious invasive American bullfrog *Rana catesbeiana* present concerns for the continued success of the region's only native turtle, and despite the vigorous demographic population structure at "Jenny Power," continued monitoring remains warranted.

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951 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Scott Goetz[1], Alan Savitzky[1], Christopher Petersen[2]

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Effect of a Large Scale Natural Disturbance on the Movements and Behaviors of *Crotalus horridus* in Southeastern Virginia

Alteration of vegetative structure and canopy cover can affect the ecology of many ectotherms. We compared movements, behaviors and habitat selection in a population

of Canebrake Rattlesnakes, *Crotalus horridus*, in Chesapeake, VA, USA before and after the landfall of Hurricane Isabel in 2003. Radiotelemetry was used to track snakes over a period of 12 years, nine years prior to the hurricane and three years post-hurricane. Hurricane Isabel resulted in a 16% decrease in canopy cover at our study site. The site, which was not salvage-logged after the storm, consists of upland and lowland pine and deciduous forest intermixed with agricultural fields and clearcuts. Prior to the hurricane *C. horridus* often ventured into agricultural fields and anthropomorphic clearcuts, possibly due to a paucity of basking areas within the largely closed-canopy forest. Use of anthropogenic clearings may increase mortality in some regions. After the hurricane *C. horridus* appeared to shift their habitat preference from anthropogenic clearings to forest gaps as sites for shedding and courtship. The snakes also exhibited increased use of forest regions where canopy loss was greater than the study site mean. These results indicate that creation of artificial forest gaps may constitute a useful conservation strategy for improvement of habitat for *C. horridus*, which is critically imperiled in many regions.

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467 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Caren Goldberg, Lisette Waits

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Landscape Genetics of Columbia Spotted Frogs and Long-toed Salamanders in a Rural Landscape of Northern Idaho, USA

Dispersal movements of amphibians may be highly influenced by landscape features such as drainages and cover type, especially in drier landscapes. In the Palouse bioregion of northern Idaho, USA, 97% of natural wetlands have been destroyed or converted to agricultural uses. Columbia Spotted Frogs (*Rana luteiventris*) and Long-toed Salamanders (*Ambystoma macrodactylum*) in this area breed in small groups almost entirely in artificial ponds on private land. We used 8 microsatellite loci for each species to analyze to relationships among breeding populations of Columbia Spotted Frogs (N = 20) and Long-toed Salamanders (N = 26) located 0.5 - 19.3 km apart. Overall genetic variation among populations was moderate and similar for both species ($G_{ST}' \approx 0.31$). Genetic structure for both frogs and salamanders showed a pattern of isolation by distance that was better explained by topographically corrected straight line distances between populations than distance measured along drainages. For Columbia Spotted Frogs, populations at the tops of drainages showed lower connectivity than those located further downstream, as has been reported for high elevation populations of this species in relatively undisturbed landscapes. Frogs showed a pattern of higher relatedness within watersheds, while salamanders demonstrated the opposite pattern. For both species, the city of Moscow was associated with the highest genetic distances. For Columbia Spotted Frogs, agriculture and clearcuts provided the least resistance to movement, while for Long-toed Salamanders, connectivity among populations was high

in forested areas, despite steeper slopes. As urbanization expands in this landscape, additional connectivity will likely be lost among populations.

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531 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009

Emanuel Gonçalves[1], Rita Borges[2]

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Interannual Fluctuations in the Structure of Temperate Reef-Fish Larval Assemblages at the Arrábida Marine Park

Studies on the composition and temporal fluctuations of nearshore rocky reef fish larval assemblages are scarce, especially in temperate systems. Understanding those fluctuations and the causes of variation are however key to deepen our knowledge on the relationships between larval supply and recruitment. We investigate inter-annual variation on the composition of these assemblages at the extreme nearshore environment of the Arrábida Marine Park (Portugal). During the Spring and Summer periods of the years 2000, 2002, 2003 and 2008, larvae were collected close to reefs, using a plankton net attached to an underwater scooter for near-bottom samples. Sub-surface samples were collected with traditional plankton hauls (in 2003) and with the scooter (in 2008). The gobies Pomatoschistus pictus and *Gobius xanthocephalus* dominated the bottom assemblages in every year. However, the results show a clear inter-annual variation in the abundance of the most representative species in terms of a significant contribution to the assemblage structure: the labrid *Symphodus melops* in 2001 and 2002; *Boops boops* in 2001 and *Sardina pilchardus* in 2002; 2008 was the most distinct year, with a much lower abundance of gobies and the absence of labrids. Tripterygiids were better represented in 2003 and 2008. The surface samples in 2008 exhibited the highest abundance of this species. Results are discussed in relation to possible factors explaining these fluctuations; the low abundance values of some species in some years show that larval supply is not constant and that in these years a decrease in recruitment should be expected.

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554 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Thomas Gorman, Carola Haas

Virginia Tech, Blacksburg, VA, United States

Range-wide and Stream-level Scale Occupancy of *Rana okaloosae*

The current geographic range of the Florida Bog Frog (*Rana okaloosae*) is known to be restricted, and the majority of the range occurs on Eglin Air Force Base, Florida. Although the general range has been identified, the distribution of occupied sites within the range has a relatively large disjuncture that is not well understood. We conducted aural surveys of *R. okaloosae* three times/year from May-August, 2006-2008 along road and walking transect routes. These detection/non-detection data were used to estimate the probability of occupancy, colonization, and detection. Additionally, we related these population-level parameters to landscape characteristics at two different spatial scales, range-wide and stream-level, to understand how occupancy and colonization of *R. okaloosae* may be influenced by scale. At both scales, occupancy of *R. okaloosae* was predicted best by higher amounts of mixed forest wetlands at survey sites. At the stream-level scale, colonization was influenced by the number of years since last fire and detection was influenced by relative humidity and temperature. At both scales, occupancy of *R. okaloosae* was patchy, colonization was low, and detection was high. *Rana okaloosae* occurred in 3 watersheds, but one watershed appeared to be isolated and detections were infrequent. Conservation of *R. okaloosae* should focus on management of high quality habitat and enhance proximity or connectivity among sites to maximize efficiency of colonization of new and previously occupied sites. Further, using multiple survey techniques can likely improve population monitoring for anurans with both patchy and uniform distributions.

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100 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

John Govoni

NOAA/NOS/CCFHR, Beaufort, NC, United States

Feeding on Protists and Particulates by the Leptocephali of the Worm Eels *Myrophis* spp. (Lotken 1852) (Teleostei, Anguilliformes, Ophichthidae), and the Potential Energy Contribution of Large Aloricate Ciliates

The food sources of the leptocephali of the Order Anguilliformes have been controversial. Leptocephali of the worm eels, *Myrophis* spp. (family Ophichthidae), collected in the northern Gulf of Mexico had many large protists in their alimentary canals. Estimates of the physiological energetics of worm eels indicate that large aloricate ciliates, and other large protozoans could potentially provide appreciable energy to these leptocephali toward the end of the premetamorphic and metamorphic

stages. Aloricate ciliates and large protozoans can account for approximately 71% of the energy in the alimentary canal at any moment during the day or night. This contribution can be substantial, given the low energy requirements of metamorphosising leptocephali. Global ocean warming will likely force a shift in oceanic food webs. A shift away from large protozoans and ciliates toward smaller mixotrophic portozoans is possible. Dirsurption of these food webs could compromise survival of leptocephali.

1045 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Sean Graham[1], Leanne Sewell[1], Ryan Earley[2], Mary Mendonca[1]

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Endocrine/Immune Interactions During Reproduction in Snakes

There is widespread evolutionary conservation and convergence of mechanisms that control and influence reproduction throughout vertebrates. Snakes are excellent comparative models for evaluating the endocrine and immune interactions associated with reproduction since they exhibit a wide range of breeding systems and reproductive strategies. Very few studies have examined the immune system of snakes, although seasonal patterns, sex differences, and associations with steroid hormones have been described. Endocrine/immune interactions of viviparous squamates studied so far (e.g., *Chalcides ocellatus*) are similar to those documented for other vertebrates, however, species with less extensive placentation (viviparous lecithotrophy) have not been investigated thoroughly, and have not been investigated in a snake. We tested the hypothesis that an innate component of the immune system (complement activity) in pregnant cottonmouths (*Agkistrodon piscivorus*) would be less efficient than in non-pregnant individuals; complement and other aspects of innate immunity (e.g., inflammation) are consistently down-regulated in pregnant mammals, apparently to protect the developing fetus. We also sought relationships between complement bacterial killing capacity and reproductive hormones, consistent with the hypothesized regulatory role between these hormones and immune factors in mammals. Our results indicate that this innate immune system component is statistically less effective in pregnant female cottonmouths relative to non-pregnant cottonmouths. We found that the sex steroid progesterone has a statistical negative association with complement activity, suggesting a role for this hormone in the immune profile of these snakes during reproduction.

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980 Herp Systematics, Pavilion West, Thursday 23 July 2009

Taran Grant

Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS, Brazil

The Phylogeny of Chemical Defense in Poison Frogs (Anura: Dendrobatidae)

Alkaloid-based chemical defense is estimated to occur in more than 300 species of amphibians and to have evolved more 11 times. More than 800 alkaloids in 28 structural classes have been found in amphibians skin secretions, mostly in poison frogs of the family Dendrobatidae. Alkaloid profiles have been used in the taxonomy of this family for decades, and explicit phylogenetic analysis of alkaloids profiles may provide insights into the evolution of acquired chemical defense and a predictive framework for experimental and comparative studies. Although it is now understood that the occurrence of a particular alkaloid depends not only on the genetic ability of the species to sequester or modify that alkaloid but also the availability of alkaloid-containing prey in the environment, the same kind of problem afflicts all phenotypic characters and does not invalidate their phylogenetic analysis. Given the particulars of this system, alkaloid profiles were scored primarily at the level of structural classes and were treated as "any-instance." These characters were included with morphological, behavioral, and DNA sequence data in a total evidence phylogenetic analysis of dart-poison frogs and their relatives. As expected, alkaloid characters show extensive homoplasy, but several clades are delimited by unambiguously optimized alkaloid synapomorphies. Moreover, the parsimonious optimization of alkaloid characters allows the formulation of precise predictions to guide future research and lead to a better understanding of the evolution of this system of chemical defense.

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417 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

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Ranaviruses in Southern Appalachian Salamanders

Ranaviruses are a group of pathogens that have been linked to amphibian die-offs in North America and elsewhere. The first known die-off from ranaviruses in the Southern Appalachian Mountains occurred in the late 1990s in anurans and newts. However, to date, no studies have investigated the occurrence of ranaviruses in plethodontid salamanders, which is the most diverse group of salamanders in the region. Therefore, we collected samples (i.e., skin swabs and tail clips) from 174 salamanders of 13 species during April 2007 and 2008 from 3 sites that differed in elevation. In 2008, samples were

collected from 2 additional sites. Samples were tested for *Ranavirus* DNA using traditional and quantitative PCR. In 2007, 81% of individuals of 10 species tested positive for *Ranavirus* infection, and the likelihood of infection increased with decreasing elevation. In 2008, 14% of 6 species tested positive and no relationship with elevation was evident, suggesting possible annual and spatial variation in *Ranavirus* prevalence or species susceptibility. In 2007, a sequenced 500-bp region of the virus major capsid protein for 4 infected plethodontid species showed distinct protein sequence differences from known *Ranavirus* species, suggesting the possibility that an un-described *Ranavirus* may be present in the Southern Appalachians. Given ranaviruses can cause catastrophic die-offs in amphibian populations and they are classified as a notifiable disease by the World Organization for Animal Health, surveillance of this pathogen should be expanded in the Southern Appalachians and perhaps elsewhere.

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33 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

David M. Green

McGill University, Montreal, Quebec, Canada

Body Size Variation and Size-assortative Mating in Anurans

Size-assortative mating, suggesting sexual selection, competition and/or mate choice on the basis of body size, has frequently been reported among anuran amphibians. Body size itself, though, has profound evolutionary and ecological importance and is subject to many physiological and environmental influences. Over a span of 20 years, the mean body size of individuals of both sexes in a population of Fowler's toad (*Bufo* [*Anaxyrus*] *fowleri*) has fluctuated significantly and synchronously. When the body sizes of males and females in 74 mated pairs were compared, there was a significant, positive correlation ($p < 0.001$). However, this apparently strong evidence of size-assortative mating was negated once the year-to-year fluctuations in mean body size, based on body-size measurements of 3,426 adult toads, were taken into account ($p > 0.900$). Meta-analysis of all published studies reporting sizes of individual male and female frogs and toads in mated pairs revealed strong evidence that the practise of pooling data across multiple breeding seasons tends strongly to yield positive correlations suggestive of size-assortative mating whereas single-season data generally do not. Negative results are also significantly underreported. Thus the evidence for size-assortative mating among anuran amphibians is weak at best whereas body-variation from year to year within populations appears to be pervasive and under-appreciated. Short-term data sets for any species should not a priori be considered typical when studying any character demonstrating appreciable temporal variance.

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675 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Katherine Greenwald

Ohio State University, Columbus, OH, United States

The Effect of Landscape on Population Size, Isolation, and Persistence in Ambystomatid Salamanders

Understanding the effect of landscape on amphibian population size and persistence is critical given ongoing habitat loss and global declines in amphibian populations. I use landscape and genetic data from two ambysomatid salamander species in three regions to address the following questions: (1) What spatial scale best describes genetic estimates of local population size and isolation? (2) Do groups of local populations constitute metapopulations? (3) How do population viability predictions change when dispersal estimates are based on real-world data as opposed to a general dispersal-distance function? The importance of spatial scale varies with species, as population size and isolation are best described by forest within 300 m of the pond for marbled salamanders (*Ambystoma opacum*), but best described by total forest patch area for spotted salamanders (*Ambystoma maculatum*). The local populations do appear to function as metapopulations, as no individual population is large enough to ensure long-term persistence. Models parameterized with a dispersal-distance function resulted in much more optimistic predictions than those incorporating real-world dispersal data in the form of genetic assignment tests. Under the dispersal-distance function scenario, all local populations persisted. However, basing dispersal estimates on genetic assignments revealed local populations at risk of extinction. Salamander populations in fragmented habitats must be managed on a metapopulation level, as no local populations persisted in the absence of immigration. Metapopulation models assuming dispersal-distance function dynamics should be interpreted with caution, as these functions may not accurately describe dispersal patterns in highly heterogeneous landscapes.

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991 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Katherine Greenwald[1], Jessica Wooten[2]

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Potential Adaptive Benefits of Kleptogenesis in Unisexual Ambystomatid Salamanders

Kleptogenesis is a new mode of reproduction recently described in ambystomatid salamanders. Unisexual (all-female) populations of salamanders are widely distributed

across eastern North America. These salamanders are generally triploid (three sets of chromosomes), but can be diploid, tetraploid and even pentaploid (two, four or five sets, respectively). The genome may be comprised of DNA from up to four "true" (bisexual) species: the Blue-spotted Salamander (*Ambystoma laterale*), Jefferson's Salamander (*A. jeffersonianum*), Smallmouth Salamander (*A. texanum*) and Tiger Salamander (*A. tigrinum*). This results in a large number of possible nuclear genomotypes (genome combinations) in the unisexuals. For example, an LJJ individual would be a triploid with one laterale genome and two jeffersonianum genomes, while an LJTTi individual would be a tetraploid with one genome from each bisexual species. Unisexuals require sperm from a co-occurring bisexual species to initiate reproduction; however, they can then either discard the sperm and reproduce asexually, or incorporate the sperm into the resulting zygotes. It is unknown what adaptive benefits are gained by this mode of reproduction, or what ecological impact it has on other *Ambystoma* species. We investigate niche divergence among the bisexual species involved in the hybrid complex, and ask whether unisexual females moving into new areas may be able to acquire complete genomes for their offspring that are already pre-adapted to local conditions.

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781 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Ericka Grey

University of South Dakota, Vermillion, SD, United States

Myological Investigation of Osteological Characters of Cypriniform Gill Arches

Ichthyological studies involving fish skeletal anatomy and phylogenetics have a rich history. It does not appear, however, that there is a corresponding body of research relating phylogenetically informative osteological characters with the associated musculature. One goal of my research is to compare a subset of osteological characters that I have collected, with the morphologists from the Cypriniform tree of life group, with the associated musculature from two families, Catostomidae and Cyprinidae, of Cypriniformes. The relationships of these families are disputed in the literature. Previous workers have assumed the monophyly of the ascending limb process, but differences in bone density, shape of the ascending limb, and extent of attachment, suggest that perhaps this is not monophyletic. I am investigating the potential extent of attachment of these muscles, including the retractor ceratobranchialis 5, retractor ceratobranchialis 5 externus, and retractor ceratobranchialis 5 transversus to test this assertion of homology. A second goal is to clarify the presence or absence of the rectus communis muscle in Cypriniformes. There are several inconsistencies in the data reported by previous workers, but the osteological features, such as the presence of a ventral process on hypobranchial 3, suggest that this muscle is present. This has been supported by a dissection of *Cyprinus carpio*. Dissections of additional cypriniform families are underway to determine the distribution of this muscle.

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573 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Churchill Grimes[1], Edward Houde[2], Daniel Margulies[3]

[1]Natioinal Marine Fisheries Service, Santa Cruz, CA, United States, [2]University of Maryland, Solomons, MD, United States, [3]Interamerican Tropical Tuna Commission, La Jolla, CA, United States

The Role of Oceanographic Features in the Reproductive Strategies of Some Scombrid Fishes

We use results on the distribution, abundance, trophic ecology and growth of several scombrid species, i.e., yellowfin and blackfin tuna, little tunny and king and Spanish mackerel from the U.S. south Atlantic and Gulf of Mexico and yellowfin tuna and Spanish mackerel from the Gulf of Panama in the Pacific Ocean to demonstrate that scombrid fishes have evolved to use oceanographic features at different spatial scales to assure reproductive success. Although adults of most species reside in relatively oligotrophic oceanic and coastal shelf pelagic environments, they spawn in oceanographic features such upwelling, estuarine plumes and frontal features where both physical and biological process concentrate resources and may confer a trophic advantage and promote feeding, growth and survival of larvae. However, oceanographic features also concentrate predators, so for this strategy to be evolutionarily stable the advantage of superior diet and faster growth must out weigh the disadvantage of greater predation risk.

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454 Snake Ecology, Pavilion East, Monday 27 July 2009

Patrick Gregory[1]

[1]University of Victoria, Victoria, British Columbia, Canada, and University of Kent, Canterbury, Kent, United Kingdom

Working Towards the *Natrix* Matrix: Growth Curves for Grass Snakes

Body size influences numerous aspects of an animal's ecology, including demographic traits such as age/size at maturity, reproductive output, and survivorship. Knowledge of growth rate is therefore essential for constructing population matrix models and determining sensitivity of population growth rate to variation in birth or death rates at different ages or sizes. I analyzed patterns of growth for a population of grass snakes (*Natrix natrix*) at a site in southeastern England, based on a small, "noisy" data set with significant outliers, and compared different ways of constructing growth curves. Grass snakes at this site are sexually dimorphic - females are larger than males and have relatively larger heads, but relatively shorter tails. Ontogenetic change in head size with

respect to body size is negatively allometric, but growth in tail length is isometric. Female grass snakes at this site mature at an SVL of about 600 mm, but size at maturity is not known for males. Body size in grass snakes varies geographically, perhaps reflecting variation in major prey, but anecdotal evidence suggests historical declines in maximum size. However, geographical and temporal comparisons of body size are potentially compromised by differences between methods of measurement and by sampling biases in the field.

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152 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Kevin Gribbins[1], David Sever[2], Stanley Trauth[3]

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The Ultrastructure of Spermiogenesis within the *Agkistrodon* Complex

Although much information exists detailing the morphology of the spermatozoa within squamates, few studies focus on the ultrastructural changes that occur during spermatogenesis. Furthermore, only one complete study (*Scincella lateralis*) describes the changes to spermatids within squamates during the entire process of spermiogenesis. Thus, the purpose of this study is to explore the steps of spermiogenesis within two species belonging to the *Agkistrodon* complex. *Agkistrodon piscivorus* and *A. contortrix* testicular tissues were collected from southeastern Louisiana and Arkansas during the spermatogenic months. Results show consistent similarities between the two species throughout most of spermiogenesis. As the spermatid begins to elongate, the manchette microtubules can be visualized and the chromatin fibers adopt a spiral configuration. However, Copperheads tend to have a much more developed manchette than Cottonmouths. The early acrosome complex and the flagella form in very similar ways within these two pitvipers. Nevertheless, there are also slight variations in the acrosome complex between these two crotalids later in spermiogenesis. The similarities seen during spermiogenesis in Copperheads and Cottonmouths (spiraling chromatin condensation, open distal nucleoplasm near the basal plate, more electron dense and striated subacrosomal space, perforatorium outside of the nuclear apex) are much different than that seen in the course of spermatid development in *S. lateralis*. Thus, these differences may be synapomorphies within the *Agkistrodon* complex and could be useful nontraditional morphological characters if future spermiogenic data is collected for other species within Ophidia and Squamata. These types of characters ultimately may help elucidate or strengthen phylogenetic relationships within squamates.

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882 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Jesse Grismer[1], Todd Jackman[1], Aaron Bauer[1], Kumthorn Thirakhupt[4], Anchalee Aowphol[4], L. Lee Grismer[2], Chan Kin Onn[3], Perry Wood Jr.[1]

[1]Villanova University, Villanova, PA, United States, [2]La Sierra University, Riverside, CA, United States, [3]Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia, [4]Chulalongkorn University, Bangkok, Thailand

Asexuality on the Beach: Phylogeny, Biogeography and the Origin of Parthenogenesis in *Leiolepis*

The Indochinese lizard genus *Leiolepis* comprises four sexual species (*Leiolepis belliana*, *L. guttata*, *L. peguensis*, and *L. reevesii*) and three asexual species (*Leiolepis boehmei*, *L. guentherpetersi*, and *L. triploida*) that collectively range from China, Vietnam, Laos, Cambodia, Myanmar, and Thailand southward through Peninsular Malaysia. The taxonomy has long been problematic due to the high degree of intraspecific variation among the more widespread taxa, and species boundaries remain contentious. No explicit species-level phylogenetic hypothesis has yet been proposed for *Leiolepis*. We investigated evolutionary relationships within *Leiolepis* using nuclear (KIF-24 and Kiaa 2018) and mitochondrial genes (ND2). The nuclear gene trees reflect incomplete lineage sorting, but agree with the mitochondrial data in recovering *L. guttata* as the basal lineage in the genus, with *Leiolepis belliana* and *L. reevesi* actually representing a single, wide-ranging species. Typical "*belliana*" and "*reevesi*" forms grade into one another, both morphologically and genetically, in southern Cambodia, and the morphologically distinct Myanmar species, *Leiolepis peguensis* appears to be a derivative of this wide-ranging lineage. Asexuality in *Leiolepis* has arisen three times via hybridization that may have been facilitated by secondary contacts created by changing sea levels during the last glacial maximum. Our results confirm as *L. guttata* is the maternal ancestor of *L. guentherpetersi* and recovers *L. reevesi* from Southern Vietnam as the maternal lineage of *L. triploida*. Different analytical approaches yield conflicting phylogenetic results within *Leiolepis*. This is probably due to the effects of long branch attraction on root placement.

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308 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009

Eileen D. Grogan[1], Richard Lund[2]

[1]Saint Joseph's University, Philadelphia, PA, United States, [2]Carnegie Museum, Pittsburgh, PA, United States

Live Birth and Superfetation in a 318 Million Years Old Carboniferous Chondrichthyan

Extant chondrichthyans are represented by sharks, skates and rays (Subclass Elasmbranchii) and chimaeras (Subclass Holocephali) and are the descendants of a long and more diverse lineage extending from the Paleozoic Era (542-251million years ago). All are characterized, in part, by internal fertilization. Over their evolutionary history, oviparity (egg-laying) has traditionally been assumed to be the primitive birthing mode for these fishes and for vertebrates in general, with matrotrophic nutrition and viviparity being derived. Yet, newly emergent data, including that presented here, documents live birth in early gnathostomes. The fossilized remains of two specimens of *Harpagofututor volsellorhinus* from the Bear Gulch of Montana now provide the first direct evidence of live birth and superfetation in a Paleozoic chondrichthyan taxon. There is no evidence of yolk sacs. Analysis of the fetuses and soft tissue pigments of the female reproductive tract support matrophic nutrition. The new data confirm viviparity within Paleozoic holocephalan chondrichthyans and presents the first report of superfetation in an extinct fish. The reproductive strategy suggested for this taxon would have maximized the holocephalan's reproductive success in a tropical Paleozoic marine bay that was characterized by high faunal diversity and fine niche partitioning and subject to a seasonally-monsoonal climate.

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499 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009

Lu Guan[1], John Dower[1], Skip McKinnell[2]

[1]University of Victoria, Victoria, BC, Canada, [2]North Pacific Marine Science Organization (PICES), Sidney, BC, Canada

Quantifying Mesoscale Patterns Of Spatiotemporal Variability In The Ichthyoplankton Community Of The Strait Of Georgia

As part of the Canadian Healthy Oceans Network (CHONe) we are examining the ichthyoplankton community in the Strait of Georgia (British Columbia, Canada). Despite being an important nursery ground for numerous commercially valuable fish species, virtually nothing is known about patterns of larval dispersal in the Strait. More specifically, it is not known whether there exist distinctive dispersal corridors along

which larvae are advected from source to sink regions, or whether the Strait is better considered as a single regional pool in which larvae drift, unpredictably, before settling. Understanding which pattern best describes larval dynamics in the Strait is important for evaluating the effectiveness of existing protected areas, and for decisions about siting additional protected areas in the future. We initiated our study by examining previously unanalyzed data from a series of spatially intensive field surveys from 1979-1981. Using a GIS approach, we mapped the historical distribution of ichthyoplankton in the Strait to look for evidence of consistent spatial patterns through years (e.g. sources and sinks, hotspots). In general, it appears that larval abundance is typically higher in the southern Strait and closer to shore. This retrospective analysis was then used to guide the design of our 2009 spring survey, the preliminary results of which will also be presented.

1012 Fish Ecology I, Pavilion East, Friday 24 July 2009

George Guillen, Jenny Wrast, Dianna Ramirez

University of Houston Clear Lake, Environmental Institute of Houston, Houston, TX, United States

Freshwater Fish as Possible Sources of Indicator Bacteria in Urban Warmwater Coastal Streams

Many freshwater systems within the United States are classified as not supporting contact recreation uses based on elevated indicator bacteria levels. Indicator bacteria groups used in freshwater systems include *E. coli* bacteria. The use of indicator bacteria and their control is considered a central strategy in reducing risks from exposure to waterborne pathogens. *E. coli* indicator bacteria levels have been correlated with increased risks from waterborne diseases. It has been assumed that all indicator bacteria originate from warm-blooded organisms including humans and wildlife. The concentration of bacteria in water is assumed to be a function of loading from these sources and instream ambient conditions that affect their survival. Total Maximum Daily Load (TMDL) studies and subsequent implementation strategies have focused on identification and management of these sources of bacteria. However recent studies suggest that cold-blooded vertebrates such as reptiles may also represent a previously unknown source and/or transport pathway for indicator bacteria. Water quality managers may therefore need to re-evaluate estimates of loading and transport mechanisms. During 2008-09 we conducted studies to evaluate the potential loading of *E. coli* bacteria from various fish species into several freshwater urban streams within Houston, Texas. Our data suggest that some fish species may represent a significant pathway in *E. coli* transport. However, based on laboratory studies it is unlikely that fish are the original source of *E. coli* but rather an efficient transport vector. The implications of these findings in regards to water quality modeling and management are discussed.

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297 Poster Session I, Exhibit Hall, Friday 24 July 2009

Jenny Gubler, Kirsten Nicholson

Central Michigan University, Mount Pleasant, MI, United States

Range Extension, Genetic Variation, and Biogeography of *Anolis limifrons*

Anolis limifrons is a diminutive and slender lizard species typically found saltating in bushes or low-lying vegatation within 2 meters of the ground in moist rainforests. This species ranges from eastern Honduras continuously to eastern Panama but few if any records report its existance in the Darien province. Here we report on the collection of *Anolis limifrons* from two localities, one at the border of the Darien province, the other within the Darien province near the border with Colombia. We also report on genetic variation of *A. limifrons* throughout its range and find considerable variation and potential population segregation suggestive of cryptic speciation. We discuss the implications of our results to the biogeography of the species and test hypotheses proposed for the orgin and distribution of the *Norops* clade.

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141 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Nayeli Gurrola-Sanchez[1], Carlos Pedraza-Lara[3], Rodolfo Perez-Rodriguez[2], Gerardo Perez-Ponce de Leon[2], Ignacio Doadrio[3], Omar Dominguez-Dominguez[1]

[1]Universidad Michoacana de San Nicolas de Hidalgo, Morelia, Michoacan, Mexico, [2]Universidad Nacional Autónoma de Mexico, Mexico, DF, Mexico, [3]Museo Nacional de Ciencias Naturales, Madrid, Madrid, Spain

Compared Phylogeography of Drainages of Central Mexico Based on Codistrubuted Fish Species

Tectonic, volcanic and climatic events that produce changes in hydrographic systems are the main causes of diversification of freshwater fishes. The study of the evolutionary history of freshwater fishes permits to infer theories on the biotic and geological evolution of a region, which can further be applied to understand processes of population divergence, speciation and for conservation purposes. In Central Mexico, the freshwater ecosystems are characterized by their genesis, dynamism, destruction, and compartmentalization induced by intense geologic activity and climatic changes that occurred since the early Miocene. In this work we addressed the phylogeography of five codistributed groups of fishes in Central Mexico (Goodeidae family, *Ictalurus*, *Algansea*, *Notropis* and *Yuriria*), and describe the main historical biogeographic patterns of basins in Central Mexico in order to understand the processes that determine them in relation to the molecular clock hypothesis, and the geological events that have taken place in the region since the Miocene. The geological complexity, combined with the climatic history

of the past 15 million years, gave the freshwater fish biogeographic history a high degree of complexity, which is characterized by a taxon-pulse dynamic, in which dispersal, isolation and extinction events occurred in different spatial and temporal scales. Co-distributed species are not always affected in the same way when a common geological event determines, for instance, the connection between two water bodies, or the isolation or fragmentation of the original habitat.

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432 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Tristan Guttridge[1], Samuel Gruber[2], Jens Krause[1]

[1]University of Leeds, Leeds, United Kingdom, [2]Bimini Biological Field Station, Bimini, Bahamas

Refuging and Social Behavior of Free-ranging Juvenile Lemon Sharks, *Negaprion brevirostris* in a Tropical Lagoon

Group behaviours are widespread in sharks however comparatively little is known about the interactions between individuals and how these might shape the structure and organisation of groups. In this study 40 juvenile lemon sharks *Negaprion brevirostris* were monitored for a period of 24 months in two shallow water sites at Bimini, Bahamas. Sharks were externally marked with colour coded tags that enabled accurate visual identification of individuals in both solitary and social encounters, such as following, paralleling and circling. Scan sampling on 84 observation days was completed resulting in a data base of 8000 records. Group size ranged from 2-11 individuals with some individuals interacting regularly throughout the 24 month period. Group behaviours were related to environmental variables and assessed through the use of social network theory. This network approach provided a quantitative framework enabling the characterisation of social structure at both the individual and population level. Associative patterns were investigated for a number of shark attributes such as body length, sex and relatedness. This study offers an assessment of and insight into the social life of a predatory shark providing quantitative information on group behaviours of free-ranging sharks. Further, the application of the latest analysis techniques will enable these results to be interpreted and evaluated alongside studies of other animal groups.

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928 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Daniel Ha[1], Dean Grubbs[2], Charles Cotton[1], John Musick[1]

[1]Virginia Institute of Marine Science, Gloucester Point, VA, United States, [2]Florida State University Coastal and Marine Laboratory, St. Teresa, FL, United States

Shark CPUE Trends from Virginia's Atlantic Waters: Trends 1972-2008

In this study we use the Virginia Institute of Marine Science's shark long line survey data set to examine trends in catch per unit effort (cpue) of common species in the Virginia portion of the Mid-Atlantic Bight. This survey started in 1972, and continues to the present day, using the same bottom long line gear throughout. Data from 1972 to 2008 were analyzed with a Generalized Additive Model after being arc-sine root transformed. The results show that most large shark species in the survey (*Carcharhinus plumbeus*, *Carcharhinus obscurus*, *Carcharhinus limbatus*, *Galeocerdo cuvier*, and *Carcharias taurus*) have declined significantly in CPUE since the beginning of the survey. One species, *Carcharhinus brevipinna* has increased in abundance over the course of the study, and one species (*C. limbatus*) has shown clear signs of a recovery. The trends for management groups as defined by the National Oceanic and Atmospheric Administration also are significant, showing drastic declines early in the study. Only for a small species of shark, *Rhizprionodon terraenovae*, is the trend in CPUE equivocal over the course of this study. The most likely cause of the declines shown in this study is fishing mortality, although other factors are discussed.

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660 Poster Session I, Exhibit Hall, Friday 24 July 2009

S. Insley Haciski, Jacqueline F. Webb

University of Rhode Island, Kingston, RI, United States

Preliminary Observations on the Development of *Leucoraja erinacea* (Little Skate), with Reference to the Mechanosensory Lateral Line System

The development of the elasmobranch lateral line system has been studied in only a few species, with papers published just twice in the past century, and has not been studied in detail in batoids. The development of the little skate, *Leucoraja erinacea*, will be described as the basis for the study of the development of its lateral line system. Adult skates were maintained in tanks with recirculating seawater at 15-16°C. Eggs were candled and embryos were fixed in 10% formalin in PBS over several months (n=32). Other eggs, laid on known dates, were sampled periodically to begin to generate a detailed developmental series. Disc width (DW) and tail length scale positively with TL (n=38). Paired somites and tail bud were visible at 4.5 mm TL (14 days post-deposition [dpd]). Pharyngeal arches were visible at 9 mm TL (18 dpd). External gills were visible at 25 mm TL and were resorbed in a 73 mm TL specimen. Hyomandibular and scapular

lateral line canals were first visible in a 50 mm TL specimen with partially fused pectoral fins that remain caudal to the mouth until fusion is complete around 62 mm TL. A cleared and stained hatchling (93 mm TL, day of hatch) revealed what looks like a complete dorsal and ventral lateral line canal system. Further details of lateral line development will be studied using histological analysis and SEM to determine distribution of and ontogenetic trends in neuromast size and shape, and the timing and pattern of lateral line canal morphogenesis.

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30 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Greg Haenel

Elon University, Elon, NC, United States

Effect of Habitat Type on Clutch Size in a Wide Ranging Lizard, *Urosaurus ornatus*

Number and size of offspring are key ecological and evolutionary traits directly impacting both population growth and individual fitness. Optimality models predict that if selection acts to optimize offspring size, variation in total reproductive investment will be expressed largely through changes in offspring number. Variation in resource environment should therefore, manifest itself in part through differences in clutch size. This study compared clutch sizes among arboreal and saxicolous populations of Tree lizards, *Urosaurus ornatus*, to test how these different environments impact clutch size. Tree lizards should find greater ranges of microclimate and greater insect abundance among the leaves of trees as opposed to the more exposed rock surfaces, allowing greater allocation of resources to egg production. Clutch size was measured in 14 populations as part of a larger study (n=30 arboreal and n=36 saxicolous). Body condition (residuals of mass regressed on SVL) was significantly higher for male arboreal lizards. Clutch size varied significantly among populations. Females living on trees had significantly larger clutch sizes for a given body size than those living on rocks. In fact, average clutch size of arboreal females was larger than those living on rocks (mean number of eggs = 8.2 and 6.4 respectively) even though arboreal females did not tend to have greater overall SVLs. Habitat type plays an important role in clutch size variation among populations of Tree lizards. As tree distributions shifted due to past climate change, Tree lizard habitat use may have also changed impacting local lizard population growth through clutch size.

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492 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Bridgette E. Hagerty[1], Kenneth E. Nussear[2], Todd C. Esque[2], C. Richard Tracy[1]

[1]University of Nevada, Reno, Reno, NV, United States, [2]U.S. Geological Survey, Henderson, NV, United States

A Landscape Genetic Approach to Identifying Connectivity for the Mojave Desert Tortoise

Increasingly, changes in land-use and urbanization are fragmenting habitat for species, pushing landscape connectivity to the forefront of research in conservation biology. Heterogeneity in landscape features alters how organisms respond to, and move among, habitat patches. Therefore, a detailed understanding of landscape connectivity is important to determine the ecological and evolutionary processes leading to population differentiation. Geographic distance is a significant explanatory variable for genetic differences within the Mojave population of the desert tortoise. Here, we used a landscape genetics approach to evaluate deviation from this pattern, and we quantified landscape connectivity and genetic similarity for Mojave desert tortoises. We compared four statistical models of suitable habitat that could influence movement of tortoises through the landscape to a null model of movement of individuals through the habitat via a straight line. To determine structural connectivity, we used the "least cost path" and "isolation-by-resistance" models. These two models provide different perspectives on landscape connectivity; however, both models supported the hypothesis that topography can be more influential in shaping patterns of gene flow than geographic distance for tortoises. Life history characteristics of the desert tortoise influence gene flow, resulting in substantial time lags in the visible genetic patterns. Therefore, we could not detect the effects of habitat fragmentation using population genetics. Nevertheless, major highways and urban sprawl have ablated a majority of the habitat corridors potentially used by desert tortoises. We recommend management actions that are sensitive to the positive effects of restoring historic levels of gene flow among desert tortoise subpopulations.

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646 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Travis Hagey[1], Jonathan Losos[2], Luke Harmon[1]

[1]University of Idaho, Moscow, ID, United States, [2]Harvard University, Museum of Comparative Zoology, Cambridge, MA, United States

Cruise Foraging of Invasive Chameleon (*Chamaeleo jacksonii xantholophus*) in Hawai'i

We quantified the foraging behavior of the Jackson's chameleon (*Chamaeleo jacksonii xantholophus*), an invasive insectivorous lizard species in Hawai'i. Using video taken in the field, we measured chameleon foraging behavior, focusing on percent time moving, moves per minute, and movement speeds. Our results supported previous findings that chameleons are "cruise foragers" (sensu Butler, 2005), a foraging behavior unlike almost all other species of lizards.

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494 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Margaret Haines, C. Tristan Stayton

Bucknell University, Lewisburg, PA, United States

The Effect of Tail Length on Swimming Performance in the Dusky Salamander (*Desmognathus fuscus*): An Experimental Manipulation

Salamanders swim away from predators by undulating their tail and body. While the tail is visibly involved in aquatic locomotion, it is unclear what aspects of tail morphology are related to increased swimming performance. In addition to natural interspecific variation in tail length, individual salamanders may exhibit variation in tail length due to autotomy. Furthermore, tissue sampling in salamanders often involves tail clipping. Since tail length is variable over a salamander's lifetime, it is important to understand how tail length influences swimming performance in this species. We investigated the effect of tail length on maximum burst speed in 20 *Desmognathus fuscus*. Next, we removed a portion of the tail in half of the individuals and burst speed was measured immediately after clipping, 4 weeks later, and 12 weeks later. Prior to any experimental manipulation, those with relatively longer tails did not swim faster than those with shorter tails. When an average of 39% of the tail was removed, salamanders did not show a significant change in swim speed. This is consistent with previous work on lizards, which demonstrate that partial tail loss does not influence locomotor performance. Because burst speed is independent of tail length, we suggest that tail length is related to other aspects of survival.

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769 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Dominik Halas

University of Minnesota, St. Paul, MN, United States

A Multi-Gene Phylogeny of the *Notropis rubellus* species group: Patterns of Diversification in the Central Highlands of North America

The Central Highlands of North America (the Appalachian, Ozark, and Ouachita Mountains) have a complex biogeographical history, which has caused the region to have the highest diversity level of freshwater fishes outside of the tropics. Reconstructing this biogeographical history requires multiple well-supported phylogenies of widespread taxa. The *Notropis rubellus* species group is one such taxon, with a disjunct distribution in unglaciated regions of the Central Highlands and glaciated regions of the Central Lowlands. The group was once considered to be a single widespread species, but cytochrome b evidence revealed within it the presence of seven distinct species. The relationships among these species contain valuable information on the biogeographical history of the Central Highlands; however, basal relationships among them are poorly resolved. To obtain a better estimate of the relationships among the species, I have sequenced the first intron of the ribosomal S7 protein in multiple individuals from each clade. A phylogeny based on the S7 data shows considerable geographic structure. Several of the clades recovered from cytochrome b are also well-supported by S7; however, not all species identified using cytochrome b data form monophyletic groups in the S7 phylogeny, and the relationships among clades in the S7 data also differ. The variation between S7 and cytochrome b suggests that additional nuclear loci must be sequenced to fully resolve the basal relationships of the *Notropis rubellus* species group, and to determine the processes which have led to its spread and diversification throughout eastern North America.

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387 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Joshua Hale[1], Geoffrey Heard[3], Michael Kearney[2], Jane Melville[1]

[1]Museum Victoria, Melbourne, Victoria, Australia, [2]University of Melbourne, Melbourne, Victoria, Australia, [3]La Trobe University, Melbourne, Victoria, Australia

Population Genetics of the Growling Grass Frog, *Litoria raniformis*, in an Altered Landscape in South-eastern Australia

As habitat destruction and fragmentation has been implicated in many frog declines and extinctions worldwide, it is important that we understand how populations respond to these changes. This is of particular importance in urban environments where there may be a variety of different dispersal barriers. In this study, we have investigated the impact of human induced habitat fragmentation on the population genetic structure of the Growling Grass Frog, *Litoria raniformis*. Over the last 20 years, *L. raniformis*, has suffered significant declines in abundance and distribution throughout its range in south-eastern Australia, and is currently listed by the IUCN as endangered. The precise cause of this decline is unknown, however habitat fragmentation and destruction is likely to have been an important contributor. Population genetic structure was assessed from 12 ponds within the Merri Creek, which runs through the suburbs of Melbourne, using approximately 600bp of the mitochondrial gene COI, and 11 microsatellite loci. Relatively low levels of mtDNA haplotype diversity were observed throughout the Merri Creek. Gene flow was high between close populations (less than 1km), but restricted over longer distances. Further, urban and industrial development formed a significant barrier to dispersal. Understanding population genetic structure is essential for informing and directing conservation strategies for this iconic but under-studied endangered species.

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366 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kathryn Hale[1], Ross Alford[2], Lin Schwarzkopf[2]

[1]Eastern Illinois University, Charleston, IL, United States, [2]James Cook University, Townsville, QLD, Australia

Long-term Monitoring of Herpetofaunal Richness at Moorrinya National Park, Queensland, Australia

Documenting amphibian and reptilian diversity in protected habitats is necessary to guide management practices aimed at conserving these species. Long-term monitoring efforts can also reveal shifts in species richness within a habitat, such as might occur following colonization by non-native species. We surveyed the anurans and squamates at sites representing each of five habitat types within Moorrinya National Park (MNP),

Queensland. Surveys encompassed at least 1 week of each of 12 years at six sites, always in late autumn. Visual encounter surveys, pitfall trapping, and spotlighting were conducted at each site. A total of 63 species were sampled, of which 11 were frogs, 11 were snakes, and 41 were lizards. Scincidae was the dominant taxon overall, comprising over 26% of species. The majority skinks were in the genus *Ctenotus*. Pythons (*Aspidites* sp.) were the most common snakes observed, but snake richness was highest within Elapidae. Among anurans, *Litoria* was represented by the most species, whereas *Opisthodon* (*Limnodynastes*) was observed most consistently across all years. The frequency of capturing reptiles was greater than that for amphibians. Although cane toads (*Bufo marinus*) were present in 8 of 12 years at MNP, they were observed in only one of the last five years of our study, indicating that this invasive species experiences periodic population declines in this habitat. Monitoring efforts at MNP should be expanded to understand the population dynamics of this species, and its possible impacts on other species within the amphibian and reptile communities at this site.

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219 Snake Conservation, Pavilion West, Monday 27 July 2009

Brian Halstead, Glenn Wylie, Peter Coates, Michael Casazza

U.S. Geological Survey, Dixon, CA, United States

Factor Analysis as a Tool for Conserving the Giant Gartersnake

Resource managers often have little information regarding the habitat requirements and distribution of rare species. Factor analysis-based habitat suitability models can describe the ecological niche of a species and identify locations where these conditions occur on the landscape using existing occurrence data. We evaluated the use of factor analyses to assess habitats suitable for *Thamnophis gigas* (the Giant Gartersnake), a rare, threatened species precinctive to the Central Valley of California, and to map the locations of suitable habitat in the Sacramento Valley. Factor analyses indicated that the niche of *T. gigas* is composed of low elevation sites near wetlands, canals, and rice agriculture. In the Sacramento Valley, these sites are restricted to the central and southern portions of the valley. Based upon the results of the factor analyses, recovery planning for *T. gigas* will require an on-the-ground assessment of the current distribution and abundance of *T. gigas*, maintaining the few remaining natural wetlands and the practice of rice agriculture in the Sacramento Valley, and studying the effects of land use changes on *T. gigas* populations. Factor analyses are well suited for assisting with conservation planning for rare species about which little is known.

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715 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Paul Hampton

University of Louisiana at Lafayette, Lafayette, LA, United States

Interspecific Prey and Predator Feeding Performance in Natricines

An organism's feeding performance can have profound consequences on its ecology, behavior, and fitness. Feeding performance is dependent upon morphological and behavioral modifications of both predator and prey which can influence the costs required for successful consumption of prey. Although several studies have investigated feeding performance, few have involved both interspecific prey and predator comparisons. I am interested in the relationship between predator and prey morphologies and prey handling performance in natricines. Specifically, I am measuring the size and shape of predators and their prey, fish and frogs, and how these variables influence prey handling time and number of pterygoid walks. Preliminary results suggest differences in handling performance between prey species with frogs showing a higher cost of handling. Handling costs also appear to differ among predator species which is likely attributable to differences in feeding morphology. These results suggest that prey selection is correlated with feeding morphology and performance in natricines.

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708 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Paul Hampton, Brad Moon

University of Louisiana at Lafayette, Lafayette, LA, United States

Does Prey Envenomation Improve Digestive Performance in *Agkistrodon piscivorus*?

Pitviper venom is a combination of neurotoxins and proteolytic enzymes. It has been hypothesized that the tissue-destroying qualities of crotaline venom have evolved to enhance the digestion of large prey in cool environments, in which ingested prey may putrefy and kill the predator before digestion is completed. The results of previous experiments intended to test this hypothesis have been contradictory and inconclusive. Recently, a thorough study found no effects of venom on specific dynamic action or gut passage time. In the experiment relatively small prey were provided as meals with ambient temperature equal to or above preferred activity temperature for the species. When large prey are consumed and ambient temperatures are sub-optimal venom may significantly enhance prey digestion. We are studying the effects of pitviper venom on the post-prandial metabolic rate and gut passage time in cottonmouth snakes (*Agkistrodon piscivorus*) provided large meals at sub-optimal temperatures. Specifically,

we are measuring post-prandial oxygen consumption by the snakes after they have eaten rats injected with reconstituted lyophilized *A. piscivorus* venom (experimental animals) or injected with saline solution (control animals). Preliminary results suggest that envenomated prey are digested faster and may elicit a lower cost of digestion (specific dynamic action) than prey that are not envenomated.

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939 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Corey Handelsman, Sarah Fitzpatrick, Julian Torres Dowdall, Lisa Angeloni, Cameron Ghalambor

Colorado State University, Fort Collins, CO, United States

Morphological Responses to the Removal of Predation in the Trinidadian Guppy (*Poecilia reticulata*)

Spatial and temporal variation in predatory regimes is thought to be a mechanism of adaptive evolution and has been shown to yield predictable and repeatable phenotypes among populations. We hypothesized that local adaptation to either a low or high predation habitat would drive morphological divergence in the Trinidadian Guppy (*Poecilia reticulata*), representing fitness trade-offs between the respective environments. Thus, if the predator regime were altered, we would expect a phenotypic response based on a priori predictions of guppy morphology observed in wild populations that differ in predatory environments. We tested this hypothesis by marking and introducing the offspring of wild *P. reticulata* from high predation streams into two low predation streams in the Guanapo drainage in the Northern Range Mountains of Trinidad. Mark-recapture sampling was conducted monthly to assess changes in morphology, juvenile recruitment, and survivorship. Recaptured fish from the introduction sites were photographed each month and digitized at 14 homologous landmarks to quantify lateral body morphology. Superimposed landmark configurations were used to calculate geometric shape variables and depict the source of shape variation among individuals. Compared to the founding population, subsequent recruits exhibited an increase in overall and head size, a shortened caudal peduncle, eye shift dorsally, and mouth shift ventrally. These results largely match our a priori predictions of body morphology that have been observed in low-predation fish, and suggest the predatory regime mediates divergent natural selection in *P. reticulata*.

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935 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Corey Handelsman, Julian Torres Dowdall, Sarah Fitzpatrick, Cameron Ghalambor

Colorado State University, Fort Collins, CO, United States

The Shortest Distance Between Two Points: Do Different Approaches to Geometric Morphometrics Produce Different Results?

Morphology has a long history in evolutionary biology. Prior to molecular advances, comparative morphology was the foundation of taxonomic classification. In 1917, D'arcy Thompson developed a methodology for quantifying organismal shape and graphically depicting shape changes between taxa. The advancement of morphometrics continued through the 20th century as multivariate statistical models were developed for analyzing linear measurements used to describe shape. The inception of geometric morphometrics in the 1990s turned our focus to homologous landmark analysis and revolutionized morphological methods. Theory and methods were developed for analyzing shape independently of size. The field of morphometrics has since radiated through most biological disciplines and the abundance of tools and resources available to biometricians are unprecedented. While this has undoubtedly increased our understanding of morphological evolution, we are now faced with the problem of methodological consistency. Several studies have applied geometric morphometrics to non-homologous landmarks and produced results that are inconsistent with landmark-based analyses of conspecifics. Here we applied geometric morphometrics to both homologous and non-homologous landmarks on the same specimens of Trinidadian guppies (*Poecilia reticulata*) from high and low predation populations. The analysis using homologous landmarks identified individuals by predation regime and was independent of size. In contrast, the non-homologous approach identified individuals by size and failed to find significant differences between populations when size was removed from the model. We suggest that results from geometric morphometric analyses on non-homologous landmarks be interpreted with caution.

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329 Storm Symposium, Pavilion West, Friday 24 July 2009

Charles Hanifin

Stanford University, Stanford, CA, United States

Of Channels and Coevolution: Tetrodotoxin(TTX) Toxicity in the Salamandridae

Tetrodotoxin (TTX) plays an important antipredator role in the family Salamandridae. It is central to the coevolutionary arms-race between newts of the genus *Taricha* and garter

snake predators (genus: *Thamnophis*). TTX is present in other Eurasian "true" newts (e.g. *Triturus*, and *Cynops*) but the evolutionary history of TTX toxicity in salamandrid amphibians is unknown. Because TTX-bearing newts must also be resistant to TTX, information about TTX resistance in newts can shed light of the evolution of TTX toxicity in these taxa. Here I report the likely evolutionary history of a genetic and physiological mechanism that partially explains TTX resistance in newts. *Taricha* muscle fibers are highly resistant to TTX. This resistance results from amino-acid substitutions in the TTX binding site of the newt skeletal muscle voltage-gated sodium channel (Na_V 1.4). These changes are present in all of the known TTX bearing salamandrid genera: *Taricha*, *Cynops*, *Notophthalmus*, and *Triturus*. These changes are also present in a non TTX-bearing species *Pachytriton labiatus* closely related to *Cynops*. These results suggest that TTX resistance (and thus toxicity) arose once in the Salamandridae and this TTX-bearing phenotype may be an ancient feature (≈ 69 MYA) of this group. Examination of muscle and/or voltage-gated sodium channel genes from 5 other species of salamanders indicates that basal salamandrid lineages (e.g. *Tylototriton* and *Salamandra*) posses moderate levels of TTX resistance as well as amino-acid substitutions shared with TTX-bearing newts. These results suggest that early Salamandrids may have either possessed TTX or were preadapted for the TTX-bearing phenotype.

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135 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER HERPETOLOGY AWARD

Leigh Anne Harden

University of North Carolina at Wilmington, Wilmington, NC, United States

Diamondback Terrapin (*Malaclemys terrapin*) Habitat utilization in a North Carolina Salt Marsh: Assessment of Overlap with Blue Crab Fisheries

Diamondback terrapins (*Malaclemys terrapin*) inhabit brackish water marshes along the east and gulf coasts of North America. For over a decade, scientists have been documenting local terrapin population declines and evidence suggests that fisheries-related mortalities due to crab pot bycatch may be a major cause of this decline. The 2004 North Carolina Blue Crab Fishery Management Plan states that data on terrapin population distribution and habitat utilization is necessary in order to design effective regulations to minimize interactions between terrapins and crab pots. The primary goal of our study was to use telemetry and remote monitoring to assess the potential for spatial and temporal overlap between terrapin habitat and crab fishing efforts in southeastern North Carolina. From June 2008 to June 2009, we used radio telemetry to track the movements and activity patterns of 29 terrapins in Middle and Masonboro Sounds, NC. We also documented location of commercial crab fishing gear in these regions during the same time frame. These waters serve as important habitat for both terrapins and blue crabs and there have been reports of incidental captures and

mortalities of terrapins in crab pots set in these regions. In conjunction with radio telemetry, we used micro-dataloggers to continuously monitor carapace temperatures of 17 terrapins, as well as environmental temperatures (water, surface mud, and deep mud). Temperature recordings provided detailed information on daily and seasonal patterns of habitat utilization. Initial results indicate that potential for overlap appears to be site-specific in shallow waters near shore during spring and summer.

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597 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Michael Hardman[1], John Sullivan[2], John Lundberg[2]

[1]Finnish Museum of Natural History, Helsinki, Finland, [2]The Academy of Natural Sciences in Philadelphia, Philadelphia, PA 19103, United States

Claroteid Catfishes of the Congo Basin

Claroteid catfishes are a poorly known but important component of the Congo ichthyofauna. Inadequate diagnoses and a confused taxonomy have limited the extent to which this clade has been available to biodiversity and evolutionary studies. With support from the All Catfish Species Inventory, a revision of the group has identified 23 species in the Congo basin (excluding Lake Tanganyika) according to external characters, counts and proportional metrics obtained from museum specimens. Twenty-one of the 23 claroteid species are endemic to the Congo basin. Congo claroteids display a diversity of zoogeographic patterns. Some patterns are consistent with those of other clades and point to general phenomena such as vicariance in response to landscape evolution. Other patterns are taxon-specific and appeal to more subtle explanations. These patterns and their possible causes will be discussed in light of historical, geographic and phenotypic factors as well as the results of a preliminary nucleotide sequence analysis.

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861 ELHS/LFC Connectivity Symposium II, Galleria South, Friday 24 July 2009

Jonathan Hare

NOAA NMFS NEFSC, Narragansett, RI, United States

Population Connectivity and Temperate Nursery Habitats: Are Estuaries and Seagrasses So Special?

Many temperate species exemplify the classic migration triangle, with adults migrating to spawn and late-larvae and juveniles using distinct, nearshore habitats. Owing to their widespread use, these habitats are deemed essential to population connectivity - defined as the successful movement of individuals from spawning to reproduction through life

history stages and habitats. However, one could argue that this emphasis on nearshore habitats results, in part, on proximity and ease of study. Based on a recent list of fishes of the Western North Atlantic Ocean (Fahay 2007), the relative importance of nearshore nurseries will be assessed for the entire fauna, shelf components of the fauna, and managed species only. Comparisons with similar information from tropical regions will examine whether phylogenetic differences between faunal composition and nearshore habitat use contribute to differences between tropical and temperate regions. Finally, physical characteristics of nearshore habitats will be compared between temperature and tropical regions to evaluate whether differences in environmental forcing contribute to differences or similarities in population connectivity.

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59 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Kelly Hare, Alison Cree

University of Otago, Dunedin, Otago, New Zealand

Changing Environmental Temperatures vs. Changing Weather and Whether it Matters for Viviparous Lizards

The potential impacts of changing global temperatures on the embryonic development and subsequent phenotype of reptiles are significant research topics. In addition to rising temperatures, changes in local weather patterns are also predicted. For example, in the next 100 y summer temperatures are predicted to rise (+1-1.5°C) and rainfall and cloud cover increase (+5-10%) in south-eastern New Zealand (Otago). We measured the phenotypic consequences of an increase or reduction in basking availability to offspring of the non-threatened McCann's skink (*Oligosoma maccanni*) from Otago. During gestation pregnant *O. maccanni* were exposed to 'average/normal' (40 h), low (28 h) and high (56 h) availability of basking per week. Pregnancy success was reduced for females from the low basking regime. Female offspring from the 'normal' and high basking regimes grew faster, attaining a longer length by three months of age. At birth, sprint speed was faster for male offspring from the 'normal' and low basking regimes, but by three months of age no difference occurred among all individuals. These data suggest that optimal production of female offspring, with faster growth and subsequent earlier maturity, occurs at 40+ h of available basking per week. The predicted increased rainfall and cloud-cover in Otago over the next 100 y may reduce basking availability for pregnant females, limiting the number of offspring produced and lengthening time till maturity. To further explore the potential impacts of global climate change, studies combining increased temperatures with reduced basking availability (and potentially increased moisture) would be useful.

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897 Fish Genetics II, Parlor ABC, Monday 27 July 2009

John Hargrove[1], Daryl Parkyn[1], James Austin[1], Debra Murie[1], Amanda Demopoulos[2]

[1]University of Florida, Gainesville,FL, United States, [2]U.S. Geological Survey Florida Integrated Science Center, Gainesville,FL, United States

Using Polymerase Chain Reaction to Aid Visual Analysis of French Grunt Stomach Contents

Stomach contents are commonly examined to investigate trophic interactions of fish communities and their environments. Despite the utility of these studies, there are intrinsic limitations that make reliable identification of consumed prey problematic. Physical structures of fish such as pharyngeal teeth allow predators to macerate prey items beyond recognition and differential rates of digestion affect how long an organism resides in the stomach. The diets of French grunt (*Haemulon flavolineatum*) were examined because of their ecological significance within the Caribbean coral reef environment; however, difficulties in prey identification were encountered because this species possess pharyngeal teeth and forage primarily on soft-bodied prey items such as polychaete and sipunculid worms. We are supplementing visual identification of stomach contents using the polymerase chain reaction (PCR) to amplify fragments of the mitochondrial DNA (mtDNA) cytochrome oxidase 1 (CO1) gene region from prey tissue recovered from stomachs of French grunt. The supplemental identification of prey items is accomplished using a barcoding approach, where a standardized gene region from prey DNA is compared to those of known organisms using Basic Local Alignment Search Tool (BLAST), testing for sequence similarity in major genetic databases (BOLD, GenBank, EMBL, etc.).

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668 Lizard Ecology, Pavilion East, Friday 24 July 2009; ASIH STOYE AWARD GENERAL HERPETOLOGY

Alexis Harrison

Harvard University, Cambridge, MA, United States

Niche Conservatism and Convergence in *Anolis* lizards and *Eleutherodactylus* Frogs of Puerto Rico and Jamaica

A fundamental question in the study of niche evolution is whether different groups exhibit similar patterns of niche diversification and niche use. The climatic niche, the set of climatic conditions that permits a species to persist in an area, provides a good opportunity to study niche evolution because it can be rapidly estimated for a broad array of species using species distribution modeling. I estimated the climatic niche for 39

species of the lizard genus *Anolis* and the frog genus *Eleutherodactylus* from Puerto Rico and Jamaica, and examined niche similarity for all pairs of species. I tested three evolutionary hypotheses that might explain niche similarity between the two groups: niche conservatism, shared geographic history, and/or shared habitat specialization. Niche similarity among *Anolis* and *Eleutherodactylus* was not explained by niche conservatism, but was explained by shared geographic history and shared habitat specialization.

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672 Poster Session I, Exhibit Hall, Friday 24 July 2009; ASIH STORER HERPETOLOGY AWARD

Alexis Harrison

Harvard University, Cambridge, MA, United States

The Dewlap, Body Size, and Male Reproductive Success in *Anolis carolinensis* and *Anolis sagrei*

Competition between male *Anolis* lizards for territories and mates is intense; therefore selection on traits affecting the outcome of competition should be strong. In *Anolis*, such traits may include body size and condition, and the size and color of the dewlap, a colorful flap of throat skin that is held erect during courtship and territorial defense. I tested the hypothesis that these traits affect male competition in a single Florida population of *A. carolinensis* and *A. sagrei* using three parameters that reflect male competitive success: territory size, number of females in a territory, and number of offspring. I present results that relate these parameters to male body size, condition, and dewlap characteristics.

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162 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Elizabeth Harrison, Jerome Lorenz, Joel Trexler

Florida International University, Miami, FL, United States

The Invasive *Cichlasoma urophthalmus* (Mayan cichlid) in the Florida Everglades

The Mayan cichlid (*Cichlasoma urophthalmus*), which is endemic to Central America, was first recorded within the Everglades National Park in 1983. The impact of this species on native biota has not been well quantified but recent observational data has suggested that Mayan cichlids negatively impact native fish species through predation. This research will examine the effect of Mayan cichlids on native fish populations from 1991 to 2006. Fish community data from throw traps and drop traps were collected and

analyzed from three estuarine sites and one impounded site within the Everglades (Taylor River, Joe Bay, Highway Creek and Barnes Sound respectively). These sites range in salinity from 0 - 49ppt and were sampled eight months per year from 1990 to 2006. Analysis of similarity (ANOSIM) and nonmetric multi-dimensional scaling (NMDS) plots showed that the four sites differed significantly in the years sampled ($p<0.01$). Hydrological years and habitats sampled also differed significantly. SIMPER analysis showed that Mayan cichlids contributed substantially to the differences among sites. Analysis of the axes from NMDS showed that several native fish species were negatively correlated with Mayan cichlid relative abundance. Mayan cichlid density had a significant negative effect on densities of native fish.

1006 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Kelli Haskett, George Guillen

University of Houston Clear Lake, Environmental Institute of Houston, Houston, TX, United States

Population Dynamics of Texas Diamondback Terrapin located on Selected Estuarine Islands within Galveston Bay, Texas

The status of the Texas diamondback terrapin, *Malaclemys terrapin littoralis,* is unknown but believed to be depressed. This is the only turtle species to live exclusively in brackish water. Terrapin are top-level predators that regulate coastal wetland food webs. Their numbers have been declining since the late 1800's when commercial harvesting occurred. Their numbers may still be declining due to crabbing by-catch, pollution, illegal harvest, and habitat loss. The species is considered endangered in many states and a "species of concern" in Texas. Consequently it is essential to know if the population of Texas diamondback terrapins is sufficiently large and will remain viable under current levels of environmental disturbances. The primary objective of our study was to determine current terrapin in portions of the Galveston Bay system. The geographic focus of our study was an area where terrapin have been previously observed in West Bay. The study was primarily conducted during 2008. Traps, land surveys and mark recapture methods were used to monitor terrapin populations. A total of 129 individual terrapin were caught on North and South Deer Islands. Previous studies by Hogan (2002) using only traps reported 135 terrapin in the same vicinity. There were slightly more males than females captured during our study. Future research is needed in other portions of the Texas to attain a more comprehensive assessment of the status of this species.

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955 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Elizabeth Hassell, Mark Belk, Eric Billman

Brigham Young University, Provo, UT, United States

Male and Female *Brachyraphis rhabdophora* Show Different Ontogenetic Morphological Responses to Predator Regime

Morphological adaptation to variation in the environment has been documented numerous times in fishes; however, the ontogeny of morphological variation is not well understood. We characterized body shape in ordered size classes of the livebearing fish *Brachyraphis rhabdophora* from multiple populations to assess how sex, predation environment, and size (i.e., immature and mature size classes) affect shape variation. Male morphologies differ between predator regimes but follow parallel trajectories from immature to mature size classes. Immature females exhibit morphologically distinct forms based on predator regime, but ontogenetic trajectories converge over time such that shape of mature females do not differ between predator and non-predator environments. We suggest that although predation regime affects shape in both sexes, pregnancy may act as a constraint on shape of mature females.

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738 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Stacie Hathaway, Robert Fisher

WERC - San Diego Field Station USGS, San Diego, CA, United States

Assessment of the Terrestrial Herpetofauna of Palmyra Atoll, Line Islands

The Line Islands are poorly studied herpetologically. Palmyra Atoll is the northernmost and smallest vegetated landmass in this island chain. We reviewed the literature and museum records for Line Islands herpetofauna and examined the majority of specimens collected from Palmyra Atoll. We systematically conducted diurnal and nocturnal surveys for herpetofauna from 2006 to 2008. These surveys were undertaken to develop a current baseline for the diversity and distribution of herpetofauna. A rat removal project has been proposed for the near future and because this potential management action might change the dynamics of any species present, these baseline data are important for monitoring impacts. We did not detect *Bufo marinus*, a non-native species, recorded in 1960's museum records from Palmyra Atoll. We detected three gecko species recorded in museum records including one native species (*Lepidodactylus* n. sp.), one early introduction (*Lepidodactylus lugubris*) probably associated with World War II developments on the atoll, and one recent introduction (*Hemidactylus frenatus*; earliest record 2002). The native species was detected on eastern and southern islets of the atoll and the two islets in the central lagoon but not on the northern or western islets. The mourning gecko (*L. lugubris*), a parthenogenic species, is represented by many different

clone types. This species was widespread across the atoll but it appears that different clones may have different islet distributions. The recent invader, the house gecko (*H. frenatus*), was found only to occur on northern islets (with highest densities around the urban core) and on the closest lagoon islet.

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315 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Sarah Havens, Anne Maglia

Missouri University of Science and Technology, Rolla, MO, United States

Small Frog, Big World: The Developmental Patterns of a Miniature Species, *Acris blanchardi* and Their Implications

Blanchard's cricket frog (*Acris blanchardi*), a North American hylid, is of ecological and evolutionary importance because of its miniature body size and range-wide population declines/extirpations. In addition to unique post-metamorphic developmental patterns that include some common elements never ossifying; the species has a short life span. Skeletal malformations and asymmetries also have been observed in higher numbers relative to other hylids. Decline and/or malformations may be linked to its short life history and developmental patterns. Herein, we examined *A. blanchardi* development relative to that of other hylids including *Hyla chrysoscelis*, *Pseudacris crucifer* and *Pseudacris ocularis*, and include qualitative descriptions, and comparisons of timing and sequences of ossification events and geometric and linear morphometric analyses of the larval cranium and postcranial elements. We outline variations in ossification sequences and relative size of chondrocranial elements, and discuss the implications of our findings relative to miniaturization, hylid evolution, malformations and population declines.

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950 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Virgil C. Hawkes

LGL Limited Environmental Research Associates, Sidney, BC, Canada

Mapping of Critical Habitat for the Oregon Spotted Frog (*Rana pretiosa*) in British Columbia, Canada

The Oregon Spotted (*Rana pretiosa*) is critically endangered in Canada and only several extant populations remain, all of which occur in southwestern British Columbia. At least one of the populations is at risk of becoming extirpated despite captive rearing and habitat mitigation efforts. The Species at Risk Act, which is Canada's equivalent of the

US Endangered Species Act, lays out a process for the recovery of critically endangered species. Included in this process is the establishment of a Recovery Team that is tasked with developing a Recovery Strategy. Part of species recovery includes the identification and mapping of critical habitat at known or historically occupied sites. The Species at Risk Act defines critical habitat as the habitat necessary for the survival or recovery of a listed endangered, threatened or extirpated species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species. Based on these criteria, a scientifically-defensible process for delineating critical habitat for the Oregon Spotted Frog was developed for one population in BC. The delineation of critical habitat focused on defining habitat units that provide important breeding/oviposition season, active season, and over-wintering season habitat. A habitat suitability index (HSI) model approach was paired with a habitat mapping exercise to rate the suitability of a given habitat type to provide the attributes necessary for Oregon Spotted Frogs to fulfill their life requisites during a particular season.

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376 Fish Phylogeography, Pavilion West, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Malorie Hayes

Southeastern Louisiana University, Hammond, LA, United States

Phylogeography of *Percina nigrofasciata* (Percidae)

The family Percidae, the second largest family of freshwater fishes in North America, includes over 180 species, predominantly composed of darters. Only recently have the relationships within *Percina*, the second largest genus of darters, been explored with DNA sequence data. *Percina nigrofasciata* possesses one of the largest geographic ranges within the genus and is widely distributed on the Gulf Coastal Plain. In 1956, a morphological study by Crawford identified two subspecies within *P. nigrofasciata*: *P. nigrofasciata nigrofasciata*, *P. nigrofasciata raneyi*, and a zone of intergradation for populations in the Altamaha and Savannah River system below the fall line. The existence of multiple morphologically distinctive forms (2 subspecies and a zone of intergradation) within *P. nigrofasciata* provides an excellent opportunity to examine the phylogeographic relationships within this widespread taxon. I investigated genetic variation within *P. nigrofasciata* using the cytochrome b gene in order to test Crawford's morphologically based taxonomic designations. Results failed to recover the monophyly of *Percina nigrofasciata* under maximum parsimony and Bayesian analyses, and two distinct clades of blackbanded darters recovered in our study generally correspond to the previously identified morphological groupings.

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377 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Malorie Hayes[1], Bruce Collette[1]

[1]Southeastern Louisiana Univesrity, Hammond, LA, United States, [2]NOAA/NMFS, Washintgon, DC, United States

Morphology of *Percarina* and its phylogenetic position in the family Percidae -

The Percidae is composed of ten genera and over 190 species. North America has the most percids, seven genera and over 175 species while Eurasia has less diversity with six genera and 14 species. Despite extensive research done on the family, recent hypotheses of percid relationships have excluded the genus *Percarina*. The only hypothesized relationships involving *Percarina* were precladistic studies by Collette (1963) and Collette and Banarescu (1965). *Percarina* has a limited distribution, occurring only in the northwestern Black Sea basin. Characters described by Wiley (1992) were the basis for initial investigation but additional characters were added. Phylogenetic analysis was performed using PAUP* 4.0b10. In both most parsimonious trees, Percidae was recovered as monophyletic supporting previous investigations. The recovered trees show *Percarina* sister to *Gymnocephalus*. *Percarina* possess very strong anal fin spines similar to the outgroups and *Perca* and *Gymnocephalus*. *Percarina* and *Gymnocephalus* are the only genera with preopercular spines although some other genera may have some preopercular serrations. *Percarina* is deep-bodied with standard length three times body depth, similar to *Perca* and *Gymnocephalus*; other genera are shallower-bodied with standard length five to nine times the body depth. *Percarina* has a short, stout interopercle, similar to that of *Gymnocephalus*, *Perca*, and *Sander*; other genera have a shallower more elongate interopercle. *Percarina* is similar to *Gymnocephalus* and *Zingel* in having enlarged foramina along the lower jaw. *Percarina*, *Zingel* and some *Gymnocephalus* have a reduced posterior ramus of the dentary. *Percarina* and *Sander* have an elongate premaxilla.

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654 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Talon Haynie[1], Mark Adams[2], Peter Unmack[1], Jerald Johnson[1]

[1]Brigham Young University, Provo, UT, United States, [2]South Australian Museum, Adelaide, SA, Australia

Phenotypic Plasticity or Hybridization: Meristic and Genetic Variation in the Australian Fish Species *Retropinna semoni* along the Murray River

Previous work has shown that meristic counts in *Retropinna* (Osmeriformes) are lower in northern areas (warmer) than southern areas (cooler). Here we test three hypotheses along an upstream downstream gradient: 1) variation is due to phenotypic plasticity as a

result of different environmental conditions during early development. If temperature is affecting meristic counts we predict there should be a gradual change from higher to lower counts as one moves downstream. 2) Previous work found evidence for hybridization in the lower portion of the Murray River in South Australia with Retropinna from coastal streams (which have higher meristic counts). We predict that upstream populations will have similar counts, but in South Australia counts will tend to be higher on average due to hybridization with southern coastal populations. 3) A third possibility is that a combination of both hypotheses may be supported, with higher counts upstream, gradually decreasing until the South Australian border, and then increasing again. Fish were sampled from eleven localities along the length of the Murray River (~2,000 km). Dorsal and anal fin ray counts and total vertebrae were obtained from x-rays from 30 fish per site. Allozyme electrophoresis was conducted on 10 individuals per population using 27 loci. A sharp change in meristic counts was found around the South Australian border. Similarly, allozyme alleles from coastal populations were present in the Murray River in South Australia. This evidence supports the hypothesis that meristic variation is a result of hybridization between resident Murray River fish and coastal populations.

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859 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Lisa Hazard

Montclair State University, Montclair, NJ, United States

Behavioral Aversion of Two New Jersey Amphibian Species to Road Deicers

Winter road deicers (primarily NaCl, but also CaCl2 and other alternatives) may contaminate local watersheds to levels high enough to potentially impact amphibian populations. Amphibians that migrate to vernal pools early in the spring, when salt levels could still be high, may be especially vulnerable. We exposed adult Wood Frogs (*Lithobates sylvaticus*), Eastern Newts (*Notophthalmus viridescens*), and Couch's Spadefoot Toads (*Scaphiopus couchii*, used to validate methods) to salt solutions to determine whether they could detect and avoid high concentrations of road deicers. Animals were mildly dehydrated to induce thirst, then placed in a shallow dish containing 0-500 mM NaCl or CaCl2. Location (in or out of the dish) and behavior (moving, standing, sitting, or water absorption response) were recorded during a 10-minute trial. Both spadefoot toads and newts showed behavioral aversion to high salt concentrations. However, Wood Frogs showed no aversion to either salt, remaining in even 500 mM solutions for 10 minutes despite significant mass loss due to osmotic water loss. Breeding Wood Frogs may not be capable of evaluating pond salinity, leaving eggs and tadpoles potentially vulnerable to increased mortality or subtler sublethal effects due to road salt runoff.

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650 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Fabio Hazin[1], Paulo Oliveira[1], Felipe Carvalho[2], Mariana Rego[1], Rui Coelho[2], Andrew Piercy[2], George Burgess[2]

[1]Universidade Federal Rural de Pernambuco, Recife,PE/NE, Brazil, [2]University of Florida, Gainesville, FL, United States

By-catch of Crocodile Shark, *Pseudocarcharias kamoharai*, in the Tuna Pelagic Longline Fishery in the Southwestern Atlantic Ocean: Abundance, Distribution, Mortality and Reproductive Parameters

The crocodile shark *Pseudocarcharias kamoharai* is commonly taken as by-catch by the swordfish and tuna longline fishery in Brazilian waters of the tropical western Atlantic Ocean. In this paper, fisheries data recorded by observers on board since 2007 (in a total of 2,869 longline sets) and reproductive parameters estimated from 490 specimens (313 females, 177 males) caught between February 2005 and September 2007, were presented. Even though the crocodile shark accounts for less than 1% of the total catch (in number) of this fishery, it was recorded in 8.1% of the longline sets made and represented 4.2% of the total shark catch. The crocodile shark does not have a commercial interest to this fishery, so caught specimens are usually discarded. At-vessel fishing mortality was high (78.5% of the specimens), with the remainder 21.5% discarded alive. The size at birth was estimated at 41.5 cm total length (TL) and sampled specimens ranged from 65.5 to 109.0 cm TL for males and from 75.0 to 122.0 cm TL for females. Size at first maturity (L50) was estimated at 80.0 cm TL for males and 91.6 cm TL for females, and a high proportion of the specimens sampled were mature (68% of the females and 80% of the males). *Pseudocarcharias kamoharai* was recorded over and extensive geographical region throughout the study area, from latitudes 5ºN to 25ºS, but it was particularly abundant in the equatorial region, from 5º N to 5º S.

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112 Fish Conservation I, Parlor ABC, Sunday 26 July 2009

Alex Hearn[1], James Ketchum[1], Sandra Bessudo[2], Randall Arauz[3], German Soler[2], Eduardo Espinoza[4], Cesar Penaherrera[5], Pete Klimley[1]

[1]UC Davis, Davis, CA, United States, [2]Fundacion Malpelo, Bogota, Colombia, [3]PRETOMA, San Jose, Costa Rica, [4]Galapagos National Park, Galapagos, Ecuador, [5]Charles Darwin Foundation, Galapagos, Ecuador

Site Fidelity and Inter-island Movement of Scalloped Hammerhead Sharks, *Sphyrna lewini*, in the Galapagos Marine Reserve and Eastern Tropical Pacific

Hammerhead sharks *Sphyrna lewini* display site fidelity to certain locations, or hotspots, at oceanic islets in the Eastern Tropical Pacific. However, do they also make migrations between hotspots within an island archipelago and between island groups? From 2006-2008, hammerheads were fitted with ultrasonic tags at Cocos (54 sharks), Malpelo (69) and Darwin and Wolf islands in northern Galapagos (102). Arrays of ultrasonic receivers were deployed at each island group. Sharks tagged at the Darwin hotspot migrated frequently back and forth to the hotspot at Wolf, a distance of 38 km, spending more time there than on the other side of Darwin island. Sharks tagged at Wolf behaved in a similar fashion. These trips, mainly initiated at night, were rarely undertaken as direct migrations. Although hammerhead sharks are common throughout the Galapagos Marine Reserve, tagged hammerheads from the northern islands were only detected as far south as Roca Redonda, while three individuals were detected at Cocos, a distance of about 700 km. One individual tagged at Malpelo was detected at Cocos a month later, a distance of 600 km, and then in Galapagos. These movements show that at least a low level of connectivity exists between the island archipelagos. The arrival and residence times of tagged individuals at each island suggest a certain degree of synchronicity between individuals. Understanding the timing and direction of long distance movement patterns can contribute to the design of fisheries management strategies aimed at reducing hammerhead by-catch.

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898 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Alex Hearn[3], James Ketchum[1], Pete Klimley[1], Eduardo Espinoza[1]

[1]UC Davis, Davis, CA, United States, [2]Galapagos National Park, Galapagos, Ecuador, [3]Charles Darwin Foundation, Galapagos, Ecuador

Hotspots Within hotspots? Aggregations of Pelagic Fishes at Southeastern Corner of Wolf Island, Galapagos

Are pelagic species such as sharks and tuna distributed homogenously in the oceans? Large assemblages of these species have been observed at seamounts and offshore

islands in the Eastern Tropical Pacific, which are considered hotspots of pelagic biodiversity. Is the species distribution uniform at these hotspots or do species aggregate at a finer spatial scale? We employ three techniques to demonstrate that the aggregations of scalloped hammerhead sharks, *Sphyrna lewini*, and other pelagic species are confined to the southeastern corner of Wolf Island (Galapagos Marine Reserve). Coded ultrasonic beacons were placed on individuals and they were detected by monitors moored at the southeastern corner of Wolf Island and not by monitors deployed at other sites surrounding the island. Hammerhead and Galapagos sharks were tracked for two-day periods and shown to reside a disproportionately large fraction of their time at the southeastern corner. Visual censuses were carried out seasonally at the eight monitor sites at Wolf Island, recording the abundance of tunas, jacks, and many other species. The highest diversity and abundance of these species occurred in the southeastern corner of the island. Future oceanographic studies will be carried out to determine whether some aggregating species provide "a wall of mouths" to consume plankton caught in an entrainment zone up-current of the island and other species use this volcanic site with lava flows leading from it, each with a unique magnetic signature, to guide them as they migrate nightly to their offshore feeding grounds in the open ocean.

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768 Herp Systematics, Pavilion West, Thursday 23 July 2009

Matthew Heinicke, S. Blair Hedges

Pennsylvania State University, University Park, PA, United States

Relationships, Divergence Times, and Evolutionary History of West Indian *Eleutherodactylus*

Frogs of the genus *Eleutherodactylus* comprise the majority of the West Indian amphibian fauna, with 161 species stemming from a single mainland ancestor. Although this radiation formerly was possibly thought to result from Mesozoic vicariance, more recent genetic data suggest a Cenozoic origin by dispersal. We have assembled existing and new nucleotide sequence data for 145 species of West Indian *Eleutherodactylus* and used phylogenetic and molecular clock analyses to better understand the post-dispersal evolutionary history of the group. Results of our analyses suggest that both among-island dispersals and within-island speciation have been important in West Indian *Eleutherodactylus* diversification and in the assembly of individual island faunas. Divergence times and relative diversification rates of clades within *Eleutherodactylus* are presented, and the evolutionary and biogeographic implications of these data are discussed.

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393 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Ron Heintz[1], Nicola Hillgruber[2], Elizabeth Siddon[2]

[1]NOAA, Juneau, AK, United States, [2]University of Alaska JCFOS, Juneau, AK, United States

Growth and Energy Allocation in Larval Pollock (*Theragra chalcogramma*) from the Bering Sea

We collected larval and juvenile pollock from the Bering Sea in May, July and September in an effort to understand their growth (length, RNA/DNA, dry mass) and condition (energy and lipid) changes during early development. Sampling in May focused on the ice-free area near the Alaska Peninsula. In July sampling entailed fishing along transects over the continental shelf. There was limited sampling near the Alaska Peninsula and most larvae were encountered near the Pribilof Islands. Sampling in September provided fish from both the previously described areas. This study is part of a larger project aimed at linking larval distribution to oceanographic conditions in order to predict the effects of climate change on pollck in the Bering Sea. Larvae collected in May near Unimak Pass averaged 6.6 mm and 350 ug dry mass. Juvenile pollock sampled from the same area in September averaged 73.0 mm in length, suggesting a 1.7% growth rate over summer. Larvae collected near the Pribilof Islands apparently grew faster. Larvae averaged 10.8 mm in length and 1030 ug dry mass in July. By September, juveniles averaged 56 mm, suggesting a 2.2% growth rate. If these differences in growth continued it would take an additional 50 days before the two groups would be equal in size. Thus, improved growing conditions near the Pribilofs may not have offset the benefit of the longer growing season observed near Unimak Pass.

1020 AES Ecology II, Galleria South, Sunday 26 July 2009

Michael Heithaus[1], Craig Layman[1], Phillip Matich[1], Bryan Delius[1], Aaron Wirsing[2], Meagan Dunphy-Daly[1]

[1]Florida International University, North Miami, FL, United States, [2]University of Washington, Seattle, WA, United States

Stable Isotopic Analysis Reveals Individual Variation in Feeding Behavior of Juvenile Bull Sharks

Increasingly, it is being recognized that individual variation in foraging ecology is an important component of ecological dynamics. However, because of the logistical difficulties of repeated sampling of individuals and the limitations of stomach contents analysis investigations into the potential for sympatric individuals to vary in their foraging behavior or trophic position have been limited in elasmobranchs. Stable isotopes, which integrate the signature of prey species consumed over relatively long time scales are perfectly suited to such investigations. We used stable isotope ratios in

juvenile bull shark (*Carcharhinus leucas*) tissues to investigate variation in individual trophic interactions. There was no significant variation in mean trophic niches of sharks with sex, size, season, or position within their estuarine nursery. Mean $\delta^{13}C$ suggested that sharks are opportunistic and forage from marine and freshwater/estuarine food webs. Mean values, however, masked substantial and ecologically important individual-level variation in feeding history. A number of individuals foraged primarily from marine food webs, others specialized in freshwater/estuarine food webs, and a third group had intermediate signatures. All three foraging tactics were found throughout the estuary, suggesting that 1) juvenile bull sharks might play important roles in community and ecosystem dynamics from marine to freshwater environments, and 2) focusing on mean trophic positions of mobile predators and ignoring individual-level variation in trophic niches may underestimate ecological impacts of declines in their populations.

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506 Herp Biogeography, Galleria North, Saturday 25 July 2009

Evon Hekkala

Tulane University, New Orleans, LA, United States

Evaluation of Historic Taxonomic Affiliation and Population Genetic Parameters of Ranid Frogs Using Archival Samples

Patterns of genetic diversity among extant wildlife populations may result from anthropogenic fragmentation of ancestrally contiguous populations. We utilized archival collections to ascertain taxonomic and population affiliation and genetic variation over time in declining or extirpated populations of the Northern Leopard frog (*Rana pipiens*), mountain yellow legged frog (*R. muscosa*), and Las Vegas Valley leopard frog (*R. fisheri*). Patterns of genetic variation within members of this genus frequently suggest fine scale partitioning reflecting local adaptation. Analyses included haplotype and genotype matching of mitochondrial and nuclear markers to data from extant Ranid populations; Bayesian analysis using STRUCTURE; and tree building approaches. These analyses identified inter- and intra-specific relationships among historic and contemporary samples to evaluate historic population linkages and to identify appropriate source populations for restoration and recovery efforts. These data will enable researchers to compare contemporary samples with those taken over a longer time frame for better evaluation of successful restoration.

1042 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Dean Hendrickson[1], Adam Cohen[1], Gary Garrett[2], Robert Edwards[3]

[1]University of Texas, Austin, TX, United States, [2]Texas Parks and Wildlife Department, Mountain Home, TX, United States, [3]University of Texas-Pan American, Edinburg, TX, United States

The Fishes of Texas Project: Clark Hubbs' Legacy Continues

For nearly 60 years, Dr. Clark Hubbs studied diverse aspects of the biology, ecology, and conservation of Texas' freshwater fishes. During the 1950s, '60s and '70s he collected broadly across much of the state depositing preserved voucher specimens in the Fish Collection of the Texas Natural History Collection (TNHC) at the University of Texas at Austin. We combined all TNHC vouchered fish collection records for Texas with those from 33 other collections and recently completed manually georeferencing the resultant 67,060 species occurrence records representing about 2 million specimens from what turned out to be 5,729 unique localities. With all known fish occurrence records for Texas now available in a digital and geographically explicit format we can more easily detect errors and are now beginning the arduous task of verification of questionable occurrences via inspection of vouchers. We are also now able to start exploring powerful new techniques such as Ecological Niche Modeling which, with this large historic data set, appears to be a promising tool for better understanding of both conservation status and management of the Texas fish fauna. This presentation will review the overall project as well as Hubbs' contribution to it and discuss preliminary outputs from our niche modeling efforts as well as plans to make the project data available to the research community and the general public.

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195 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009; ASIH STOYE AWARD PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Justin Henningsen

University of Massachusetts Amherst, Amherst, MA, United States

Does Testosterone Mediate Seasonal Changes in Signal Size And Performance Capacity? A Test With Two Anoles

Sexually dimorphic structures are common in nature and often play an important role in the reproductive biology of many species. Most male *Anolis* lizards have an extendable throat fan, or dewlap, used in intra- and intersexual encounters. Recent work has shown that dewlap size and bite force change seasonally in individuals. To test whether this seasonal plasticity is mediated by testosterone (T), I performed castration and hormone replacement experiments in two species. Castration reduced (or T increased) dewlap

size and bite force in brown anoles (*A. sagrei*) at the onset of the breeding season. In green anoles (*A. carolinensis*), changes in dewlap size and bite force were independent of T at the end of the breeding season. These data suggest that steroid hormones are likely mediators of seasonal changes in signal size and performance capacity in some anoles. They also illustrate the importance of other factors likely to affect sensitivity to hormone levels.

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846 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Emily Henry, Jacob Goldfarb, Krista Mougey, Gad Perry

Texas Tech University, Lubbock, TX, United States

Ecology of the Texas Horned Lizard in the Rolling Plains of Texas

Phrynosoma cornutum is considered threatened in Texas and has declined over much of its range. Significant geographical variation has been shown in reptiles and proposed for this species, suggesting that local data may be essential for elucidating possible causes for the decline and determining evolutionary influences on life history. From 2005-2008, we monitored a population of horned lizards on a private ranch near Post, TX. A total of 389 lizards were encountered and 117 of them were radio-tracked. Average snout-vent length (SVL) for this population supports the existence of a latitudinal size gradient. Both sexes reach maturity at approximately the same SVL, but the average SVL of adult females (88.7 mm) is significantly larger than that of males (78.4 mm). Growth rate is significantly correlated with SVL, with smaller lizards having much higher growth rates, and we did not detect a sexual difference in growth rates. Lizards mated during the months of May and June, eggs were laid from late May into the middle of July, and hatchlings were seen beginning in mid July. Several lizards were confirmed to lay two clutches within one season. The average relative clutch mass was calculated in two ways: 1) average clutch mass relative to lizard mass is 59.5%; and 2) average clutch mass relative to total mass is 36.8%. Yearly survivorship ranges from 16 to 53%, and the identity of several predators was determined.

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495 Herp Conservation III , Grand Ballroom II, Monday 27 July 2009

Paula F. P. Henry[1], G. Michael Haramis[1], Daniel Day[2]

[1]USGS Patuxent Wildlife Research Center, Beltsville, MD, United States, [2]USGS Patuxent Wildlife Research Center, Laurel, MD, United States

Population Study of Diamondback Terrapins (*Malaclemys terrapin*) on a Marsh Island in the Chesapeake Bay

Although historical records indicate that diamondback terrapins were once abundant throughout the Chesapeake Bay, terrapin populations are believed to have declined drastically in the upper Bay. A documented decline has been reported along a major Bay tributary, the Patuxent River. Because of conservation concerns for Bay terrapins, we sought to document the status of terrapins in Tangier Sound, an area characterized by large offshore islands and extensive bordering salt marsh, that is thought to be the heart of terrapin range within the Bay. Focus of our work was a mark-recapture study at Martin National Wildlife Refuge, a marsh island habitat located on Smith Island. Using multiple trapping techniques, we retrieved 4254 individuals and 1309 recaptured terrapins, collecting morphometric and demographic distribution data across the terrapins' nesting, feeding, and wintering habitats. Our data indicate a large and potentially thriving population of terrapins living in this mesohaline region of the Bay. Findings on which critical environmental factors support high terrapin productivity at this island refuge location might ultimately serve as a benchmark for evaluating and restoring terrapin habitats elsewhere in the Bay.

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491 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Paula F. P. Henry[1], G. Michael Haramis[1], Daniel Day[2], Stan Hopkins[1]

[1]USGS Patuxent Wildlife Research Center, Beltsville, MD, United States, [2]USGS Patuxent Wildlife Research Center, Laurel, MD, United States

Assessing Effects of Land Development on Diamondback Terrapin Nesting Productivity

Diamondback terrapins, (*Malaclemys terrapin*) have been shown to exhibit strong nest site philopatry, making the survival of nesting females, nests, and hatchlings particularly vulnerable to habitat change. Terrapin productivity is thought to be particularly sensitive to alterations or loss of the immediate nesting beach and of the proximate nursery wetlands to various forms of shoreline development. In 2002 and 2003 the USGS surveyed beaches in the Maryland portion of Chesapeake Bay for evidence and distribution of terrapin nesting. The survey covered 3,000 km of shoreline and recorded GPS locations of over 7,760 nesting attempts. From data collected at these

locations, we identified local factors associated with land development that might place future terrapin nesting productivity at risk. Using Arc GIS and county-based land coverage maps for years 2004 through 2008, we measured distance between each nest collected during the 2002 survey to attributes related to both natural and human-impacted habitats such as roadways, shorelines, wetlands, and refuge sites. A series of logistic regressions applied for each map "year" was used to identify areas of potential concern, that is, sites combining both 'historically" elevated concentrations of nesting attempts and areas within the range of land and residential development. This application of GIS can be used to identify areas in urgent need of preservation for terrapins from rapidly expanding human development.

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32 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Pamela Henson[1], Bruce Collette[2]

[1]Smithsonian Institution, Washington, DC, United States, [2]National Marine Fisheries Service, Washington, DC, United States

The Smithsonian and Darwin

Shortly after publication of Charles Darwin's On the Origin of Species in 1859, Smithsonian Secretary Joseph Henry purchased a copy for the Institution's scientific library and wrote to colleagues that he found Darwin's work quite convincing. In response to the controversy over "the antiquity of man," Henry sought to make Americans aware of the European discoveries of human artifacts in proximity with the bones of extinct fauna. Spencer Baird, the first curator of the U.S. National Museum, immediately accepted Darwin's theory and incorporated it into the work of the National Museum, specifically the classification of plants and animals. The Institution has been drawn into public controversies over evolution on several occasions, such as the Scopes Trial in 1925 and when the "Dynamics of Evolution" exhibit opened at the National Museum of Natural History in 1979. Smithsonian scientists accepted the Darwinian theory of evolution within a year of its publication and incorporated its principles into the operations of its scientific bureaus, notably the National Museum of Natural History, Bureau of American Ethnology, and Smithsonian Astrophysical Observatory. The Institution has consistently maintained the stance that evolution is an accepted scientific theory that should not be evaluated in the light of personal religious beliefs.

Selina Heppell[1], Tomoharu Eguchi[2], Heather Haas[3], Paul Richards[4], Melissa Snover[5]

[1]Oregon State University, Corvallis, OR, United States, [2]SW Fisheries Science Center, La Jolla, CA, United States, [3]NE Fisheries Science Center, Woods Hole, MA, United States, [4]SE Fisheries Science Center, Miami, FL, United States, [5]Pacific Islands Fisheries Science Center, Honolulu, HI, United States

Developing Models to Assess the Impacts of Fisheries Bycatch on Sea Turtle Populations

Assessing the effects of anthropogenic mortality at the population-level is a difficult task, particularly for wide-ranging marine species such as sea turtles. Nevertheless, quantitative evaluation of impacts is important because it can provide a scientific basis for management actions and recovery planning. While population viability analysis (PVA) is highly uncertain for data poor species, simple models have been used to identify thresholds for population persistence or recovery. We are exploring a series of potential models to evaluate the impacts of anthropogenic mortality on sea turtle populations which could be used to set thresholds for incidental mortality. We have developed 3 alternative assessment models: two are based generally on the "Potential Biological Removal" (PBR) model used for marine mammals, and one is a stochastic simulation approach to determine probability of recovery under different bycatch levels. Our analysis includes the construction of plausible life history models for each turtle species that capture the range of our uncertainty about vital rates such as age at maturity and survival rates, which we then use in stochastic simulations. These simulated populations are then "sampled" to mimic data collection and used to evaluate the performance of each of our assessment models. We assess the probability of overestimating or underestimating a maximum removal level relative to pre-established goals of population persistence or recovery over a time frame of 50-100 years. This framework for evaluation of assessment model performance is important when data are highly uncertain, and provides results that can be used to choose among assessment approaches.

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947 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Selina Heppell, Scott Heppell, Linsey Arnold, Susanna Piovano, Wade Smith

Oregon State University, Corvallis, OR, United States

Investigating Maternal Effects on Spawn Timing and Larval Characteristics of Pacific Ocean Perch, Sebastes alutus, from the Gulf of Alaska

Research on live-bearing fishes of the genus Sebastes has shown positive relationships between the age of females and the quality of their offspring, where "quality" is measured as size, oil globule volume, growth rate, days to starvation, and/or swimming speed. Females of different age classes may also spawn at different times, with younger females generally releasing their larvae later in the parturition season. These studies have re-introduced an important concept in life history evolution that ties to fisheries management: the potential need to preserve age structure of the spawning stock, not simply biomass. We are investigating the size- and age-specific characteristics of spawning Pacific ocean perch (POP) from the Gulf of Alaska to see if patterns observed in nearshore rockfishes also occur in this deep water species. We have found that early spawners are larger on average, but weak support for age-related differences in reproductive characteristics among females. However, our scope of inference is limited due to a lack of old females in our samples. Surprisingly, we have found a substantial number of females (5-10%) show evidence of differential development in the two ovaries, suggesting that some fish are able to release their larvae one ovary at a time. Our research has not found a strong relationship between mother's age and offspring quality in POP, but has revealed important aspects of reproductive physiology in this species.

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906 General Herpetology, Galleria South, Sunday 26 July 2009

Rachael Herman, Justin Henningsen, Duncan Irschick

University of Massachusetts - Amherst, Amherst, MA, United States

Tail Autotomy and its Effects on Locomotion in the Northern Dusky Salamander

Many animals have evolved the ability to autotomize their tail when facing a predation attack. Though many studies have shown varying results on the costs of tail autotomy in lizards, few studies have focused on this unique behavior in salamanders. The purpose of this experiment was to find how tail loss affects locomotion in the northern dusky salamander, *Desmognathus fuscus*. After marking adult individuals at four points along the midline of the dorsal side, we used a high-speed camera to film the salamanders running before and after we removed 50% of their tail, and then again after we removed a total of 90% of their tail. Using a digitizing program, we analyzed the videos via the

marked points and calculated different angles formed by the body, the maximums of these angles, linear velocity, stride length, and stride frequency. We found no significant differences in any of these variables between the different tail treatments. We did find that 90% tail loss resulted in a significant increase in the frequency of toppling of the body that the salamanders experienced during running. We concluded that tail autotomy has no effect on the kinematics of locomotion but does affect the stability of *D. fuscus*.

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360 ELHS/LFC Ecology I, Galleria South, Broadway 1&2 25 July 2009

Frank Hernandez Jr[1], Sean Powers[2], William Graham[1]

[1]Dauphin Island Sea Lab, Dauphin Island, AL, United States, [2]University of South Alabama, Mobile, AL, United States

Jellyfish Predation on Ichthyoplankton in the Northern Gulf of Mexico: Estimating the Impact on Recruitment and Fisheries

Gelatinous zooplankton (e.g., jellyfish and ctenophores) are often cited as major predators of ichthyoplankton, yet their contribution to overall mortality during fish egg and larval stages is unknown. In the northern Gulf of Mexico, some jellyfish species can appear in large seasonal blooms that coincide in time and space with the spawning seasons of several recreationally and commercially important marine fish species. The degree of overlap between jellyfish blooms and adult fish spawning seasons may be an important factor in determining the year class strength for these fish species. We examined the potential effect of jellyfish blooms on fisheries production using moon jellyfish (*Aurelia* spp.) and Red Drum (*Sciaenops ocellatus*) as a model. For our analyses, abundances of red drum larvae were estimated from ichthyoplankton samples collected during a two-year biological baseline survey off the coast of Alabama (USA). Estimates of red drum egg abundances were derived from the same survey using molecular egg identification protocols. Historic data on jellyfish abundances and occurrences were combined with published clearance rates to estimate potential ichthyoplankton mortality due to jellyfish predation. Stage-specific mortality values were then used in a forward-projecting "equivalent adult model" to estimate the impact of jellyfish predation on the recruitment of age-1 red drum and subsequent fishery landings.

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363 Poster Session III, Exhibit Hall, Sunday 26 July 2009

L. Patricia Hernandez[1], Christopher Martin[2]

[1]George Washington University, Washington, DC, United States, [2]University of California, Davis, Davis, CA, United States

Morphological Divergence in Trophic Structures within Incipient Species of Bahamian Pupfish

Sympatric speciation has often resulted in significant morphological differentiation of trophic features. An incredibly young radiation of *Cyprinodon* species (<6,000 years old), characterized by distinct head and body shape, resides within hypersaline lakes in San Salvador, Bahamas. Not only are these incipient species morphologically distinct, our gut content analyses show they have distinct diets. These trophic morphs include a detritivore, a piscivore, a specialized scale feeder and an ostracod feeding specialist. Previous work describing craniofacial differences within these morphs examined basic changes in head shape. To more carefully assess the specific morphological differences that characterize this Bahamian radiation we have dissected, cleared and stained, and micro-CT scanned individuals. The most significant differences were seen between the scale feeder and all other morphs. The premaxillomandibular ligament, shown to be necessary for cyprinodontiform premaxillary protrusion, was strongest within scale feeders. Moreover, due to bigger and more numerous teeth a larger toothed area of the premaxilla is evident in scale specialists. While some meristic characters (tooth number) underwent changes, much of the trophic divergence within this radiation was due to changes in continuous variables. For example, while all morphs contained the same basic divisions of the adductor mandibulae complex, the relative size and connectivity among divisions varied significantly. Notably, scale specialists again showed the most divergent morphology, suggesting that divergent selection for scale-biting might be stronger or act on a greater number of traits than selection for piscivory or ostracod feeding. These results highlight how differential growth may effect functionally relevant trophic specializations.

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292 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

L. Patricia Hernandez, Faye Oberg

George Washington University, Washington, DC, United States

Untangling the Palatal Organ: Ontogeny and Evolution of a Novel Cypriniform Structure

Previous research on cyprinform feeding has demonstrated a great variety of feeding mechanisms associated with the pharyngeal jaws and kinethmoid-mediated

premaxillary protrusion. A relatively neglected morphological feature of the cypriniform feeding apparatus is the palatal organ. Research on goldfish has shown that the palatal organ plays a key role in separating edible from inedible prey items during benthic feeding. Located in the pharyngeal roof, the palatal organ is a muscular cushion composed of a highly disorganized tangle of differently sized muscle fibers covered by an epithelium studded with mucous cells. The combination of muscle fiber types seen in the adult may reflect the complex embryological origin of this organ. During feeding in goldfish and carp the palatal organ muscles work to entrap and move food along to the pharyngeal teeth. Here, we provide data on both the ontogeny of this structure as well as preliminary comparative data that suggest that the importance of palatal organ structure has been largely overlooked in studies of cypriniform trophic diversity. Here we describe the anatomy of the palatal organ in several ontogenetic stages of the zebrafish. The palatal organ, while less well-developed in zebrafish and other rasborins than in goldfish and carp, develops by 6 days post-fertilization. Our data suggest that the palatal organ develops from a number of muscle progenitor populations including those giving rise to extraocular and branchial muscles. Identifying the developmental mechanisms responsible for the origin of this feeding adaptation may enhance our understanding of how functional novelties arise and evolve.

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253 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Michelle Heupel[1], Colin Simpfendorfer[1], Richard Fitzpatrick[2]

[1]James Cook University, Townsville, QLD, Australia, [2]Australasian Natural History Unit, Townsville, QLD, Australia

Preliminary Analysis of Grey Reef Shark Movements on the Great Barrier Reef

Data on the presence and distribution of reef sharks on the Great Barrier Reef (GBR) are currently limited. In addition, recent research examining the abundance of reef sharks has produced contradictory results about the status of these populations. This results in a need for a better understanding of the movement and space utilization of these species to help interpret the limited data available for these populations. This pilot study examined the movements of grey reef sharks (*Carcharhinus amblyrhynchos*) on 6 reefs in the northern GBR to define whether individuals remained attached to a single reef platform and define the efficacy of Marine Park Zoning in sheltering these individuals from fishing pressure. Five different management zone areas were represented in the study site. A series of 31 VR2 acoustic receivers were deployed to passively track the movement of reef sharks from January to July 2008. Eight sharks ranging in size from 84 - 152 cm total length (TL) were monitored for periods of 13-167 days and detected on 1-130 days during that period. Three patterns of movement were observed from the eight sharks fitted with transmitters: 1) long-term presence at a single reef, 2) movement away from the monitored area, and 3) movement between and among reef platforms.

Implications of these movement patterns for research and management of these populations will be discussed.

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995 Fish Ecology III, Pavilion West, Monday 27 July 2009

Lyndie Hice, David Conover

School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY, United States

Latitudinal Variation in Atlantic Silverside Vertebral Number and the Adaptive Significance of Jordan's Rule

The Atlantic silverside, *Menidia menidia*, displays a very strong and spatially fine-scale increase in vertebral number with latitude along the east coast of North America, consistent with Jordan's Rule. Most of the vertebral number variation is genetic and such tight clinal patterns, which persist even on a microgeographic scale, implicate natural selection as the cause but its adaptive significance is unclear. High latitude populations are thought to have evolved a greater number of vertebrae to allow for increased body flexibility in colder, more viscous water, however empirical evidence is limited. To test this theory, we hypothesized that at high temperatures, southern Atlantic silverside populations would show significantly higher critical swimming speeds than northern populations, but the reverse would be true at lower temperatures. Swimming speed experiments were conducted on southern (South Carolina) and northern (Nova Scotia) populations reared in a common environment. Each population was tested at range of larval sizes and experimental temperatures. Swimming speed increased with size in both populations. The southern population exhibited maximum swimming speed at the highest experimental temperature, while the northern population performed best at intermediate temperature. There was no strong evidence of reversal of swimming ability at low temperature as expected. Additional trials at a wider range of temperatures voluntary swimming experiments in artificially manipulated viscosity will also be presented. Few studies have investigated the link between vertebral number and swimming ability and these results provide evidence of potential agents of vertebral number selection in the wild.

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710 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Rachel High, James Chapman, Mindy Walker

Rockhurst University, Kansas City, MO, United States

A Sequel: Evaluating the Success of Timber Rattlesnake Relocation Efforts In Light of a Second Season

Among *Crotalus* species, *C. horridus* (Timber Rattlesnakes) has perhaps the most interaction with humans as a consequence of its occurrence near human population centers. In eastern Kansas, burgeoning human development in rural areas adversely impacts aggregation sites and summer foraging routes in this species. In spring of 2007, a suburban population of Timber Rattlesnakes in eastern Kansas under such threat of human development (n=31) was removed from the endangered den site and relocated to a safe habitat. All individuals were weighed, measured and implanted with microchips for identification, and scale clippings were taken for further identification and genetic analysis. Seven of these individuals were surgically implanted with radio-transmitters for telemetry tracking. These snakes were tracked every third day of their active seasons (2007 and 2008, with 2008 data presented herein) to document their foraging routes and examine their general health. Prey density and diversity were also assessed. Though two of the original seven radio-implanted snakes were lost (one to predation in 2007 and one to exposure after emergence in 2008), a gravid female was added to the relocated population in the summer of 2008. As predicted, foraging loops tended to tighten and become less erratic during the second season at the relocation site. Also indicated herein are preliminary results concerning the genetic health of the translocated population as assessed by variation at six microsatellite loci (Villarreal et al. 1996).

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589 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Rebbecca L. Hill, Brett Hanshew, Tiffany S. Garcia

Oregon State University, Corvallis, OR, United States

Habitat Restoration Influence on Amphibian Community Structure, Willamette Mission State Park, Oregon

Habitat restoration projects can impact amphibian communities in non-intuitive ways. A collaborative restoration effort in Willamette Mission State Park, which borders the Willamette river near Salem, Oregon, is one example of how reestablishing historical flood channels may detrimentally impact amphibian populations. The flood of 1861 moved the Willamette River to its current location, yet a remnant channel still divides the 1,600 acre park. The channel inlet and outlet were blocked by dikes for agricultural

production and the resulting water bodies provide ephemeral and permanent lentic habitats for amphibians. The objective of the restoration project is to restore natural riverine functions, hydraulic conditions, and geomorphologic processes by removing the dikes. This will reconnect the river with its natural floodplain and provide annual riverine flow through the park. The shift in available aquatic habitat from lentic to lotic is expected to change the park's amphibian biodiversity and species richness; therefore, we initiated a 5-year amphibian monitoring survey designed to track changes in species richness, habitat use, and relative abundance. Terrestrial survey techniques follow established protocol and aquatic survey methods have been hybridized from established lotic and lentic protocols to reflect the change in habitat type over time. We predict a reduction in available aquatic breeding habitat and consequently a decrease in amphibian abundance including the following species: *Rana aurora aurora*, *Ambystoma gracile*, *Taricha granulosa*, *Pseudacris regilla*, *Rana catesbeiana*, and *Ambystoma macrodactylum*. However, we predict no change in terrestrial-breeding plethodontid populations (*Ensatina escholtzii*).

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71 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Eric Hilton

Virginia Institute of Marine Science, Gloucester Point, VA, United States

Darwin's Fossils

One remarkable aspect of Darwin's On the Origin of Species was his synthesis of many fields of study – a precocial "integrative" research program. Geology played an important early role in development of the concept of evolution by natural selection, through Darwin's reading of Lyell's Principles of Geology and the concept of gradualism. In this presentation this inspiration and the effect of Darwin's formalization of evolution on paleontology will be discussed. Darwin drew from the paleontological record in developing his ideas, but after the The Origin he did not return to further explore evidence from the fossil record, focusing rather on observations of natural and sexual selection in extant organisms. In The Origin Darwin concerned himself with processes and patterns found in the fossil record, such as extinction and sudden appearance of groups. He commented extensively on the "imperfection of the geological record." Even with imperfections acknowledged (and some overcome as the field matured), paleontologists adopted his ideas (at least subsequent to some of his most outspoken early critics, such as Agassiz and Owen). Paleontologists came to view their discipline as providing direct evidence for ancestry and decent. It is the search for ancestors in the fossil record that in many ways hindered the progress of paleontology. With the cladistic revolution and a shift from identifying a particular taxon as an "ancestor" of another (Darwin's "intermediate forms") in most subdisciplines, with perhaps the exception of paleoanthropology, paleontology holds its own with neontology to contribute greatly to the understanding of evolution.

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709 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

M. Vincent Hirt

University of Minnesota, St. Paul, MN, United States

Dating the Cypriniformes Tree of Life

Cypriniformes is a large group of primary freshwater fishes containing more than 3,500 species and are found in Africa, Asia, Europe, and North America. The oldest cypriniform fossils date to the Early Paleocene approximately 62 million years ago, although the actual age of the Order is unknown. I present an analysis of divergence times of cypriniform families as well as an estimate of the divergence of cypriniforms from other ostariophyans using fossil calibrated molecular phylogenies. I reconstructed molecular-based phylogenetic trees using the nuclear protein coding genes EGR2b (816 bp), IRBP (849 bp), and RAG1 (1527 bp). Sequences from 100 ingroup and 5 outgroup taxa were compiled and phylogenetic trees were generated using maximum likelihood and Bayesian methods. The dates of the oldest known fossil from each of the 4 cypriniform families with a fossil record and the dates of 3 well identified and dated cyprinid fossils were used as fossil calibration points. Two methods were used to estimate divergence times; a method proposed by Marshall (2008) and a Bayesian method. I estimate that Cypriniformes diverged from the other ostariophysans in the Cretaceous, possibly in the Early Cretaceous, Cyprinidae and Catostomidae are Cretaceous in age, Gyrinocheilidae has an origin near the Cretaceous/Paleogene boundary, and the other cypriniform families (Botiidae, Vaillentelidae, Cobitidae, Balitoridae, and Nemacheilidae) all originated in the Eocene. These dates are 20-30 million years older than the fossil record and previous estimates.

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184 General Ichthyology, Parlor ABC, Sunday 26 July 2009

Gerald Hoff

Alaska Fisheries Science Center, Seattle, WA, United States

Skate Nursery Habitat in the Eastern Bering Sea

Four nursery sites for the Alaska skate (*Bathyraja parmifera*), two for the Aleutian skate (*B. aleutica*) and two for the Bering skate (*B. interrupta*) were identified along the upper continental slope in the eastern Bering Sea. All sites were located near major undersea canyons from 145-380 m depth in relatively flat sandy/muddy bottom habitat. Bottom temperatures were relatively constant throughout the year, varying from 3.7 º to 4.6 º C. Egg case densities varied between nursery sites and were encountered at the Alaska

skate nursery in Bering Canyon at greater than 800,000 eggs/km^2. Based on egg case composition, sites were predominantly used by a single skate species for egg deposition, however up to six skate species used the habitat commonly. Seasonal sampling indicated that sites were continuously occupied throughout the year, and embryo length composition showed multiple cohorts developing simultaneously. Nursery sites were predominantly occupied by mature adult skates with few neonates or newly emergent skates present. Data from bottom trawl survey data suggests juvenile skates occupy habitat different than nursery sites. The movement of juvenile skates out of nursery habitat after hatching may lessen predation by common predators such as the Pacific cod *Gadus macrocephalus* and the Pacific halibut *Hippoglossus stenolepis*.

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185 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Gerald Hoff, Jay Orr, Duane Stevenson

Alaska Fisheries Science Center, Seattle, Washington, United States

Diagnostic Characters of Skate Egg Cases from Alaska

Skates of the genus *Bathyraja* (Rajidae) produce large keratin egg cases that protect the developing embryo until emergence. Egg cases of the 12 recognized skate species of the genus *Bathyraja* from Alaskan waters have been identified. Four diagnostic characters that provide species-specific recognition include surface texture, keel width and its extent onto the horns, byssal thread attachment location, and overall egg case size. In general, egg cases of deep-water species have narrow lateral keels that do not extend onto the horns and have surface textures of bristly, furry, or fuzzy rows of elongated surface spines. Shallow-water species have wide lateral keels that extend far onto the horns and surface textures that are relatively smooth with rows of low blunt spines. Egg case size and byssal thread attachment locations broadly overlap amongst species. However, in conjunction with keel and surface texture characteristics, size and byssal attachments help definitively identify egg case to species. Egg case characteristics may reflect phylogenetic relationships and adaptations to unique habitats.

Eric Hoffmayer[1], James Franks[1], William Driggers III[2], Mark Grace[2]

[1]Gulf Coast Research Laboratory, The University of Southern Mississippi, Ocean Springs, MS, United States, [2]National Marine Fisheries Service, Southeast Fisheries Science Center, Pascagoula, MS, United States

Habitat Preferences and Movement Patterns of Dusky (*Carcharhinus obscurus*) and Silky (*Carcharhinus falciformis*) Sharks in the Northern Gulf of Mexico: Preliminary Results

Dusky (*Carcharhinus obscurus*) and silky (*C. falciformis*) sharks were once common in the western north Atlantic Ocean; however, due to commercial exploitation their populations are thought to be in decline. Few data exist describing the essential habitats of these two species. This information is imperative to understanding the behavior of these sharks so proper management practices can be implemented to aid in population recovery. The goal of this study was to describe movement patterns and habitat preferences of dusky and silky sharks in the northern Gulf of Mexico. During summer of 2008, thirteen sharks were tagged in the northern Gulf using pop-up satellite archival tags: seven silky (1.3-1.8 m, TL) and six dusky (2.7-3.1 m, TL). All tags popped off and reported data, with deployment durations ranging from 14 to 124 days. The majority of the dusky sharks traveled relatively long distances (>200 km), while all silky sharks remained within 150 km of the initial tagging location. Dusky sharks spent the majority of their time between 21 and 100 meters, with occasional dives below 100 meters, whereas silky sharks spent 99% of their time in the top 50 meters of the water column. Water temperature ranges were relatively similar with dusky sharks preferring slightly cooler temperatures between 23 and 26˚C and silky sharks preferring warmer temperatures between 26 and 29˚C. One dusky and one silky shark moved to the southern Gulf of Mexico, which demonstrates the need for shared stock management of these imperiled species.

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608 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Eric Hoffmayer[1], James Franks[1], Jennifer McKinney[1], Bruce Comyns[1], Susan Lowerre-Barbieri[2], Sarah Walters[2], Joel Bickford[1]

[1]The University of Southern Mississippi, Ocean Springs, MS, United States, [2]Fish and Wildlife Research Institute, St. Petersburg, FL, United States

Identification and Characterization of Spotted Seatrout Spawning Habitat in Two Mississippi Estuaries Utilizing Passive Acoustics

Spotted seatrout, *Cynoscion nebulosus*, is one of the most sought-after saltwater recreational fish species in the southeastern United States and inhabits estuarine and nearshore Gulf of Mexico waters from the west coast of Florida to the Gulf of Campeche. Due to overfished spotted seatrout populations, as well as habitat loss and degradation, it is critical to identify and map spotted seatrout spawning habitat in Mississippi coastal waters. Two Mississippi estuaries were selected for study: Grand Bay (a pristine bay included in the National Estuarine Research Reserve) and Biloxi Bay (a heavily impacted bay). A randomly stratified passive acoustic survey designed to monitor male spotted seatrout courtship sound production was conducted in both estuaries from May to September 2008 to describe the habitat and environmental conditions associated with spawning spotted seatrout. Each station was sampled for spotted seatrout courtship sounds using a hydrophone and digital recorder. In addition, water depth, salinity, temperature, dissolved oxygen, tidal and lunar stages, and GPS position were documented. To date, male spotted seatrout courtship sounds were detected in both estuarine systems. Preliminary results indicate that more spotted seatrout are using Grand Bay compared to Biloxi Bay as spawning habitat, based on the increased frequency of spotted seatrout courtship sounds identified. Preliminary findings suggest preferred spotted seatrout spawning habitat in the two bays to be oyster beds, artificial reefs, seagrass beds, and in water depths greater than two meters. Continuing research will better define critical spawning habitat.

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466 Poster Session II, Exhibit Hall, Saturday 25 July 2009

J. Derek Hogan[1], Juan Galarza[2], Ryan Walter[1], Daniel Heath[1]

[1]University of Windsor, Windsor, Ontario, Canada, [2]University of Hull, Hull, United Kingdom

Identifying Larval Cohorts in a Coral Reef Fish (*Coryphopterus personatus*) Using Population Genetics and Otolith Microchemistry

We seek to understand the relative contributions of successive recruitment cohorts to the structure and stability of populations. Do certain cohorts contribute more to the

replenishment of a population? What is the effect of temporal cohorts on the stability in population structure? What is the effect of mortality on these cohorts. Here we use a variety of techniques including otolith microchemical assays and population genetic tools to identify cohorts and study the effects of mortality on cohort structure and population stability.

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238 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

J. Derek Hogan[1], Roger Thiessen[1], Peter Sale[2], Daniel Heath[1]

[1]University of Windsor, Windsor, Ontario, Canada, [2]United Nations University, Hamilton, Ontario, Canada

Self-recruitment, Dispersal and Fluctuating Connectivity among Populations of a Coral Reef Fish

The degree of connectivity among marine populations, connected via larval dispersal, has important implications for the persistence and resilience of populations in the face of natural and anthropogenic disturbances, and thus how these populations should be managed. However there are few empirical studies that have measured or estimated the extent of dispersal or the degree of connectivity among populations of marine fishes, and none have investigated temporal variation in connectivity. Here we quantify the extent of connectivity among populations of a coral reef fish (*Stegastes partitus*) over a three year period by estimating dispersal and self-recruitment of larval fishes among seven sites in a ~6000 km^2 region of the Caribbean using genotype assignment methods. We found that larvae of this species could disperse the full distance of our sampling region (~200 km), despite that, self-recruitment was a regular phenomenon at the site level. Importantly, we found that dispersal-distance distributions, the degree of self-recruitment, and the patterns of connectivity all varied among years. Our data highlight the unpredictable nature of connectivity, and underscore the need for more, temporally replicated, empirical measures of connectivity to inform management decisions.

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404 Herp Conservation III , Grand Ballroom II, Monday 27 July 2009

Robert Hogg[1]

[1]Southern Oregon University, Ashland, OR, United States, [2]Bureau of Land Management (BLM), Medford, OR, United States

Population Structure and Abundance of the Western Pond Turtle (*Clemmys marmorata*) in the Jenny Creek Watershed, Cascade-Siskiyou National Monument, Southern Oregon

The U.S. Fish and Wildlife Service (USFWS) currently lists the Western pond turtle (*Clemmys marmorata*) as a species of concern, and the Bureau of Land Management (BLM) classifies the species as Bureau Sensitive. The BLM manages the Cascade-Siskiyou National Monument in Southwestern Oregon and has identified habitat with confirmed populations residing within the Jenny Creek Watershed. Visual surveys and mark-recapture efforts were last conducted in 1998, and to assess the current status of the sensitive species, I revisited three historic sites during a seven-week study through the summer of 2008. The "Jenny Power" site revealed a robust population with a strongly biased 3F:1M sex ratio. A majority of the sampled population captured with baited hoop traps was estimated to have recently attained sexual maturity, with a few juveniles approaching maturity, and the oldest adults estimated in the prime of their reproductive capabilities. Turtles were sparingly observed at the other two sites and trapping efforts at these sites produced no captures for continued mark-recapture monitoring. Low capture rates and the observed presence of the highly predacious invasive American bullfrog (*Rana catesbeiana*) present concerns for the continued success of the region's only native turtle, and despite the vigorous demographic population structure at "Jenny Power," continued monitoring remains warranted. The BLM failed to produce records from the 1998 mark-recapture efforts so this study provides documented baseline data for future monitoring.

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773 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Nancy Holcroft[1], Josephine Michener[2]

[1]Johnson County Community College, Overland Park, KS, United States, [2]University of Kansas, Lawrence, KS, United States

A Survey of Basal Euteleost Pectoral Girdles

In teleost fishes, the pectoral girdle comprises both dermal and chondral elements. The dermal elements include a post-temporal, supracleithrum, cleithrum, and one to three post-cleithra (typically two in euteleosts). The chondral elements comprise a scapula, coracoid, rarely a mesocoracoid, typically four proximal radials, and a variable number

of distal radials. Previous workers have occasionally used pectoral girdle characters for reconstruction of phylogenetic relationships among taxa within various basal euteleostean lineages (e.g., cleithrum with narrow columnar process is synapomorphic for Suborder Osmeroidei; cleithrum without ventromedial process meeting coracoid is synapomorphic for Family Alepocephalidae; three pectoral fin radials is synapomorphic for Suborder Phosichthyoidei). However, a comprehensive survey of patterns of variation of basal euteleost pectoral girdles has been lacking to date. Our data demonstrate that pectoral girdle elements of basal euteleosts vary in articulation, shape, number, and presence/absence of some elements (e.g., mesocoracoid, post-cleithra). This variation likely represents a potentially rich source of phylogenetically-informative characters which may contribute significantly to the understanding of euteleost interrelationships. We will present our findings on morphological patterns of pectoral girdle character variation in the basal euteleosts; these results represent the first part of a broader survey of euteleost pectoral girdle elements.

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196 Poster Session I, Exhibit Hall, Friday 24 July 2009

Bradford Hollingsworth[1], Melissa Stepek[1], Paisley Cato[2], J. Angelo Soto-Centeno[3]

[1]San Diego Natural History Museum, San Diego, CA, United States, [2]Western Center for Archaeology and Paleontology, Hemet, CA, United States, [3]University of Florida, Florida Museum of Natural History, Gainesville, FL, United States

Specimen Tag Replacement for the Herpetology Collection at the San Diego Natural History Museum

The specimen tag replacement project for the herpetology collection at the San Diego Natural History Museum will ensure the long-term protection of specimens with their associated data. We have begun the retagging of the amphibian and reptile collection to standardize eleven problematic tag types with an archival tag, matching a currently used type. To date, we have completed 40% of the retagging, representing over 20,000 tags, which includes 2,000 critical tags in danger of imminent disassociation of the research specimen from catalogued data. These tags are the sole mechanism to associate a specimen to the collection information stored in both the written catalogue and electronic database. Twelve types of tags are used in the collection, dating back to 1891. Of these, eleven types, representing 49,900 specimens, have some form of problem, including three types with critical disassociation concerns. Replacement tags were ordered and received from TLS Printing, the only remaining museum tag printer in North America. Students, volunteers, and staff have cut 50,000 strings and organized the tags into pre-cut bins of 200 tags each, for easy tag number retrieval. During the process of retagging the collection, we have had the opportunity to correct minor errors on jar labels and in the database, as well as, further improve our organization, storage distribution, and access. The retagging project has increased both the short-term integrity of the collection information and the long-term storage, care, and accessibility of this valuable biodiversity resource.

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625 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009

Scott Holt[1], Greg Stunz[2]

[1]The University of Texas at Austin, Port Aranasa, TX, United States, [2]Texas A&M University Corpus Christi, Corpus Christi, TX, United States

Effects of Re-Opening a Tidal Inlet on Fish and Crustacean Recruitment into the Laguna Madre, Texas

Packery Channel transects Mustang Island, Texas, connecting the Gulf of Mexico to the upper portion of the Laguna Madre. The US Army Corp of Engineers completed dredging in the fall of 2006 to permanently open the channel . This study was undertaken to determine the effects of opening the channel to the Gulf of Mexico on larval stages of fishes and macroinvertebrates (collectively referred to as meroplankton) in the vicinity of Packery Channel and on recently settled juveniles (nekton) in local seagrass nursery habitat. Meroplankton samples were taken with a conical plankton net mounted on an epibenthic sled and the nekton samples were taken with a fine-mesh beam trawl. Multivariate analysis of the meroplankton data showed clear seasonal groupings that generally separated estuarine residents from transients and spatial groupings that showed the species assemblage in the tidal inlet to be substantially different from the rest of the study area after the inlet was opened but not before. The wide dissimilarity was due to higher density and diversity at the inlet site. A Before/After - Control/Impact analysis of the nekton data showed no significant effect of either factor on mean fish density in the area. Crustacean density was significantly lower post-opening but significantly higher in the impact area compared to the control. Opening the inlet had a positive but spatially limited effect on offshore spawned species but there was neither a positive or negative effect on estuarine resident species.

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756 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Gareth Hopkins, Saphida Migabo, Mark Thompson

University of Northern British Columbia, Prince George, BC, Canada

Anti-Predator Granular Gland Skin Secretions of the Long-toed Salamander (*Ambystoma macrodactylum*) in its Northern Range

Distasteful, noxious, and/or toxic secretions from granular skin glands have been demonstrated to play important anti-predatory roles in amphibians. Previous studies have suggested that the long-toed salamander (*Ambystoma macrodactylum*), a widely distributed urodele found in its northern range in northern British Columbia, is

distasteful to predators. The source of this distastefulness has not been exclusively identified. Our objectives were to isolate the granular gland skin secretions of the long-toed salamander through electrical stimulation of its granular glands, and bioassay this secretion for anti-predatory effects with crayfish (*Cambarus* spp.). Previous studies have suggested an important role for proteins in these secretions, and we therefore tested for their presence and utility. The feeding response (consumed or rejected) of crayfish to control food pellets was compared to pellets incorporating raw salamander skin secretions and to pellets incorporating boiled secretions. Significantly more crayfish consumed control versus raw skin secretion pellets, indicating distastefulness of the granular gland skin secretions, suggesting an important anti-predatory function. While skin secretions tested positive for presence of proteins, the feeding response of crayfish to raw and boiled secretions did not differ significantly, indicating that proteins are not exclusively responsible for the anti-predatory nature of these secretions. A very small concentration of secretion was required to illicit a significant anti-feedant response in crayfish, and we discuss the implications of this in relation to a proposed dual function of the long-toed salamander's granular glands in nutrient storage, and the energetic requirements of an amphibian in its northern range.

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680 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Brian D. Horne

San Diego Zoo's Institute for Conservation Research, Escondido, CA, United States

New Directions in the Conservation of Large River Turtles in Southeast Asia

Conserving viable populations of large river turtles is often challenging due to factors such as sizeable adult home range and the corresponding logistical problems of preventing unsustainable harvesting of turtles and turtle eggs across vast areas. These problems are no more acute than in Southeast Asia; of the eight large river turtles on the IUCN's 2007 top 25 list of the most endangered turtles and tortoises, six are found in this region. Furthering this direr situation is region's burgeoning demands for electricity, which are often being met by the construction of new hydroelectric dams. Such impoundments offer unique new challenges for river turtle conservation, yet the question remains if they can be used to our conservation advantage (i.e., the creation of large protected areas). For example, the last known nesting area for the Burmese roofed turtle, *Batagur trivittata*, on the Chindwin River of Myanmar may soon be inundated when a planned hydroelectric dam is complete. It is unknown how or if turtle populations will adapt to these novel conditions and what management practices will ensure their viability. Specific areas of interest include changes in the survivorship, seasonal movements, availability and quality of food, nesting areas, and juvenile recruitment; as well as the eco-physiological modifications by adult turtles to physical changes in the environment including water temperature and quality. Herein, I will provide support for multiple avenues of research that may have global implications for

the conservation of large river turtles that are or will be impacted by river impoundments.

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31 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Lisa Horth

Old Dominion Univ, Norfolk, VA, United States

Biased Sex-Ratio (and Color-Morph Ratio) is Associated with Melanic Color Pattern in Eastern Mosquitofish

Sex ratio distortion is apparent in the progeny of melanic, but not silver, male eastern mosquitofish. In two of three populations studied, melanic males produce a male biased sex ratio (1.4M:1F and 2.5M:1F), whereas silver males produce a 1:1 sex ratio. Additionally, the ratio of melanic: silver sons is more melanic biased (4M:1S) in these two populations than in the third population (2.6M:1S). However, only in the third population do fish require cold induction for expression of melanin. Melanic fish comprise only 1% of the male population in nature so male biased sex ratio and melanic color ratio bias provide a selective advantage to the melanic morph and contribute to explaining this rare morph's persistence in nature.

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371 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Jason Hoverman[1], Matthew Gray[1], Debra Miller[2]

[1]University of Tennessee, Knoxville, TN, United States, [2]University of Georgia, Tifton, GA, United States

Anuran Susceptibilities to the Emerging Amphibian Pathogen *Ranavirus*

The pathogen *Ranavirus* has been implicated as a major cause of reported amphibian die-offs in the United States. One of the hypothesized factors in the recent emergence of ranaviruses in amphibian populations is novel strain introduction (i.e., pathogen pollution). While pathogen pollution has been identified as a significant concern, studies are needed that compare the relative susceptibility of amphibian species to novel versus endemic strains. The goals of our study were to 1) determine the susceptibility of three anuran species to ranaviruses and 2) assess the degree of susceptibility to a novel *Ranavirus* isolate. Using controlled laboratory experiments, we exposed tadpoles of pickerel frogs (*Lithobates* [=*Rana*] palustris), Cope's gray tree frogs (*Hyla chrysoscelis*), and eastern narrow-mouthed toads (*Gastrophryne carolinensis*) to a known laboratory strain of Frog virus 3 (FV3) and a novel *Ranavirus* isolate from a bullfrog ranaculture facility in

Georgia. We found that the species varied in their susceptibility to the virus isolates. Pickerel frogs exposed to the novel isolate experienced 80% mortality, but there was no increase in mortality following exposure to FV3. Gray tree frogs experienced 65% and 35% mortality following exposure to the novel isolate and FV3, respectively. Eastern narrow-mouth toads were relatively resistant to infection by both virus isolates. In addition to species-specific susceptibilities to *Ranavirus*, this research demonstrates that novel *Ranavirus* isolates can be highly pathogenic to naïve populations. Thus, strategies that reduce pathogen pollution may reduce the likelihood of *Ranavirus* emergence.

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457 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Lucy Howey[1], Bradley Wetherbee[2], Anthony Wood[2], Mahmood Shivji[1]

[1]Guy Harvey Research Institute, Nova Southeastern University, Dania Beach, FL, United States, [2]University of Rhode Island, Kingston, RI, United States

Comparative Habitat Utilization of the Blue Shark (*Prionace glauca*) and Shortfin Mako (*Isurus oxyrinchus*)

Blue and shortfin mako sharks are both highly migratory, widely distributed, pelagic species common in western North Atlantic continental shelf waters during summer months. Both undergo seasonal migrations to warmer or southern locations. Mako sharks are regional endotherms that maintain elevated temperatures in specific body parts, whereas blue sharks are typical ectotherms. Despite striking physiological and morphological differences between these species, they utilize roughly the same habitat on the continental shelf. To compare fine-scale habitat use of these two species we used pop-up satellite tags which archive depth, temperature, and light to examine environmental utilization of blue (n=10) and shortfin mako (n=6) sharks during migrations away from the shelf. All blue shark and two shortfin mako displayed long-distance migrations. Both blue and mako sharks occupied water of similar depth and temperature on the shelf, despite different prey preferences. During migration, mean depth of blue sharks was 85m compared to 50m for mako sharks. Both blue and shortfin mako sharks utilized 16-22 °C waters for 75% and 60% of their time, respectively. Both species dove frequently during migration with maximum recorded depths of 855m for a blue shark and 866m for a mako. The greatest straight-line distance traveled by a blue shark was 2485km (Cape Cod to Puerto Rico) and 2100km for a mako (Cape Cod to the Bahamas). Differences between these species while on the continental shelf appear to reflect prey consumption rather than habitat utilization; whereas, during migration the two species exhibited more pronounced differences in habitat utilization.

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849 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Tomas Hrbek

University of Puerto Rico - Rio Piedras, San Juan, Puerto Rico

Phylogenetic relationships of the Poeciliinae (Cyprinodontiformes)

Phylogenetic relationships of members of the subfamily Poeciliinae (Cyprinodontiformes) were investigated to test alternate hypotheses of diversification resulting from the assembly of the Central America and the Caribbean from the Cretaceous period onwards. We use 4333 aligned base pairs of mitochondrial DNA and 1549 aligned base pairs of nuclear DNA from 55 samples representing 48 ingroup and seven outgroup species to test this hypothesis. Mitochondrial genes analyzed include those encoding the 12S and 16S ribosomal RNAs; transfer RNAs coding for valine, leucine, isoleucine, glutamine, methionine, tryptophan, alanine, asparagine, cysteine and tyrosine; and complete cytochrome b and NADH dehydrogenase subunit I and II; nuclear gene analyzed included the third exon of the recombination activation gene 1 (RAG1). Analyses of combined mtDNA and nuclear DNA data sets result in a well supported phylogenetic hypothesis. This hypothesis is in conflict with the classical taxonomic assignment of genera into tribes and phylogenetic hypotheses based on the taxonomy; however, the molecular hypothesis defines nine clades that are geographically restricted and consistent with the geological evolution of Central America and the Caribbean. This analysis is also in conflict with phylogenetic analyses based on morphological data. Our analyses support multiple colonization events of Middle America followed by a mix of vicariance and dispersal events. Our analyses also suggest that morphological characters used to place individual species into genera and genera into tribes have evolved multiple times, possibly in response to similar ecological pressures or due to sexual selection.

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853 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Tomas Hrbek[1], Manuella Amado[1], Izeni Farias[1]

[1]University of Puerto Rico - Rio Piedras, San Juan, Puerto Rico, [2]Federal University of Amazonas, Manaus, AM, Brazil

Species Boundaries in Amazonian Discus Fishes (*Symphysodon* spp.): A Multigenic Analysis

We carried out a population genetic analysis of the fishes of the genus *Symphysodon* from the Amazon basin. We sampled 334 individuals from 24 localities spanning the complete geographic distribution of this genus, and sampling all known phenotypic groups, species and subspecies. We analyzed 474 bp of the mtDNA control region, 578 bp of the mtDNA COI gene,1443 bp of the exon 3 of RAG1 gene, and 11 microsatellite loci.

Statistical analyses of mtDNA sequence data revealed three well defined clades corresponding to the 'green' and 'blue' groups of *S. aequifasciatus*, and to a morphologically unrecognized clade from the Xingu River drainage. These three clades were nested within a paraphyletic assemblage consisting of the 'brown' group of *S. aequifasciatus* and of *S. discus*. Non-random nuclear allele sharing was observed among all groups. Microsatellite data revealed the existence of four groups corresponding to *S. discus*, the 'green' *S. aequifasciatus*, the 'brown'+'blue' *S. aequifasciatus* and Xingu+Tapajos River drainage lineage. Significant genomic sharing was observed between *S. discus* and the 'brown' *S. aequifasciatus*. Diversification is likely to be driven by both vicariant processes, as well as ecological factors. Historical and ongoing admixture also appears to be an important evolutionary force shaping patterns of biodiversity observed in the genus *Symphysodon*.

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293 AES Ecology I, Pavilion West, Saturday 25 July 2009

Hua Hsun Hsu[1], Brad Norman, Elson Aca[3], Shoou Jeng Joung[1]

[1]National Taiwan Ocean University, Keelung City 20224, Taiwan, [2]Murdoch University, Murdoch, WA 6150, Australia, [3]WWF-Philippines, Quezon City 1105, Philippines

North-South Migration of the Whale Shark (*Rhincodon typus*) in East Asian Waters and the Northwest Pacific

The migratory patterns and stocks distribution of the whale shark (*Rhincodon typus*) to date remain largely undefined. Pop-up archival transmitting (PAT) tags (Wildlife Computers Ltd.) were attached to a total of four whale sharks: two (4.02 m TL male and 3.80 m TL female, WS006 and WS007) released in Hualien (east of Taiwan) in July 2005; another 4.7 m TL male (WS200) released in Penghu (west of Taiwan) in September 2008; while another 7-8 m TL individual (sex unknown) (P-000) was tagged in Donsol (Philippines) in May 2007. The PAT tags attached to whale sharks were popped-off as follows: in the north of the East China Sea in September 2005 (WS006); east of Luzon (Philippines) in January 2006 (WS007); north of Luzon in February 2009 (WS200); and southwest of Taiwan in August 2008 (P-000), respectively. Light level signals converted to longitude-latitude data indicated that WS200 migrated south between the continental shelves of China and west of Philippines. P-000 migrated to an area south of Japan and then moved south towards southwest of Taiwan. This is the first study to prove that the range of whale sharks from South-east Asian waters and East China Sea overlap. These migration data, when combined with data on the discovery in February 2009 of a neonatal juvenile *R. typus* in Philippine waters and the capture of the only known pregnant female *R. typus* off Taiwan in 1995, suggest a breeding population that is likely to comprise one stock from the northwest Pacific.

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295 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Daniel Huber[1], Lisa Whitenack[2], Stephen Wroe[3]

[1]University of Tampa, Tampa, FL, United States, [2]University of South Florida, Tampa, FL, United States, [3]University of New South Wales, Sydney, NSW, Australia

Structural Mechanics of Primitive and Derived Shark Teeth and Jaws

Finite Element Analysis (FEA) has emerged as a powerful tool for investigating form-function relationships in both extant and extinct taxa. In FEA, biologically relevant loading patterns on skeletal elements can be simulated via computational modeling, thereby revealing the structural performance of complex morphologies. In a comparative context, structural performance can be used to assess selective pressures on the evolution of skeletal morphology. Some of the most dramatic morphological changes in the evolutionary history of cartilaginous fishes have occurred in the feeding mechanism, particularly regarding the teeth and jaws. Through FEA of the teeth and jaws of primitive (sevengill shark *Heptranchias perlo*) and derived (white shark *Carcharodon carcharias*) extant sharks, we will identify the endpoints of a gamut of structural evolution in chondrichthyan feeding mechanisms. Preliminary analyses suggest that expansion of the bodies of the upper and lower jaws have substantially increased the strength of these structures, while changes in tooth morphology from multicusped to single-cusped do not affect structural strength of the tooth. Additionally, simulated comparisons of cartilaginous vs. bony jaws indicate that the structural performance and force-transmitting ability of prismatically calcified cartilage are surprisingly high. These data will assist in the development of a conceptual framework for future phylogenetically-informed studies on the structural evolution of chondrichthyan feeding mechanisms. As chondrichthyans are the most basal extant gnathostomes, these analyses will also shed light on both the evolution of jaws and the evolution of cartilage as a skeletal material.

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214 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Klaus Huebert, Su Sponaugle, Robert Cowen

University of Miami / RSMAS, Miami, FL, United States

Effects of Vertical Migrations by Pelagic Reef Fish Larvae on Larval Transport

The degree to which the population connectivity of fishes is influenced by active behavior of fish larvae remains controversial. One type of behavior that potentially affects larval transport is vertical migration between depths with different ambient currents. Our objective was to describe the vertical migrations of pelagic coral reef fish

larvae in the Straits of Florida, and quantify their influence on larval transport. Spring, summer, and fall time series of plankton net tows were conducted offshore of Miami. The upper 100 m of the water column was sampled repeatedly at 3 h intervals for two diel cycles, with different nets sampling at four discrete depth ranges. Simultaneously, currents at depth were recorded by a shipboard ADCP instrument. Length and developmental stage were determined for over 7,000 larvae of 11 reef fish families. In several taxa, larger larvae were distributed significantly deeper than smaller larvae, revealing downward vertical migration with ontogeny. Vertical distributions of some taxa also varied significantly between day and night, revealing diel vertical migrations. The dominant alongshore component of the Florida Current resulted in rapid transport through the Straits of Florida, while cross-shore current was an order of magnitude weaker and highly variable. Progressive vector diagrams of currents at different depths revealed that that transport of larvae at deeper depths was substantially less than in the upper water column, possibly favoring retention in the Straits of Florida. Our results demonstrate that species-specific larval vertical migration behavior can affect larval transport and connectivity.

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215 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Klaus Huebert, Su Sponaugle

University of Miami / RSMAS, Miami, FL, United States

Observed and Simulated Swimming Trajectories of Late-stage Coral Reef Fish Larvae Offshore of the Florida Keys

The supply of coral reef fish larvae from the open ocean to individual reefs is vital for the persistence of local fish populations. Larvae that are competent to settle are often fast swimmers, and their transport may depend on swimming behavior as well as currents. Our goal was to measure the effects of swimming behavior during the final stretch of larval transport. We observed late-stage bicolor damselfish (*Stegastes partitus*) larvae 1 km offshore of French Reef, Key Largo, Florida, and recorded their *in situ* swimming trajectories. While all larvae swam remarkably straight, their swimming directions were distributed randomly. Larvae swam at speeds of 2 - 32 cm s^{-1} and transport due to swimming was of similar magnitude as transport due to cross-shore current, but much less than transport due to alongshore current. We used a simulation model to generate swimming trajectories of much longer duration than could feasibly be observed directly. This enabled us to better quantify the contribution of swimming behavior to larval transport. The observed and simulated swimming trajectories indicate that horizontal swimming by larvae with or without an external reference frame is important at spatial scales of several km.

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78 Poster Session II, Saturday 25 July 2009

Kimberly Hughes[1], Wesley Warren[1], F. Helen Rodd[1]

[1]Florida State University, Tallahassee, FL, United States, [2]Washington University Genome Sequencing Center, St. Louis, MO, United States, [3]University of Toronto, Toronto, Ontario, Canada

Developments in Poeciliid Genomics

Poeciliid fishes have long been important models in animal behavior, ecology, and evolutionary biology. Development of genetic and genomic resources for poeciliids has lagged behind that seen in many other fish species. Nevertheless, this kind of resource development has been accelerating in the last few years. This talk will describe some of the new resources that are coming online, and also propose some ways in which the research community could deploy these new tools.

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659 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

C. Darrin Hulsey

University of Tennessee, Knoxville, TN, United States

Comparative Lower Jaw Evolution in Cichlid Adaptive Radiations

The lower jaw is a major determinant of feeding diversification in cichlid adaptive radiations. It also provides an ideal phenotype to compare rates and patterns of macroevolution among cichlid radiations. Using a novel phylogeny of four genes (ND2, Dlx2, Mitfb, and S7), I examined the phylogenetic relationships among two of the most evolutionarily disparate cichlid radiations: 1) the Heroines of Central America and 2) the Lake Malawi species flock. To quantify jaw morphology, I measured the in-levers and out-levers of the lower jaw in 38 and 51 species in each flock respectively. Then I examined the modularity of the jaw across the phylogeny and compared how integrated the jaw was in the two radiations. Using several external calibration points, I also generated a time-calibrated chronogram for both groups and examined the rates that jaw morphology and mechanics evolved in the two radiations. The rates differed in surprising ways between the two clades.

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717 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Peter Hundt, Andrew Simons

University of Minnesota, St. Paul, MN, United States

Phylogenetic Relationships of Studfish, Subgenus *Xenisma* (Teleostei: Cyprinidontiformes: Fundulidae: *Fundulus*) Using Morphological and Molecular Characters

The Studfishes, genus *Fundulus*, subgenus *Xenisma* include 5 extant (*Fundulus bifax*, *F. catenatus*, *F. julisia*, *F. rathbuni*, and *F. stellifer*) and 1 extinct (*F. albolineatus*) species which are found in clear freshwater streams throughout southeastern and central United States. The extant species inhabit the Mobile Basin (*F. stellifer* and *F. bifax*), the Mississippi River Basin (*F. catenatus* and *F. julisia*), and the Atlantic Slope Drainage (*F. rathbuni*). A previous study used morphological data in a phylogenetic analysis of *Xenisma* to determine that *F. rathbuni* is sister to a monophyletic group containing all remaining extant member of *Xenisma*. Within that clade, *F. julisia* and *F. albolineatus* were sister to a polytomy containing *F. catenatus*, *F. bifax*, and *F. stellifer*. Herein, I use phylogenetic analyses of mitochondrial and nuclear loci combined with morphological data to address the unresolved polytomy and to further analyze the relationships within *Xenisma*.

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744 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Ione Hunt von Herbing

University of North Texas, Denton, TX, United States

Connectivity and Conservation Physiology in Cold-Oceans

Generally, within the marine environment, our understanding of the processes that regulate and maintain connectivity and biodiversity is limited, but much less is known about cold ocean ecosystems. Perhaps, what is critically missing is knowledge of geographically based differences in physiological traits and whether such differences affect the allocation of internal energy resources to biological processes such as growth, reproduction and activity metabolism. Using new knowledge and perspectives from the exciting and emerging field of Conservation Physiology, I will explore relationships between connectivity and physiology in a commercially important marine fish, Atlantic cod, *Gadus morhua*, which has been the focus of my research for over 20 years. This boreal and Arctic species is an important case study for conservation, as it has suffered enormous declines due to anthropogenic threats over the last several decades. Linking connectivity and conservation physiology will assist in determining the degree of threat

to marine fishes and therefore help to set priority areas for conservation action. In my experience there is a need for investigator awareness of geographically based differences in approaches, training, research etc., particularly in a field as technologically challenging as physiology. More important than acknowledging the differences among us, is the willingness for diverse investigators to cooperate and share information, as this may serve to contribute to our understanding of how resilient or weak fish populations are to global environmental stress.

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813 General Herpetology, Galleria South, Sunday 26 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Kristiina Hurme

University of Connecticut, Storrs, CT, United States

Anti-predator Behavior and Activity Budgets in Schooling vs. Non-schooling Tadpoles

Group-living is a widespread phenomenon among animals that increases survival through increased predator detection and dilution of risk. Anuran larvae experience high levels of predation in aquatic environments and tadpole schooling has evolved independently in many anuran lineages, presumably as an anti-predator defense. Individuals within schools experience safety in numbers and may exhibit increased activity and foraging levels that are too risky for solitary tadpoles. This increased foraging allows for rapid development (and therefore less time spent in the larval stage), yet increases conspicuousness to predators. I compared the activity budgets and anti-predator behavior of schooling (*Leptodactylus insularum*) and non-schooling (*Physalaemus pustulosus*) Neotropical tadpoles. Schooling tadpoles exhibited higher activity levels in the absence and presence of predators, and were more vulnerable to insect predation.

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187 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Thomas Hurst[1], Benjamin Laurel[1], Stephan Munch[2]

[1]Alaska Fisheries Science Center, Newport, OR, United States, [2]Stony Brook University, Stony Brook, NY, United States

Ontogenic, Thermal, and Cohort-specific Effects on Growth Rates of Early Life Stages of Pacific Cod

Pacific cod (*Gadus macrocephalus*) is an important component of fisheries and foodwebs in the north Pacific Ocean and Bering Sea. However, vital rates of early life stages of this

species have yet to be described in detail. We experimentally determined the thermal sensitivity of growth rates of eggs, larvae, and juveniles. Two experiments were carried out with different stages of larvae and three experiments were carried out with juveniles (6 experiments total). Growth rates at each ontogenetic stage were measured in three replicate tanks at 3-5 temperatures, encompassing the range likely to be encountered by fish in the Gulf of Alaska and Bering Sea. Specific growth rates increased with temperature at all stages and decreased with increases in body size. Juveniles appeared more responsive to temperature variation than larvae: growth rates among larvae at 8°C were 82% higher than those observed at 2°C; rates among juveniles averaged 153% higher at 8°C than 2°C. Larval experiments were conducted with laboratory-reared fish and produced similar temperature reaction norms among years. However, in juvenile experiments conducted with fish from naturally produced cohorts, the observed temperature reaction norms varied among years. Of three cohorts examined, the fish spawned in a cold year (2007) performed best at low temperatures but poorest at high temperatures. These data are currently being used to describe spatial and temporal variation in habitat quality for larval and juvenile Pacific cod in the Bering Sea to determine bottom-up effects on recruitment variability.

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909 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009

John Hyde, Carol Kimbrell, Eric Lynn

NOAA Fisheries, La Jolla, CA, United States

Examination of Population Connectivity in Sardine (*Sardinops sagax caeruleus*) in the North East Pacific Using Microsatellite Markers

Sardine (*Sardinops sagax caeruleus*) have long been a major part of the commercial fishery along the west coast of North America. Collapse of sardine populations in the 1940's and 50's devastated commercial fishers and processing. Though large-scale population fluctuations are now known to occur naturally, overfishing may increase the severity of population declines. In recent years the demand for aquaculture feed has placed increased fishing effort on sardine populations. With increasing exploitation of this resource comes the need to ensure proper management of the fishery. Despite extensive tagging studies in the 1930's and 40's the stock structure and dynamics of sardine populations remains poorly understood. Studies of egg and larval abundance suggest that at least two distinct spawning habitats exist, supporting the existence of separate regional stocks. However, genetic studies have yet to yield clear answers to this problem. Genetic stock structure is expected to be minimal when dealing with species that are highly abundant and exhibit migratory behavior. In such cases larger sample sizes and more genetic markers are often necessary to separate the low-level genetic differentiation from the background noise. In an attempt to better address this issue we examined sardine collected at multiple sites from Canada into the Gulf of California using 20 microsatellite markers. Using these data we test previous stock hypotheses and the utility of these markers to monitor the migratory dynamics of these stocks.

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476 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER HERPETOLOGY AWARD

Matthew Igleski

Central Michigan University, Mount Pleasant, MI, United States

Are the Goals of Amphibian Monitoring Programs Being Met by Data Collection Methods?

As a reflex to amphibian declines worldwide state agencies in North America have begun to monitor amphibian populations. Call surveys have become the predominate tool for amphibian monitoring and are generally conducted during peak breeding seasons utilizing volunteers to collect data. However, the current methodology used by several agencies may not be meeting the goals of these monitoring programs. For that reason the question that needs to be addressed is whether data being collected will actually detect decline in amphibian populations. Many studies have tested aspects of survey effectiveness, but not the entire procedure. Criticisms of the current approach have been mentioned in recent studies. Featured criticisms include the collection of data that could be difficult or even impossible to analyze statistically (i.e. inadequate sample sizes), as well as, less than ideal sample procedures. Through these studies it has become evident that some aspects of survey programs could benefit from modifying their sampling methods. Extending time spent at sites and increasing the number of visits to sample sites would likely yield more precise and unbiased data. For example, some studies have suggested spending 10 minutes at each study site (longer than most agencies run surveys) because this ensures a 90% detection of all species present. Making call surveys more effective increases the probability of detecting actual amphibian decline and facilitates better allocation of conservation resources.

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575 AES Ecology II, Galleria South, Sunday 26 July 2009

Johanna Imhoff, Jason Romine, George Burgess

Florida Program for Shark Research, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

Evidence of a Winter Refuge for Juvenile Bull Sharks (*Carcharhinus leucas*) in the Northern Banana River, Florida, USA

The Indian River Lagoon System (IRL), Florida, USA, consisting of the Indian River, Banana River and Mosquito Lagoon, is known to be a nursery area for juvenile bull sharks (*Carcharhinus leucas*), but little is known about movements and habitat use within this estuary. We used passive acoustic telemetry methods to monitor the movements of

juvenile bull sharks within the IRL system. Four juvenile bull sharks (98-122 cm TL) were captured in the northern Banana River within the Kennedy Space Center Restricted Area between December 2008 and March 2009. Preliminary acoustic data indicated that these animals remained within the restricted area during winter months and exhibited similar movement patterns and equal home range sizes (2.35 km^2). One animal was recaptured after 84 days suggesting strong site attachment and allowing for examination of the acoustic tag insertion site. Two sharks were captured during December and all four sharks were captured at temperatures below 20 °C. Previous studies have documented that during the winter months, juvenile bull sharks were typically captured at temperatures above 20 °C and used southern IRL areas such as the Sebastian Inlet. To our knowledge, this is only the second record of the presence of healthy juvenile bull sharks within the northern IRL in December and indicates that juvenile bull sharks overwinter within this area despite potentially deadly episodic cold kill events.

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560 ELHS/LFC Ecology II, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Emilio A. Inda-Diaz[1], Laura Sanchez-Velasco[1], Miguel F. Lavin[2]

[1]Departamento de Plancton y Ecologia Marina - Centro Interdisciplinario de Ciencias Marinas - IPN, La Paz, BCS, Mexico, [2]Departamento de Oceanografia Fisica - Centro de Investigacion Cientifica y Educacion Superior de Ensenada, Ensenada BC, Mexico

Three-dimensional Distribution of Fish Larvae Around a Surface Front in the Gulf of California

The three-dimensional distribution of fish larvae and zooplankton biomass around a surface front south of the central archipelago of the Gulf of California is described from data collected during August 2005, June 2006, and February 2007. Zooplankton samples were obtained with a closing-opening net in four depth strata. In general, zooplankton biomass and fish larvae abundance decreased with depth from a surface maximum, especially during summer (June and August). In June 2006, zooplankton biomass, fish larvae abundance and richness were higher at the south (warm) side of the front than in the north (cool) side; this tendency remained in the deeper layers of the water column. For August 2005 the reverse pattern was found: the highest values of zooplankton biomass were at the north (cool) side, while the highest larval abundance and richness was found at the south (warm) side of the front. In February 2007, when the mixed layer is deeper than in the other periods, high abundance values of fish larvae and zooplankton biomass were observed down to 200 m depth, but with the maximum values in the south (warm) side of the front. The changes in the vertical distribution of the fish larvae and zooplankton biomass are the result of seasonal changes in the hydrographic structure of the water column, caused by several physical processes (circulation, mixing, convection).

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683 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Allison Ingram, Gloria Arratia

University of Kansas, Biodiversity Research Center, Lawrence, KS, United States

Cypriniformes Tree of Life: Diversity of Opercular Bones in Cypriniforms and Their Phylogenetic Implications

Although the opercular bones play an important role as a cover for the branchial chamber and with some elements closely connected to the suspensorium, they are rarely used in phylogenetic analyses of actinopterygians, especially of teleosts. Important exceptions are the special shape and relationships of the preopercle in lower actinopterygians, and the presence versus absence of the interopercle in neopterygians. Opercular bones can be highly modified in shape and size in some teleostean subgroups. Among ostariophysans, three opercular characters have been interpreted as synapormphies of Siluriformes. Phylogenetic analyses of Cypriniformes have suggested a few characters as potential synapomorphies of certain subgroups (e.g., Catostomidae, Cyprinidae). However, a comprehensive survey of patterns of variation in the cypriniform opercular series and the sensory canals associated with them is missing. Preliminary data demonstrate that the opercular bones vary in a number of elements: articulation and relationships between the opercular and other cranial bones; shape; processes; and the development and patterns of the sensory canal system and its relationships to the rest of the cephalic sensory system. This variation likely represents a potentially rich source of phylogenetic characters, which may contribute significantly to the understanding of cypriniform interrelationships. We will present our findings on the morphological patterns of opercular bones and their variation in Cypriniformes.

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808 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Richard Inman[1], Kenneth Nussear[1], C. Richard Tracy[1]

[1]USGS, Henderson, NV, United States, [2]UNR, Reno, NV, United States

Predicting Spring Activity in Desert Tortoises (*Gopherus agassizii*)

Current methods to estimate population density for *Gopherus agassizii* require knowledge of the proportion of animals that are active during times when sampling is conducted. Assessing the proportion of animals that are active is both time consuming and expensive to obtain. We used bio-logging techniques (a new field that can be defined as the investigation of phenomena in or around free-ranging organisms that are beyond the boundary of our visibility or experience) to measure the activity of twenty-four adult desert tortoises for two and a half months during the middle and end of the activity season in 2005 and 2006. From these data we developed models using environmental and operative temperatures to predict the proportion of tortoises that

were above ground and active for daily and hourly time-scales using beta-regression and multi-model inference methods. Climate-derived variables were able to explain 76% of the daily and 68% of the hourly activity of desert tortoise. Soil and air temperatures provided the greatest predictive inference, while measures of humidity and wind-speed provided little inference. We found that the accuracy of these simple biophysical models were no worse than current methods that require intensive field observations of animals with VHF radio-telemetry. We suggest that current methods to estimate population density could use predictive models that incorporate biophysical variables to predict daily activity instead of traditional personnel intensive field methods with no loss of accuracy or precision and at a much lower cost.

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725 Fish Systematics, Pavilion East, Monday 27 July 2009

Kristen Irwin, Aldemaro Romero

Arkansas State University, Jonesboro, AR, United States

Evolution of Troglomorphisms among Hypogean Fishes do not Occur in Parallel

Many hypogean species exhibit a series of features associated with the subterranean environment referred to as troglomorphisms. These characters most commonly include reduction and/or loss of eyes and pigmentation. In cave dwelling fishes, a reduction in number and complexity of scales has also been reported. Though not all hypogean fish species exhibit troglomorphisms, those that do often show a great variance in reduction of the characters, even within the same species. We performed an analysis of these variations for eye development, pigmentation and scales. To that end, we compared those features for the 298 species of cave fishes described to date. These characters were quantified for each species and used to analyze evolutionary patterns. We found that the reduction/loss of these features do not occur in parallel. We propose that such a finding is the result of a combination of varying environmental conditions as well as the phylogenetic history of these species.

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926 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Leigh Anne Isaac

University of Victoria, Victoria, BC, Canada

Exploring Relationships between Garter Snake Color Pattern and Behavior: A Comparison of Phenotypically Variable Populations of Wandering Garter Snake, *Thamnophis elegans vagrans*

It has been widely demonstrated in the literature that colour is important to organisms, particularly those that live in habitats where light predominates. For example, colour patterns influence an individual's ability to forage, communicate with conspecifics, thermoregulate, and avoid predators. Predation is a major selective force and in response, prey have evolved a variety of morphological and behavioural adaptations to avoid being eaten. Early work on animal colour patterns showed that dorsal pigmentation patterns in snakes were correlated with different predator avoidance behaviours. More specifically, striped and uni-coloured species relied on flight to avoid being eaten. Irregularly banded and blotched species, on the other hand, relied on defense and these patterns likely functioned to reduce initial detection by predators. Here, I test these predictions using the Wandering Garter Snake, *Thamnophis elegans vagrans*. I examine intraspecific differences in behaviour of *T. e. vagrans* from two phenotypically distinct populations across British Columbia that exhibit differences in colour type. I present the preliminary behaviour and locomotory performance data measured both *in situ* and in the laboratory to examine intraspecific relationships between snake colour pattern and behaviour. I interpret these data in the context of an animal's ability to be camouflaged or cryptic in the surrounding environment using disparity values as described by Endler & Mielke (2005). I also consider long-term implications of variation in colour pattern and its connection with behaviour by considering patterns of injuries that are sustained by snakes in the field.

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543 Poster Session I, Exhibit Hall, Friday 24 July 2009

Asiful Islam

SERI, Harvard Medical School, Boston, MA, United States

Induced Insemination of Thai pangas (*Pangasius sutchi*) by PG and HCG Hormone Extracts

The spawning of *Pangasius sutchi* was induced by pituitary gonadotrophin (PG) and human chorionic gonadotropin (HCG) hormone extracts. The total-standard length curve showed a straight line with a strong correlation (r = 0.986 and 0.987). The length-

weight relationship was best expressed in logarithmic scale, followed by a cube law. Absolute fecundity of *P. sutchi* ranged from 122000 to 241900 oocytes, with an average of 181950 oocytes. During the peak-spawning season, in the single-dose PG hormone induction, the average number of eggs released was 182075 ± 95136, the fertilization rate was 69-95%, and the average hatching rate was 70.04 ± 34.73%. In the double-dose HCG hormone induction, the following number of eggs was released: 50000 to 200000. The average fertilization rate was 73.00 ± 40.99% and the average hatching rate was 58.33 ± 32.78%. With the double dose PG hormone extract, the following number of eggs was released: 160000 to 260000. The average fertilization rate was 76.50 ± 42.68% and the average hatching rate was 58.75 ± 32.83%. PG hormones performed successful hatchings in Thai pangas. The suitable water temperature for breeding and hatching was 28-34^0 C. The physicochemical parameters of water had a role in the induced reproduction and growth of *P. sutchi* fry and fingerlings.

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869 Herp Systematics, Pavilion West, Thursday 23 July 2009

Todd Jackman, Aaron Bauer, Eli Greenbaum

Villanova University, Villanova, PA, United States

Phylogenetic Relationships of the "*Gekko* Group" Geckos

The “Gekko group” consists of seven gekkonid gecko genera that have previously been considered to be closely related on the basis of similarities in pedal structure. The group includes the genera *Gehyra*, *Hemiphyllodactylus*, *Gekko*, *Lepidodactylus*, *Luperosaurus*, *Perochirus* and *Pseudogekko*. In addition, the parachuting geckos of the genus *Ptychozoon* have also been assumed to be allied to *Gekko*. Using multiple nuclear and mitochondrial genes, we show that these genera form two well-supported clades, but there is no support for the monophyly of the group as a whole. *Gehyra*, *Hemiphyllodactylus*, and *Perochirus* constitute one major clade and all remaining genera are strongly supported as a monophyletic group with affinities to other groups of Asian-Pacific geckos. In the clade that contains the genera *Gekko* and *Lepidodactylus*, we have sampled about half of the known species. *Ptychozoon* is nested within the genus *Gekko* and a unique deletion in the nuclear gene RAG1 unites it with *G. vittatus* and several Indochinese species of *Gekko*. The genera *Pseudogekko* and *Luperosaurus* are nested within the genus *Lepidodactylus* and the latter genus exhibits a particularly close relationship to *Lepidodactylus* from Vanuatu and the Solomon Islands. This is somewhat surprising given the superficial similarity of *Luperosaurus* to members of the genera *Gekko* and *Ptychozoon*. There is no significant conflict between mitochondrial and nuclear genes. This phylogenetic hypothesis shows a fairly common pattern of morphologically and ecologically specialized forms arising within widespread generalist species.

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142 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009

Kelsey James[1], David Ebert[1], Douglas Long[2], Dominique Didier[3]

[1]Pacific Shark Research Center, Moss Landing Marine Laboratories, Moss Landing, CA, United States, [2]Oakland Museum of Califonrnia, Oakland, CA, United States, [3]Millersville University, Millersville, PA, United States

A New Species of Chimaeroid, *Hydrolagus* sp. nov. (Chondrichthyes: Chimaeriformes: Chimaeridae) from the Eastern North Pacific

A new species of chimaera, *Hydrolagus* sp. nov., (Chimaeridae) is described from the eastern North Pacific. It is distinct from other eastern Pacific chimaeroids by the following characteristics: a large dorsal fin spine extending beyond dorsal fin apex, a long second dorsal fin of uniform height throughout, trifid claspers forked for approximately one-quarter the total clasper length and a uniform black coloration. This new species is compared to other eastern Pacific members of the genus *Hydrolagus* including *H. mccoskeri*, *H. alphus*, *H. macrophthalmus*, and *H. colliei*. Remote operated vehicle (ROV) video footage has identified and documented the new *Hydrolagus* species from the Gulf of California. ROV observations suggest that individuals typically occur over soft-bottom habitats or cobble patches with minimal vertical relief. This is in contrast to other eastern Pacific *Hydrolagus* species that tend to occur in areas of high rocky relief. The known distribution of this new species at present extends from southern California, along the Baja California Peninsula and into the Gulf of California.

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758 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Fredric Janzen

Iowa State University, Ames, IA, United States

Climate Change and Temperature-dependent Sex Determination in Turtles

Turtles globally are increasingly imperiled, primarily by anthropogenic processes. Now, rapid global climate change stands to exacerbate these problems, since so many of these species also have temperature-dependent sex determination (TSD). In this talk, I present findings obtained from over two decades of collaborative study of a population of painted turtles (*Chrysemys picta*) with TSD. I first illustrate the considerable sensitivity of offspring cohort sex ratios to annual variation in climate and then report on quantitative genetic analyses of key traits that could permit TSD in this population to adapt to biased offspring sex ratios expected under climate change. The results of this extensive research indicate that field heritabilities of (1) thermal sensitivity of embryonic sex determination, (2) nest-site choice with respect to vegetation cover, and (3) timing of nesting are all

small. Thus, the potential for evolutionary response of TSD to expected climate change appears to be limited. The implications of these findings will be discussed in the context of possible conservation and management actions.

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703 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Robert Javonillo

George Washington University, Washington, DC, United States

Evolution of Reproductive Novelties Among Characid Fishes (Teleostei: Ostariophysi) as Revealed by an Emergent Phylogenetic Signal in Molecular Data

The family Characidae is a diverse group of otophysan fishes divided into 13 subfamilies and numerous genera that are not part of any subfamily (i.e., incertae sedis). Comparative studies of reproduction have been hampered by lack of cladistic resolution among characid lineages. To overcome this obstacle, I assembled a matrix of 98 taxa, representing members of most subfamilies and a number of incertae sedis genera. Character data were obtained from PCR amplifications and sequences from prior studies. Sequences fell into four gene partitions, with three genes in the mitochondrial subset (12S, 16S, COI genes) and one gene in the nuclear subset (RAG2 gene). Paradoxically, the partition with the fewest informative characters dominated the phylogenetic signal. Phylogenies inferred under both Bayesian and parsimony criteria reject the monophyly of certain groups (e.g., *Hyphessobrycon*, *Knodus*, *Bryconamericus*, Stevardiinae), do not reject the monophyly of others (e.g., Cheirodontinae, "clade A" of previous authors), and present new sister-group hypotheses (e.g., Aphyocharacinae sister to Cheirodontinae, *Brittanichthys* sister to *Paracheirodon*). When insemination is mapped onto either the Bayesian or parsimony tree, it has at least four origins, each associated with evolutionary modifications of the spermatozoon. One explanation for similarities in courtship behaviors among corynopomins involves behavioral homology with different underlying morphological substrates. If the "gill gland," a sexually dimorphic structure thought to secrete pheromones, evolved in a Dollo-like manner, it was present in the most recent common ancestor of *Exodon*, Tetragonopterinae, Characinae (excluding *Gnathocharax*), Aphyocharacinae, Cheirodontinae, and "clade A.

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106 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Benjamin Jellen, Robert Aldridge

St. Louis University, St. Louis, MO, United States

Mating Order: A Proximate Mechanism Underlying the Occurrence of Differential Paternity within the Ophidia

Females receive ample sperm to fertilize all available ova through a single mating event, yet females of many taxa will mate multiple times and with multiple males during the mating period. Multiple paternity in the ophidia was first documented in 1941; however, its widespread occurrence and intra-litter paternity patterns were not realized until the advent of molecular techniques approximately 40 years later. Recent research has focused on why females multiply mate and has spawned numerous hypotheses including: insurance against male sterility, genetic incompatibility avoidance, trading-up, and increased genotypic and/or phenotypic affects for resultant offspring. However, laboratory and field investigations designed to examine these hypotheses have proved inconclusive providing inconsistent results within and among species. Only one study has examined the affects of mating order on paternity and, using staged laboratory mating trials, demonstrated an advantage for the first mating male. We radio-equipped free-ranging female Nerodia sipedon and monitored their reproductive behaviors up to six times daily throughout the 2007-2009 mating periods. Morphological measurements and mating order were recorded for all mating males and blood was collected from all individuals. All dams, sires, and offspring were genotyped at six microsatellite DNA loci to determine intra-litter paternity patterns and for potential genotypic affects for resultant offspring. Here, Preliminary data supports the hypothesis that differential paternity within the ophidia is simply a function of mating order, particularly for outbred populations of species not exhibiting male-male combat. This is the first study to examine mating order affects in a free-ranging snake species.

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15 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Farish A. Jenkins, Jr.

Harvard University, Cambridge, MA, United States

Darwin's Tangled Bank: *Tiktaalik roseae* and the Landmark Vertebrate Transition to Terrestrial Life

The discovery of well-preserved amphibious elpistostegalian fish in the Upper Devonian Fram Formation of the Canadian Arctic archipelago (originally deposited on a near-equatorial landmass) provides unique documentation of the transformations of cranial

and postcranial features under the selective influence of a major shift in physical parameters between aqueous and terrestrial environments. Although some typically piscine features persist (bony scalation, lepidotrichia, robust branchial skeleton), the head, trunk and appendages all evidence structural changes related to challenges induced by an increase in gravitational loading, and feeding and moving in shallow water and on terrestrial substrates. Kinesis of various components of the skull known in other sarcopterygians (e.g., the palatoquadrate, and the bipartite, jointed braincase) is abandoned; the broad, flat and well-consolidated skull bears elevated orbits, and is free to move independently of the trunk through reduction and loss of the opercular and supracleithral series, with the establishment of a true neck. In sarcopterygians such as *Eusthenopteron* the short ribs are confined to the paraxial region. In *T. roseae*, the integrity of the thoraco-abdominal cavities and the stability of the trunk are promoted by costal elongation, and the establishment of broad, imbricating costal plates, a feature inherited by early tetrapods. Joints of the robust pectoral fin permitted shoulder and elbow flexion, and extension of distal elements, that functioned in limb-like support. Although numerous lineages of terrestrial vertebrates ultimately reverted to aquatic habits and re-acquired swimming and diving adaptations, elpistostegalians represent the singularly known case of the emergence of terrestrial tetrapods.

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702 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Tereza Jezkova, Jef Jaeger, Brett Riddle

University of Nevada, Las Vegas, Las Vegas, NV, United States

Does Climatic Change Promote Niche Evolution? A Case Study Of The Desert Horned Lizard (*Phrynosoma platyrhinos*)

We evaluated phylogeographic structure, niche partitioning, and late Quaternary range shifting in the desert horned lizard (*Phrynosoma platyrhinos*) - a desert-adapted species from the Mojave, Sonoran, and Great Basin deserts of North America. We sequenced mitochondrial DNA from 212 specimens of *P. platyrhinos*, representing 102 localities, and conducted tree and network analyses. We evaluated range shifts as a response to climatic changes since the last glacial maximum (LGM) using ecological niche modeling. We explored climatic niche partitioning with respect to the mtDNA clades and the stability of regional populations. The phylogeographic analysis reveals high genetic diversity and pronounced structure within the Mojave and Sonoran deserts but low diversity within the Great Basin. The lizards from the Great Basin exhibit thinning of haplotypes in a northward direction consistent with relatively recent expansion northward, most likely following the warming climate after the LGM. This interpretation is supported by the ecological niche models which indicate that during the LGM, the climatic niche remained suitable for the species within the Mojave and Sonoran deserts but not in the Great Basin. Assessments of climatic niches indicate that the populations of *P. platyrhinos* from the Great Basin occupy a non-overlapping climatic

niche with respect to populations from the more climatically stable regions in the south. We speculate that the climatic changes at the end of the last glacial period may have created a novel niche space in the Great Basin that promoted niche evolution in these lizards.

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326 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Katherine Jirik, Christopher Lowe

California State University Long Beach, Long Beach, CA, United States

Influence of Temperature on the Habitat Use and Movement Patterns of Round Stingrays in a Southern California Estuary

Sexual segregation among elasmobranchs often results in differential habitat use, with females of some species moving into shallow, inshore environments during certain seasons. Generalizing habitat preferences can be complicated further if thermal regimes differ between habitat types within an inshore environment (e.g. restored vs. natural estuarine areas). We compared the abundance and movement patterns of round stingrays (*Urobatis halleri*) in restored and natural habitats of the Anaheim Bay Estuary (California, USA) to determine whether rays prefer warmer water habitats and if females utilize restored areas during pregnancy. Rays were seasonally abundant with the highest densities occurring from June-August. Higher ray densities correlated with warmer seafloor water temperatures. Ray densities were also higher in the restored habitat than the natural habitat. All rays collected in restored areas during summer were female, but sex ratios in natural areas were only slightly female-biased. Pregnancy was confirmed for female rays collected in restored habitat using ultrasonography. Ultrasound image analysis revealed a difference in the developmental stages present between mid-summer and early fall. In addition, a study of ray short-term movements showed that the proportion of time female rays spent in restored habitat decreased as water temperatures decreased. Longer-term movements indicated that most rays that used restored areas emigrated from the estuary in late summer or early fall, just before water temperatures in restored habitat began to decrease. Water temperature influences ray habitat preference, and pregnant females that aggregate in restored areas may attain a thermally-derived reproductive benefit by selecting warmer habitats during gestation.

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333 Poster Session I, Exhibit Hall, Friday 24 July 2009

Katherine Jirik, Christopher Lowe

California State University Long Beach, Long Beach, CA, United States

First Reported Occurrences of the Green Sea Turtle, *Chelonia mydas*, in the Anaheim Bay Estuary (Seal Beach, California)

This study reports the first known observations of *Chelonia mydas* in the Anaheim Bay Estuary (Seal Beach National Wildlife Refuge, California, USA). Observations of *C. mydas* were made in conjunction with another project, particularly in relation to different estuarine habitat types (mitigated, natural, or harbor), season, and seafloor water temperature. *C. mydas* were only sighted in mitigated habitat, often in groups of 2-4 individuals. *C. mydas* were observed during August and September in 2007, and from June-October in 2008. Using seafloor water temperature monitoring equipment, we approximated the ambient water temperature conditions that *C. mydas* experienced when sighted. The mean water temperatures at the time of sighting in 2007 and 2008 were 23.7°C and 22.7°C, respectively. Stinson (1984) similarly found that the mean body temperature of *C. mydas* studied during winter in San Diego Bay, California, was 23.35°C. Despite the difference in latitude between Seal Beach and San Diego and the time of year when *C. mydas* are present in each location, individuals appear to select waters of a similar temperature range. Our study highlights the importance of understanding that a successfully-restored southern California estuary has the potential to support a small number of *C. mydas* individuals, and that the temperature preference of this species may affect which marine environments it perceives as viable habitat. These perceptions, along with other thermal influences such as heated seawater effluents and climate change, may affect the distribution pattern of seasonally resident *C. mydas* populations in the northeastern Pacific.

1007 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009; ASIH STOYE AWARD CONSERVATION

Denim Jochimsen

University of Idaho, Moscow, ID, United States

Seasonal and Landscape Variation of Snake Road Mortality on the Upper Snake River Plain

Understanding the complexity of road effects on wildlife becomes increasingly important as these urban features continue to expand across the landscape. Roads bisect a range of habitats, and can negatively influence wildlife through mortality inflicted by vehicles and disruption of movement patterns. A growing literature base implicates

roads in the decline of amphibian and reptile populations, although these groups are underrepresented in road ecology studies. This research was designed to document the magnitude of road mortality on snake species that occur in sagebrush steppe habitat, provide insight into how susceptibility to this mortality differs among species, season, and by sex and age class of individuals, and examine how different landscape variables influence the spatial pattern of road-kills. I conducted road-cruising surveys along a 183-km route in southeastern Idaho in 2003 and documented an overall mortality rate of 0.020 snakes/km traveled, with 93.3% percent of all individuals discovered dead on the road. Individuals comprised 4 different species, however, the majority of observations (74.7%) were of gophersnakes (*Pituophis catenifer*). Road mortality varied seasonally by age and sex for both gophersnakes and western rattlesnakes (*Crotalus oreganus*) and observations were most strongly associated with percent grass cover for both species. The positive association with grasses, which are mostly invasive cheatgrass and crested wheatgrass, suggests that habitat conversion may be increasing the likelihood of road mortality as opposed to sagebrush dominated areas.

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823 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Mattias Johansson

Coastal Oregon Marine Experiment Station, Hatfield Marine Science Center, Oregon State University, Newport, OR, United States

Pheromone Receptor Gene Diversity in Rockfishes (Genus *Sebastes*)

Pacific coast rockfishes (*Sebastes* spp.) comprise an extremely diverse and successful species complex. They are found from the inter-tidal to depths greater than 1500 m, in almost every habitat type from Mexico to Alaska. With an estimated 102 species in this group, rockfish present unique opportunities to use genetic studies to examine the process of speciation. The use of odor cues has been proposed as one method by which rockfishes recognize conspecifics and select mates. Changes in mate recognition may provide one mechanism for the formation of reproductive isolation in rockfishes. Mate pairing in rockfish is discrete because they have internal fertilization and require complex courtship rituals before copulation can take place. In general, male rockfish align themselves next to a female before swimming forward and placing their urogenital papilla near the snout of the female. It has been suggested that this behavior allows the male to release a courtship pheromone as near as possible to the olfactory bulb of the female. The vomeronasal type one (V1r) pheromone receptor gene family is one of two families of receptors used to detect pheromones in mammals. Although fishes lack a vomeronasal organ, numerous species have been shown to possess complete V1r genes. In this project, we have sequenced a 500-bp segment of V1r genes from five species of rockfishes, *Sebastes caurinus*, *S. maliger*, *S. melanops*, *S. ruberrimus*, and *S. crameri*. Preliminary results suggest that V1r genes are conserved among widely separated species of rockfishes, and that closely related species may share alleles.

630 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Mattias Johansson[1], Michael Banks[1], Katie Glunt[2], Heather Hassel-Finnegan[2], Vincent Buonaccorsi[2]

[1]Coastal Oregon Marine Experiment Station, Hatfield Marine Science Center, Oregon State University, Newport, OR, United States, [2]Department of Biology, Juniata College, Huntingdon, PA, United States

Influence of Habitat Discontinuity, Geographical Distance, and Oceanography on Fine-scale Population Genetic Structure of Copper Rockfish (*Sebastes caurinus*)

The Copper Rockfish is a benthic, nonmigratory, temperate rocky reef marine species with pelagic larvae and juveniles. A previous range-wide study of the population-genetic structure of copper rockfish revealed a pattern consistent with isolation-by-distance. This could arise from an intrinsically limited dispersal capability in the species or from regularly-spaced extrinsic barriers that restrict gene flow (offshore jets that advect larvae offshore and/or habitat patchiness). Tissue samples were collected along the West Coast of the contiguous USA between Neah Bay, WA and San Diego, CA, with dense sampling along Oregon. At the whole-coast scale (~2200 km), significant population subdivision (FST = 0.0042), and a significant correlation between genetic and geographical distance were observed based on 11 microsatellite DNA loci. Population divergence was also significant among Oregon collections (~450 km, FST = 0.001). Hierarchical AMOVA identified a 130-km habitat break as a weak but significant barrier to gene flow within Oregon, across which we estimated that dispersal (Nem) is half that of the coast-wide average. However, individual-based Bayesian analyses failed to identify more than a single population along the Oregon coast. In addition, no correlation between pairwise population genetic and geographical distances was detected at this scale. The offshore jet at Cape Blanco was not a significant barrier to gene flow in this species. These findings are consistent with low larval dispersal distances calculated in previous studies on this species, support a mesoscale dispersal model, and highlight the importance of continuity of habitat and adult population size in maintaining gene flow.

798 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Angela Johnson, Lorenzo Ciannelli

Oregon State University, Corvallis, OR, United States

Effects of Hypoxia on Ichthyoplankton and Micronekton Communities Off the Oregon and Washington Coasts

Nearshore hypoxic events (DO < 2 mg/L) have been detected every summer since 2002 off the Central Oregon coast. Both upwelled hypoxic waters and increased local microbial respiration of organic carbon contribute to the decrease in oxygen within nearshore waters. There is a paucity of study addressing the effect of low DO on fish eggs and larvae for systems where coastal hypoxia is driven by upwelling currents. This is particularly unfortunate, given that these regions sustain a large fraction of the coastal ocean productivity. This study examines the spatial and temporal patterns of larval fishes along the Oregon and Washington coasts in relation to low DO waters. Study objectives include 1) identifying horizontal and vertical distributions of fish eggs and larvae in relation to water DO and 2) examining the size and condition (body mass/length index) of larval fish in relation to the water DO. Plankton samples were collected using a Hydrobios multi-net during the summer 2008 from multiple sites along the Oregon and Washington coasts. Larvae and eggs were identified to the lowest possible taxa. Species abundance was calculated and compared to environmental parameters (i.e. temperature, salinity, and dissolved oxygen). We expect to find lower fish densities in the core of the low DO waters and higher densities in adjacent non-affected areas. We also expect the altered abundance and distribution patterns to affect the size and condition of fish.

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772 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Darren Johnson, Mark Christie, Jessica Moye, Mark Hixon

Oregon State University, Corvallis, OR, United States

Quantifying Genetic and Environmental Variation in Larval Quality for a Marine Fish

For many marine fishes, early life history traits such as body size and growth rate may influence survival during the larval and post-settlement phases. Here, we summarize how larval size-at-hatching is correlated with survival in many species of fish and discuss the extent to which selective mortality of larvae may affect the dynamics of benthic populations. Next, we examine sources of variability in larval size and

swimming performance for a wild population of marine fish (the bicolor damselfish, *Stegastes partitus*), focusing on both environmental and genetic sources of variation. We measured larvae collected over two summers and quantified the degree to which the observed variation in larval size and swimming performance could be explained by both environmental and genetic effects. We used mixed-effects models and maximum likelihood estimation to model variation in larval traits as a combination of several causal components, including temperature, population density, site, year, lunar cycle, maternal effects and additive genetic variance. Studies of selective mortality of larvae indicate that larger larvae tend to experience greater survival, suggesting that variation in larval size may substantially influence recruitment success. Factors associated with significant variation in larval traits of *S. partitus* included ambient temperature, differences among lunar cycles, maternal effects and additive genetic variance. Our results therefore suggest that both extrinsic (e.g., temperature variation) and intrinsic (genotype) sources of variation in phenotype may have appreciable effects on larval survival and population replenishment.

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163 Fish Systematics II, Pavilion East, Saturday 25 July 2009

G. David Johnson[1], John R. Paxton[2]

[1]NMNH, Smithsonian Institution, Washington DC, United States, [2]Australian Museum, Sydney, Australia

Ontogeny and Systematics of Whalefishes (Stephanoberyciformes: Cetomimidae): Resolution of a Deep-Sea Conundrum, Part 1. History, Ontogenetic Transformations and Sexual Dimorphism

The oceanic bathypelagic realm (1000-4000 m) is a nutrient-poor habitat. Most fishes living there have pelagic larvae using the rich waters of the upper 200 m as a nursery. Morphological and behavioral specializations necessary to occupy such contrasting environments have resulted in remarkable developmental changes and life-history strategies. We have resolved a long-standing biological and taxonomic conundrum by documenting the most extreme example of ontogenetic metamorphoses and sexual dimorphism in vertebrates. Based on morphology (discussed here) and mitogenomic sequence data (analyzed by our Japanese colleagues), we show that fishes currently assigned to three families with greatly differing morphologies, Mirapinnidae (tapetails), Megalomycteridae (bignose fishes) and Cetomimidae (whalefishes), are larvae, males and females, respectively, of a single family Cetomimidae. Morphological transformations involve dramatic changes in the skeleton, most spectacularly in the head, and are correlated with distinctly different feeding mechanisms. Larvae have small, upturned mouths and gorge on copepods. Females have huge gapes with long, horizontal jaws and specialized gill arches allowing them to capture larger prey. Males cease feeding, lose their stomach and oesophagus, and apparently convert the energy from the bolus of copepods found in all transforming males to a massive liver that

supports them throughout adult life. Males are also characterized by extensive hyperossification and coalescence of skeletal elements; the small upper jaws fuse to one another and to hypertrophied nasal bones that support an enormous nasal organ, presumably used to locate females. The remarkable combination of developmental transformations and sexual dimorphism is unparalleled within vertebrates.

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721 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jarrett Johnson, Ben Johnson, Brad Shaffer

University of California, Davis, CA, United States

The Interaction of Temperature and Genotype on Locomotor Performance in a Salamander Hybrid Zone

Pond-breeding amphibians exhibit variation in the duration of the larval period preceding emigration from aquatic habitat to adjacent upland habitat. This plasticity allows the timing of emigratory behavior to coincide with appropriate ambient conditions. In California, introduction of the barred tiger salamander (*Ambystoma tigrinum mavortium*; BTS) has resulted in the formation of a hybrid zone with the native California tiger salamander (*A. californiense*; CTS). Hybridization has created a system in which metamorphic timing varies not only based upon yearly variation in abiotic factors, but with variation in the genotypes of hybrids. The goal of our study was to determine how genotype, morphology, and temperature interact to affect the locomotor performance of emigrating immature salamanders. Using a treadmill we assessed the time to exhaustion at two temperatures for native CTS, introduced BTS, and all 1st and 2nd generation hybrids (F1, F2, and backcrosses). We found that endurance was much greater at 25 C then at 15 C for all genotypes. Within each temperature treatment F1 hybrids exhibited the greatest endurance, followed by each backcross, and then BTS and CTS. These data indicate that emigration from natal ponds is likely facilitated by increased temperature, at least when ambient humidity levels are appropriate. Furthermore, hybrids appear to have improved capability for long-distance movements relative to either pure parental species. It does not appear that the longer times to metamorphosis observed in hybrid populations which result in emigrations at higher average nightly temperatures has a detrimental effect on movement performance.

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716 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Jarrett Johnson, Maureen Ryan, Steven Micheletti, Brad Shaffer

University of California, Davis, CA, United States

The Interaction of Genotype and Hydroperiod Affects Fitness in a Tiger Salamander Hybrid Zone

In California, barred tiger salamander (*Ambystoma tigrinum mavortium*; BTS) introductions are impacting native California tiger salamanders (*A. californiense*; CTS) through competition, predation, and hybridization. In previous laboratory and mesocosm experiments, introduced BTS and hybrids have displayed numerous ecological advantages over native CTS including faster growth, larger size at metamorphosis, faster maturation, cannibalism, and paedomorphosis. Given aquatic breeding habitat that is conducive to the attainment of large larval sizes and paedomorphs, non-native and hybrid tiger salamanders experience much greater fitness than their pure native counterparts. However, natural vernal pools in California have short hydroperiods and the plasticity of the life-history traits conferring advantages to non-native and hybrid tiger salamanders in the lab and man-made ponds is unknown. The purpose of this study is to examine the interaction of hydroperiod and genotype in determining the fitness of CTS, BTS and their hybrids. Using cattle tank mesocosms we compared the survival, time to metamorphosis, and size at metamotrphosis of native CTS, introduced BTS, wild-caught hybrids from seasonal ponds, and wild-caught hybrids from perennial ponds. We found that native CTS experienced greater survival in fast-drying cattle tank treatments than introduced BTS and hybrid salamanders. Additionally, native CTS did not display the strong positive relationship between size at metamorphosis and pond hydroperiod that was observed with introduced BTS and hybrids. These results suggest that both genetic and environmental factors are likely to influence the dynamics of secondary contact between these two species.

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892 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Jerald B. Johnson

Brigham Young University, Provo, UT, United States

Parallel Life History Evolution in Poeciliid Fishes

The poeciliid fishes are an important vertebrate model for understanding life history evolution in the wild. Early studies focused almost exclusively on guppies (*Poecilia reticulata*) and demonstrated the importance of various selective agents in driving life history diversification. Over the past decade, several additional poeciliid species have been studied, adding both breadth and depth to our understanding of poeciliid life history evolution. What is most remarkable about this growing body of work is that in

several cases it appears that common selective agents have independently led to common patterns of evolutionary diversification within species. In this presentation, I review work from our lab group and others showing evidence of parallel life history divergence in poeciliid fishes.

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167 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Gerald Johnston[1], Joseph Mitchell[2]

[1]Santa Fe College, Gainesville, FL, United States, [2]Mitchell Ecological Research Service, LLC, Gainesville, FL, United States

Ecology of Freshwater Turtles in a North Florida River: Spatial Variation in Assemblage Structure

Causes of patterns in community assembly continue to be controversial. One view is that assemblage structure (a-diversity) is closely tied to environmental conditions. Another is that historical factors affecting species entry into a locality can lead to different community structures even if the environment is similar among localities. We evaluated these hypotheses with a mark-recapture study of freshwater turtle assemblages in two ecologically distinct reaches of the lower Santa Fe River in north Florida during 2006-2009. We used a combination of capture methods (snorkeling and baited hoop traps) in both reaches. A rich turtle fauna occurs in both the blackwater (7 species) and spring-dominated clear water (8 species) localities. Species diversity (H') and evenness (J) were similar in both areas. Bray Curtis analyses revealed that both assemblages were similar in structure with the same species *Pseudemys concinna suwanniensis*, a Florida Species of Special Concern, being numerically dominant in both localities. The primary difference in a-diversity was the occurrence of *Chelydra serpentina osceola*: absent in the hard-bottomed blackwater reach but abundant (highest biomass of all species) in the soft-bottomed spring-dominated reach. Overall, the spring-dominated habitat supports higher numbers of individuals and a higher assemblage biomass, perhaps due to the presumed higher primary productivity in this reach which has abundant aquatic vegetation compared to the blackwater reach with little vegetation. Our comparisons suggest that in this north Florida river environmental conditions affect a-diversity more than historical events but that history likely influences temporal dynamics of community assembly on an irregular temporal scale.

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642 ELHS/LFC Connectivity Symposium II, Galleria South, Friday 24 July 2009

Geoffrey Jones[1]

[1]James Cook University, School of Marine and Tropical Biology, Townsville, Queensland, Australia, [2]James Cook University, ARC Centre of Excellence for Coral Reef Studies, Townsville, Queensland, Australia

Dispersal of Coral Reef Fish Larvae: Scales of Self-recruitment and Connectivity

The extent of larval dispersal among coral reefs has important implications for population replenishment, resilience to disturbance and appropriate management strategies. This talk highlights a recent dramatic increase in research effort and a growing diversity of approaches to the study of larval retention within (self-recruitment) and dispersal among (connectivity) coral reef populations. Although the majority of studies continue to rely on population genetics, a wide range of techniques are now being employed, from small-scale larval tagging and paternity analyses, to large-scale biophysical circulation models. Evidence for both extremely local scale patterns of self-recruitment (scales of meters) and ecologically significant connectivity among reefs (scales of 10s to 100s of kilometers) is accumulating. Differences in perceived spatial scales of dispersal largely reflect the scales at which different approaches can be applied. For example, otolith chemistry and population genetic assignment tests cannot accurately estimate local self-recruitment where it is known to occur. Conversely, while larval tagging and parentage analysis can quantify small-scale patterns, they are difficult to apply at scales of 100s of kilometers. Multiple approaches will be necessary to describe and cross-validate measurements over the entire dispersal kernel. Preliminary evidence suggests spatial scales of dispersal in reef fishes are highly variable within species, weakly influenced by larval duration or reef size, but strongly influenced by the geographic/oceanic setting. High levels of both self-recruitment and larval import can contribute to the resilience of reef populations and MPA networks, but these benefits will erode in degrading reef and ocean environments.

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655 Poster Session I, Exhibit Hall, Friday 24 July 2009

Teppei Jono[1], Yoko Inui[2]

[1]Kyoto University, Sakyo-ku, Kyoto, Kyoto, Japan, [2]Osaka Kyoiku University, 4-698-1 Asahigaoka, Kashiwara, Osaka, Japan

Acoustic Behavior of *Gekko japonicus*: The Gecko That Calls in Secret

It has been suggested that most reptiles are mute except for when confronting threatening stimuli. On the other hand, some species of geckos have been known to

vocalize in social contexts. Previous behavioral studies focused only on the species that frequently emit relatively laud calls, such as *Hemidactylus*. The Japanese gecko, *Gekko japonicus*, is a small, nocturnal gecko distributed widely in Japan. This species dwells in urban areas, and they have been believed to be mute except for when confronting threatening stimuli. Staged encounter trials were conducted between individuals of *G. japonicus* to describe its behavioral repertoire. Observed repertoire of *G. japonicus* was similar to geckos that of vocalizing hitherto reported. In addition, vocalization of *G. japonicus* was confirmed, although its sound pressure level (spl) is obviously smaller than that of *H. frenatus*. In most cases, acoustic behavior was observed after two individuals physically contacted each other. The number of individuals called was not significantly different between male-male and female-female trials, and acoustic behavior was often associated with aggressive behavior. In intersexual interactions, one-third of males called whereas only one female called. Intersexual calls were structurally differed from intrasexal calls and were not associated with aggressive behavior. These results show *G. japonicus* vocalizes frequently, but only when they encounter other individuals. These results also suggest intrasexual and intersexual calls of males are functionally different. Moreover, the role of acoustic behavior in this species may be different from that of other geckos that emit frequently loud calls.

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593 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Laura Jordan

California Institute of Technology, Pasadena, CA, United States

Functional Morphology of Elasmobranch Mechanosensory Lateral Line and Electrosensory Systems

The elaborate network of canals associated with the mechanosensory lateral line and electrosensory systems of elasmobranchs have been described and illustrated since the 1600s. Both systems show high degrees of interspecific diversity. Recent studies provide quantitative analyses from system level anatomy down to the functional units or sensory cells. These morphological studies lay the groundwork to understand the functional roles of various structural components of these systems in extant elasmobranchs. Mechanosensory systems differ in distribution, complexity, and mechanoreceptor types. More derived species tend to have increased lateral line branching dichotomy, which is thought to increase receptive field and sensitivity to flow generated by prey, predators, conspecifics and the animals own flow field. Nonpored lateral line canals are unique to elasmobranchs and may facilitate tactile location of prey in benthic species with high proportions of these canals on the ventral body surface. Electrosensory systems vary in pore number and density as well as canal length and orientation. Interspecific differences are related to feeding habitat where benthic feeders tend to have a high number of electrosensory pores concentrated ventrally. While sensitivity to weak

electric fields is similar among species tested, higher pore density around the mouth may enhance accuracy in locating the signal source.

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844 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Mark A. Jordan, Douglas A. Morris, Scott E. Gibson

Indiana University - Purdue University, Fort Wayne, IN, United States

Pre-Settlement History Obscures the Effect of Forest Fragmentation on Genetic Variation in The Eastern Red-Backed Salamander

Forest loss and fragmentation is expected to shape the genetic structure of amphibian populations and reduce genetic variation. Another factor widely understood to have impacted these same parameters in North America is the range expansion that occurred following glacial retreat at the end of the Pleistocene. The Eastern Red-Backed Salamander (*Plethodon cinereus*) has been subjected to both processes. In this context, we investigated the historical events that are likely to have shaped genetic variation in this species using a panel of six microsatellite markers screened on individuals sampled across ten localities in northeastern Indiana, USA. Although the likelihood of salamander occurrence increased with patch size, we found low genetic diversity across forests and minimal differentiation. We expected population structure associated with forest fragmentation to result from genetic drift in isolation but instead found that a balance between gene flow and drift was ~50 times more likely. Ratios of allele number and range (M), and coalescent modeling of population demography suggested the presence of marked historic decline in effective population size across the region. Taken together, the data point to a loss of genetic variation which preceded deforestation over the past 200 years. This result indicates an important role for ancient demographic processes in shaping current genetic variation that may make it difficult to detect the effect of recent habitat fragmentation.

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409 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Maria Jose Juan Jorda[1], Nicholas Dulvy[1], Iago Mosqueira[1], Juan Freire[1]

[1]AZTI-Tecnalia, Pasaia, Guipuzkua, Spain, [2]Simon Fraser University, Burnaby, British Columbia, Canada, [3]Cefas, Lowestoft, United Kingdom, [4]University of A Coruña, A Coruña, Spain

Comparative Analysis of the Life History Traits in the Scombridae Family

There are far more exploited fish species than there are stock assessments. The key challenge will be to develop methods for informing management of stock status for the

large majority of fishes for which there is simply not enough data with which to develop traditional data-hungry stock assessments. Beverton and Holt recognized early on that understanding the range of life histories across environments can be profoundly useful for assessing fish stocks. Scombrids, commonly known as tunas, Spanish mackerels, mackerels and bonitos, support very important commercial and recreational fisheries throughout the tropical and temperate oceans. A few species are well-known, however, the fisheries and conservation status of most scombrids is poorly understood. We use a comparative analysis of life history traits of all 50 scombrid species to understand and predict how species respond to exploitation. First, we examined life history traits across species and across different Longhurst biogeochemical provinces to test whether growth rates, reproductive rates and mortality rates follow trends predicted by life-history theory. Second, we estimated four life history invariant ratios (Lm/Linf, M/K, Tm/M, and Tm/Lm) and quantified the amount of variation explained by taxonomy and environment. Scenarios based on simple life history driven models such as these could be used as the basis for the assessment and management of data-poor species.

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511 Fish Ecology I, Pavilion East, Friday 24 July 2009

Francis Juanes

University of Massachusetts, Amherst, MA, United States

Comparing Striped Bass Prey Size-predator Size Relationships across the Species Range

Asymmetric predator size-prey size distributions are prevalent in aquatic systems and particularly in piscivorous fishes. Previous studies have shown that mean and maximum prey sizes are an increasing function of predator size whereas minimum prey sizes generally are not. The slopes of the maximum prey size vs. predator size vary among species and are often related to ontogenetic changes in mouth gape sizes. However, the variation in predator size prey-size distributions has not been assessed within a species. Here I report on variation in predator size-prey size distributions across the range of a widely distributed predator, the striped bass, *Morone saxatilis*. Datasets included modern and historical samples from Quebec to North Carolina and California. Although diets varied substantially across populations, minimum, median and maximum prey size slopes were consistent, asymmetric, and averaged 0, 13 and 30% of predator lengths. Similarly, ratio-based trophic niche breadths narrowed with predator ontogeny for all populations. The consistency of the results suggests that morphological and/or behavioral constraints may be more important in determining predator-prey relationships than site-specific prey type abundances and distributions.

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937 Poster Session I, Exhibit Hall, Friday 24 July 2009

J. Eric Juterbock, David M. Dennis

Ohio State University, Lima, OH, United States

Field Observations of Courtship and Social Behavior in Two Species of Southern Appalachian Woodland Salamanders, *Plethodon jordani* and *Plethodon shermani*

Among southern Appalachian plethodontid salamanders, we find that Red-cheeked Salamanders, *Plethodon jordani*, and Red-legged Salamanders, *Plethodon shermani*, climb frequently. We report observations on social behavior among individuals of these species, for August 2006 through September 2008. We observed *P. jordani* along a trail to Chimney Tops in Great Smoky Mountains National Park, TN, and *P. shermani* along trails in Standing Indian Recreation Area of the Nantahala National Forest, NC. Observations were conducted between sunset and sunrise, mostly during the first five hours after sunset, using headlamps for spotting salamanders, with dim beams for observations of behavior. Salamanders were not handled, but some were photographed using a flash. Tail-straddle-walk (TSW) has been observed as early as 18 August 2008 and as late as 19 September 2008, and on three consecutive nights, 29-31 August 2007, for jordani. One TSW was observed for shermani within 13 minutes of official sunset; none were observed for either species after approximately 0300 hours, although much less effort was spent pre-dawn. We have also observed pre-TSW courtship behaviors; behavior we term consortship, where a female and one or more males will sit near or very near each other, not infrequently for hours; and, trailing behavior, which more often involves a male following a female, often with nose tapping of the substrate, but which sometimes has the roles reversed. All of these behaviors have been observed up on woody vegetation. Other social behaviors observed include males courting other males and males interfering with courting pairs.

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497 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Ingrid Kaatz[1], Donald Stewart[1], Aaron Rice[2], Phillip Lobel[3]

[1]SUNY College of Environmental Science and Forestry, Syracuse, NY, United States, [2]Cornell University, Department of Neurobiology and Behavior, Ithaca, NY, United States, [3]Boston University, Department of Biology, Boston, MA, United States

Sound Producing vs. "Silent" Catfish Families: Differences in Pectoral Spine Length, Ornamentation and Dorsal Process Surface Morphology

The morphology of the pectoral spine in catfishes could effect the evolutionary origin, elaboration or atrophy of its role as a stridulation mechanism. We compared spines (351

references) between "silent" and sonic taxa (38 families, 993 species). We characterized "silent" as an absence of stridulation in disturbance (restrained simulation of a predator-grasp) or any other undisturbed behavioral context. Spine length varied from 0.8 to 145 mm. Mean percent of standard length per family varied from 7 to 36.5%. Sonic families had significantly longer spines than "silent" and well developed anterior and posterior secondary spine ornamentation. We compared sonic disturbance behavior for adult wild caught aquarium specimens within the doradoid clade (24 doradid, 12 auchenipterid species; 19 outgroup families). Among doradoids only three *Ageneiosus* species were silent and their spines differed significantly in weight but not length from two sonic auchenipterid species similar in body size and weight. Sonic microscopic ridges are found on the dorsal process of the pectoral spine. We compared dorsolateral surface morphology using dissecting and scanning electron microscopy of laboratory specimens (124 species). Sonic groups had ridges: rounded or bladed from the spine shaft base to the edge or were knobs at the process edge. Silent species lacked ridges entirely showing structures similar to those we found on locking surfaces (smooth, honey-combed, convoluted) or they had ridges. The latter group is hypothesized as "cryptically sonic". We evaluate hypotheses on behavioral and ecological selection pressures which may correlate with the absence of pectoral spine stridulation.

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875 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

David Kacev[1], Suzanne Kohin[2], Russ Vetter[2], Andrew Bohonak[1], Rebecca Lewison[1]

[1]San Diego State University, San Diego, CA, United States, [2]Southwest Fisheries Science Center, La Jolla, CA, United States

A Review of Recreational Shark Fisheries in Southern California

The recreational shark fishery in Southern California constitutes a large portion of elasmobranch catch in the region, yet relatively little is known about the fishery and its impacts on local populations. This study reviews historic monitoring of the recreational shark fishery in Southern California and what is known about annual local yield. We also review other recreational fishery monitoring from around the world and discuss how learning from these other programs can benefit our understanding of our local stocks and fisheries.

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437 Fish Ecology III, Pavilion West, Monday 27 July 2009

Eryn Kahler

University of Maryland, Eastern Shore, Princess Anne, MD, United States

Associations Between Marine Communities and Artificial and Natural Reefs of Maryland

Artificial and natural reefs exist off the coast of Maryland, but no work has been done to assess their ability to support coastal communities. The objectives of this study are: 1) designate sites as natural reef, artificial reef or non-reef, 2) compare diversity and composition among natural reefs, artificial reefs and non-reef habitats, 3) determine if community composition increases or decreases as distance between reefs increases, 4) compare diversity (richness/evenness) of the most abundant species to size of reef, and 5) compare diversity (richness/evenness) of the most abundant species to age reef. These objectives were examined by analyzing Fishing Vessel Trip Reports obtained from Captain Monty Hawkins for the years 1999-2008, along with bathymetry and substrate data collected aboard the NOAA vessel Henry B. Bigelow during the summer of 2008. The most numerous species reported by Captain Hawkins were black sea bass (*Centropristis striata*), Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), bluefish (*Pomatomus saltatrix*), scup (*Stenotomus chrysops*), red hake (*Urophycis chuss*) and Atlantic mackerel (*Scomber scombrus*). The data are currently being analyzed to determine if species composition and diversity increase as the reef's size and age increases.

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262 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Kristine Kaiser, Menemsha Alloush, Robin M. Jones, Susanne Marczak, Katherine S. Martineau, Mark V. Oliva, Peter M. Narins

UCLA, Los Angeles, CA, United States

When Sounds Collide: Effects of Anthropogenic Noise on Frog Calling Behavior

Differential susceptibility of amphibians to habitat degradation and fragmentation is not well understood. Existing studies of amphibian response to anthropogenic change typically correlate with or model life history traits; few relevant behavioral data exist. Among the most poorly understood effects of habitat change are those resulting from an increased complexity of the acoustic environment, e.g., from the presence of anthropogenic noise. Here we test the hypothesis that car engine noise differentially affects disturbance-tolerant and disturbance-sensitive species. We carried out playback

experiments with anthropogenic noise on seven frog species in Belize. We also chose one focal species, *Dendropsophus microcephalus*, to determine if this noise affected chorus tenure for individuals, or length of chorus. We used mark-recapture at two ponds: one where noise was broadcast each night and one where no noise was ever played (control). We found that species respond to noise differentially, with the most forest-dwelling species being least likely to call in the face of noise. Chorus tenure and number of times recaptured were both significantly greater at the control pond. Lengths of nightly chorus were equivalent at the beginning of the study, but were significantly different after two months. Taken together, these results suggest that the acoustic landscape acts as any other environmental parameter, shaping which species will persist, and which species may perish. While frogs are known to employ a suite of mechanisms to cope with biotic noise, this is the first investigation demonstrating chorus-level effects of anthropogenic acoustic disturbances in amphibians.

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312 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Stephen Kajiura, Michelle McComb

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Evolution and Function of the Hammerhead Shark Cephalofoil 2: Functional Implications of Sensory Receptor Distribution

The unique head morphology of sphyrnid sharks provides a dorsal ventrally compressed and laterally expanded platform upon which sensory structures are distributed. The spatial distribution of sensory organs dictates how the sharks perceive their environment. This study examined the consequences of broadly separating the eyes at the distal tips of the cephalofoil. In sphyrnid sharks the eyes are canted slightly forward which provides them with greater binocular overlap (30˚) than their carcharhinid sister taxa (10˚). However, the widely spaced eyes create a larger blind area immediately anterior to the snout in sphyrnids which would seem to be a detriment especially for an apex predator. At close ranges (10s of cm) the electrosensory system informs the sharks about the location of prey near the head. Both carcharhinid and sphyrnid sharks orient to prey-simulating electric stimuli from a mean distance of 25cm, and maximally from a distance of 40cm. This electrosensory range completely overlaps the anterior blind area of the scalloped hammerhead shark, *Sphyrna lewini*, and overlaps approximately half the anterior blind area of a representative carcharhinid species, the blacknose shark, *Carcharhinus acronotus*. By integrating visual and electrosensory information, the sphyrnids are able to continuously track prey right up to the mouth with no loss of spatial information. Therefore, the sphyrnid head morphology confers several advantages and any potential disadvantages are mitigated by sensory integration.

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14 Fish Conservation I, Parlor ABC, Sunday 26 July 2009

Qusaie Karam[1], Mohammad Ali[2], Khaled Abdul Elah[2], Matt Bentley[3], Mirza Umair Beg[1]

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Effects of Kuwait Crude Oil and Three Oil Spill Dispersants on Orange-Spotted Grouper *Epinephelus coioides* Larvae

The acute aquatic toxicities of Kuwait crude oil water-accommodated fraction (WAF) and chemically enhanced water-accommodated fractions (CE-WAFs) of three dispersants (Corexit® 9500, Corexit® 9527 & Slickgone® NS) were evaluated using early life stages of orange-spotted grouper (*Epinephelus coioides*) larvae (locally abundant important commercial species in Kuwait). The effects of exposure time and concentration on larval survival rates were investigated using 96-h flow-through renewal bioassays. Median-lethal concentrations (LC_{50}) were found that CEWAF solutions were higher toxicity than KCO WAF except the case of Slickgone® NS. The order of toxicity was Corexit® 9527 CE-WAF (87 mg/l) > Corexit® 9500 CE-WAF (142 mg/l) > KCO WAF (468 mg/l) > Slickgone® NS CE-WAF (1,175 mg/l). Time and concentration effect on fish larvae during exposure was statistically significant ($p < 0.05$) for all test chemicals except in the case of Slickgone® NS CE-WAF. The application of oil dispersants in the case of an oil spill must be considered carefully especially close to fish spawning and breeding areas due to increased toxicity of CEWAF's to native fish larvae of Kuwait.

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151 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Nancy Karraker, David Dudgeon

University of Hong Kong, Hong Kong, China

Importance of Tadpoles to Stream Communities in Tropical Asia

In some ecosystems, amphibians play important ecological roles and comprise a significant proportion of the community biomass. In light of recent amphibian population declines it has become imperative to determine how population losses may impact ecosystems. Our objectives were to delineate the importance of larval amphibians relative to other aquatic organisms in Hong Kong's streams. We conducted bi-monthly surveys of streams, quantifying density and biomass of larval amphibians (*Paa exilispinosa*, *Xenophrys brachykolos*), fishes, crustaceans, and insect larvae. Mean

biomass of tadpoles was five times higher than decapoda shrimps and crabs, the second and third most abundant taxa. Densities of tadpoles in pools ranged from 0-76 m-2 and averaged17 m-2 during the study period, but this was eclipsed by mean densities of Trichoptera (188 m-2) and shrimps (64 m-2). Despite harboring the highest human densities in the world and the consequent chronic pollution, hillstreams in Hong Kong are relatively well-protected and contain some of the highest densities of tadpoles ever reported. Declines of these two amphibian species in this region would result in the loss of the most important herbivores in these streams and possibly a significant source of prey for other stream-dwelling animals.

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656 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Ushio Kawai

Kyoto University, Kyoto, Japan

Potential Habitat Overlap of *Gekko hokouensis* and *G. yakuensis* in Yakushima, Japan - Impacts of Introduced Species on Native Species

Gekko yakuensis is native to Yakushima and distribute widely around lowland of this Island except for highly urbanized area. Closely related species, *G. hokouensis* is suggested to have been introduced to some of the localities in Yakushima. These two species hybridize frequently where they contact each other, and their offspring is viable. From previous study, it is suggested that *G. hokouensis* have been expanding their distribution along with urbanized area. The fine scale distribution survey of the localities where *G. hokouensis* is introduced, revealed that they seldom occur syntopically. Thus their habitat appears to overlap very little. Potential habitat maps of the two species and their hybrid were drawn in order to visualize the extent of the overlap. Despite the fact that the potential habitat map indicated high habitat suitability for *G. yakuensis*, they were absent from some of the localities when *G. hokouensis* occupy those area. Furthermore, the results indicated both species have low tolerance on highly urbanized area. Thus potential habitat of the two species overlap around the boundary of urban area. These results suggest that competitive exclusion of *G. hokouensis* over *G. yakuensis* occur at the boundary of urban area. In addition, some of the localities were indicated to have high possibilities of *G. hokouensis*' establishment once this species is introduced.

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638 ELHS/LFC General Ichthyology II, Broadway I & II, Saturday 25 July 2009

John Keane, Jeremy Lyle, Francisco Neira

Tasmanian Aquaculture and Fisheries Institute, Tasmania, Australia

EAC Variability and Spawning of Small Pelagic Fishes: Inferences from Larval Dynamics and Oceanography

The dynamics of larvae of five small pelagic fish taxa common in shelf waters of south-eastern Australia, namely *Trachurus* spp., *Sardinops sagax*, *Scomber australasicus*, *Etrumeus teres* and *Engraulis australis*, were linked with oceanographic features associated with the seasonal East Australian Current (EAC) to define essential habitats and predict key spawning areas. A novel approach involving multivariate analyses of water-column temperature frequencies clearly defined EAC water to the north (20.5-23.4°C), Tasman Sea water to the south (TAS; 14.8-17.5°C), and a mixed EAC-TAS water mass in between (MIX; 18.3-19.9°C). Along-shelf distributions and abundances varied markedly with water mass structure, with peak abundances frequently occurring in MIX waters just south of the EAC deflection point where upwelling of nutrient-rich slope water was evident. Quotient analyses revealed notable similarities in temperature preferences among all taxa with a marked decline in abundances in waters <18°C, i.e. those immediately south of the MIX-TAS interface, suggesting that this temperature front may be a barrier to the southward dispersal of larvae. Furthermore, cross-shelf patterns revealed variations in distribution that correspond with distinct cross-shelf variation in hydrographic conditions. Overall findings indicate larval distributions are determined by the strength and extent of the EAC, and suggest that variable hydrographic conditions play a key role in defining the timing and location of spawning of these small pelagic taxa. Our approach highlights the merits of characterising larval habitats in the context of water masses, and sets a foundation for assessing the impacts of climate change on resources within this highly susceptible region.

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665 Fish Genetics II, Parlor ABC, Monday 27 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Benjamin Keck

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Information in the Gene Trees of Introgressed Genomes: Sweeps, Zones, and Founder Effects

Hybridization is relatively frequent among teleost fish and molecular investigations have revealed many instances of genetic exchange. This introgression may erase evidence of some pre-introgression evolutionary relationships and chronology, but can

provide valuable insight into the events that led to the introgression and post-introgression evolution of the clade. Three post-introgression scenarios are: 1) the introgressed genome spreads through a clade by a selective sweep, 2) the introgressed genome remains in the 'zone' in which it was originally introgressed, or 3) the introgression occurred in a 'founder event', replacing the native genome, and evolving with the clade from that evolutionary point forward. Additionally, the introgression can occur as a single 'event', episodically, or continually. The Redline Darter, *Nothonotus rufilineatus* (Percidae: Etheostomatinae), has experienced complete mitochondrial replacement in two large geographic areas, each approximately 1/3 of the species entire range. I used mitochondrial and nuclear gene trees, AMOVA, and minimum pairwise genetic distances to discriminate between the above three possible scenarios in both of the Redline Darter clades with introgressed mitochondria. The results highlight the need for thorough sampling and analysis of the donor species to make this discrimination.

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147 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009

Jenny Kemper[1], David Ebert[1], Leonard Compagno[2], Dominique Didier[3]

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Chimaera sp. nov., A New Species of Chimaerid from Southern Africa (Chondrichthyes: Chimaeriformes: Chimaeridae)

A new species of chimaerid, *Chimaera* sp. nov., is described from specimens collected off the west coast of southern Africa. This species represents the first member of the genus *Chimaera* known from southern Africa. It is distinguished from its congeners by a combination of morphometric characters and coloration: pelvic claspers short, not extending past distal tip of pelvic fins, divided for distal one-third of length; pectoral fin when depressed reaches just to origin of pelvic fin base; caudal fin ventral margin very slightly posterior to caudal fin dorsal margin; oral and preopercular lateral line canals sharing a common branch off the infraorbital canal; distance from anterior base of dorsal fin spine to center of supratemporal canal short (13.8 % HDL); lateral line canal of body nearly straight; uniform blackish brown with dark bluish streaking, precaudal tail with longitudinal light and dark stripes. This species has a distribution from Lüderitz, Namibia to southwest of Cape Point, South Africa. *Chimaera* sp. nov. is compared to *Chimaera monstrosa*, its closest congener.

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979 Poster Session III, Exhibit Hall, Sunday 26 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Christopher Kenaley

University of Washington, Seattle, WA, United States

Confusing Species Trees with Gene Trees Misleads Ancestral State Reconstruction and Inference of Molecular Evolution: A Reanalysis of Rhodopsin Evolution in the Actinopterygii

The revolution in molecular biology that followed the Neo-Darwinian synthesis has enabled evolutionary biologists to explore the molecular underpinnings of functional protein evolution. Scientists interested in the adaptation of organisms to novel environments have the power to infer ancestral sequences and literally trace adaptive events through a lineage. Many studies have focused on the evolution of visual pigments as vertebrates explored new photoenvironments. Rhodopsin, the photopigment responsible for scotopic vision, has been the subject of several studies reconstructing ancestral states of the protein throughout the vertebrate lineage. To identify amino acid sites implicated in the functional diversity of rhodopsin, ancestral states are inferred from a rooted tree of taxa being studied using likelihood or parsimony methods. The data used to infer the tree are, in almost all cases, the same rhodopsin sequences. Likely due to an abundance of homoplasy in the rhodopsin dataset and despite high clade support, this often results in topologies that are not corroborated by other published phylogenetic studies. If the gene tree does not accurately reflect the species tree, the nodes of that gene tree do not reflect ancestral taxa, and thus, cannot be used to accurately infer ancestral states. The implications of this gene-tree, species-tree conflict in ancestral state reconstruction and novel experimental techniques for engineering ancestral proteins is explore by reanalyzing a recent study in which the topology was inferred from the rhodopsin sequence being analyzed. The reanalysis, using an independent, less homoplasious dataset to infer the topology, results in drastically different ancestral states.

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985 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Christopher Kenaley

University of Washington, Seattle, WA, United States

From Red to Blue, and Back Again: The Evolution of Highly Adaptive Visual Systems in the Lightfishes (Teleostei: Stomiiformes)

The Stomiiformes, a group of some 350 species in more than 50 genera, are the most successful clade of teleosts in the deep sea. As they radiated in the deep sea, stomiiforms adapted to this dimly lit, mostly blue photoenvironment by evolving rod-only retinae. Studying the molecular evolution of rhodopsin, the photopigment responsible for scotopic (i.e., dim-light) vision, holds great promise for unraveling the adaptive events associated with the invasion of this novel environment. Using new sequence data from rhodopsin and independent mitochondrial and nuclear markers from the Stomiiformes and their purported sister group, the Osmeriformes, the ancestral states of rhodopsin are inferred within the osmeriform-stomiiform lineage. Ancestral state reconstruction of the rhodopsin sequences corroborates the results of a previous study of deep-sea fishes that six amino acid sites are responsible for the spectral tuning of rhodopsin to the deep-sea photoenvironment. However, the ancestral states of the rhodopsin sequences within the Stomiiformes differ markedly from published studies. This is due in large part to the use of rhodopsin, a gene highly homplasious, even among closely related taxa, to produce the topology from which ancestral states were inferred. The implications of gene-tree versus species-tree conflicts in the previous studies are explored. These more accurately inferred ancestral states cast the evolution of visual systems of the stomiiforms, particularly the evolution of far-red visual capabilities, in a drastically different light.

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542 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Steven Kessel[1], Samuel Gruber[2], Rupert Perkins[1], Todd Gedamke[3], Bryan Franks[2], Demian Chapman[4]

[1]Cardiff University, South Wales, United Kingdom, [2]Bimini Biological Field Station, South Bimini, Bahamas, [3]National Marine Fisheries Service, Miami, FL, United States, [4]Stony Brook University, Stony Brook, NY, United States

Movements and Migrations of the Jupiter Lemon Sharks (*Negaprion brevirostris*)

The presence of large aggregations of adult lemon sharks (*Negaprion brevirostris*) in the coastal waters of Jupiter, FL, present the first opportunity to study the mature life stage of this otherwise well-studied species. During winter research seasons from 2006-2009,

138 sharks were obtained using drifted drop-line gear. Fifty four lemon sharks were implanted with Vemco V16H transmitters (27 males, 27 female; 165 - 225 cm PCL). Wildlife Computer MK10 tags were also attached to five adults and programmed to detach after 120 days. Localized movements were detected on a 17 station array, each with temperature profiler, stretching along 65 km of coastline. There were distinct seasonal patterns in the formation of lemon shark aggregations. Long range movements outside of the winter aggregation season were captured on more than 20 Vemco receivers contained in the FACT and ACT arrays stretching along ~2,400 km of coast on the U.S. Eastern seaboard. At the beginning of the 2009 winter season, 22 of 35 adult lemon sharks tagged during past seasons had returned to the aggregation. Adult males that were detected on receivers at the mouth of Altamaha River, GA, (N=3) and in at Winyah Bay, SC (N=1) during the summer, had returned to the Jupiter aggregation the following winter. New study sites were established at lemon shark aggregation sites in the Bahamas and Cape Canaveral to better assess population connectivity on a regional scale. We also implanted 8 bull sharks (*Carcharhinus leacus*) with V16H transmitters to compare movement patterns between species.

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456 Poster Session I, Exhibit Hall, Friday 24 July 2009

James Ketchum[1], George Shillinger[2], Alex Hearn[1], Eduardo Espinoza[3], Peter Klimley[1]

[1]University of California, Davis, Davis, CA, United States, [2]Stanford University, Stanford, CA, United States, [3]Galapagos National Park, Santa Cruz, Galapagos, Ecuador, [4]Charles Darwin Foundation, Santa Cruz, Galapagos, Ecuador

Movements and Migratory Patterns of Sharks in the Galapagos Marine Reserve and Eastern Tropical Pacific

Marine predators such as sharks exhibit a whole range of behaviors and habitat uses, reflected in their movements occurring at different spatial and temporal scales. However, these movement patterns are far from understood, particularly in the case of insular species like the scalloped hammerhead and Galapagos sharks. The Galapagos Marine Reserve (GMR) is one of the last outposts where large numbers of sharks still linger in the eastern tropical Pacific (ETP), but alternatives to conserve and manage them are lacking. We intend to fill this void of information and in turn alleviate a local management problem by studying shark movement and incorporating this into the design of the GMR. Our studies using satellite tags at the Galapagos Islands show movements of scalloped hammerhead, Galapagos, and whale sharks at different spatial scales: insular (< 50 km), inter-island (50-400 km) and oceanic (> 500 km). Insular movements are associated to 'hotspots' around islands, inter-island movements appear at different degrees of directionality within the archipelago, whereas oceanic ones are directional to regions outside the GMR. This implies connectivity and a high degree of use of different areas within the GMR, and the likelihood of migratory corridors between the Galapagos and other islands and seamounts of the ETP. The hammerhead

and Galapagos sharks showed near-surface behavior, therefore exposing these species to fishing effort in the region. Our findings have strong implications in the design of protected pelagic environments in the Galapagos Islands and ETP.

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933 Herp Genetics, Galleria North, Saturday 25 July 2009

Karen Kiemnec-Tyburczy[1], Sarah Woodley[2], Lynne Houck[1]

[1]Oregon State University, Corvallis, OR, United States, [2]Duquesne University, Pittsburgh, PA, United States

Expression of Odorant and Pheromone Receptors in a Salamander, *Plethodon shermani*

Plethodontid salamanders use chemical communication in a wide variety of ecological contexts. In these amphibians, as in most tetrapods, two olfactory epithelia are used to detect chemicals. Generally, odorants are sensed by the main olfactory epithelium (MOE) and social cues, such as pheromones, are sensed by the vomeronasal organ (VNO). In olfactory and vomeronasal sensory neurons, separate families of receptors mediate the responses to chemicals. The expression of receptor families in these distinct organs has been well-studied in mammals. But, it is difficult to draw generalizations about the evolution and recruitment of these receptors across the tetrapod lineage because expression patterns in herpetofauna are solely based on those from clawed frogs (*Xenopus*). Our goal was to isolate receptors and determine their expression patterns in the sensory organs of the red-legged salamander (*Plethodon shermani*). These salamanders are terrestrial amphibians and use protein pheromones during courtship. Using a degenerate PCR approach, we isolated olfactory receptors (OR) and vomeronasal receptors (V2R) as well as the VNO-specific ion channel, TRPC2 from *P. shermani*. We then used in situ hybridization to visualize the expression patterns of these genes in the salamander MOE and VNO. Olfactory receptor expression was limited to the MOE, while probes demonstrated the presence of TRPC2 and V2R in VNO, but not in the MOE. Our study provides the first description of the molecular basis for chemoreception in a urodele amphibian.

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479 Poster Session I, Exhibit Hall, Friday 24 July 2009

Sora Kim, Dave Casper, Paul Koch

University of California, Santa Cruz, Santa Cruz, CA, United States

Methods to Collect, Preserve, and Prepare Elasmobranch Tissues for Stable Isotope Analysis

Accurate stable isotope data that are comparable between individuals, species, and populations, as well as different time periods, requires analysis of similar tissue substrates. The stable isotope literature suggests methods for the collection of such data, but usually for avian, mammalian, and teleost taxa. Elasmobranches have a unique physiology that impacts the biochemistry of their tissues; specialized methods are required to prepare these tissues. Compounds such as lithium heparin and ethanol, which are used in blood collection and muscle preservation, can alter the carbon and nitrogen isotope values. Varying concentrations of lipids, urea or cartilage can contaminant the protein, complicating isotopic ecological studies. The isotopic effects of petroleum ether and water rinses on plasma, red blood cell (RBC), and muscle samples were compared as possible lipid and urea extraction methods. We also modified laboratory techniques to decalcify cartilage in skate muscle and powdered vertebrae samples. Finally, we analyzed the $\delta^{15}N$ and $\delta^{13}C$ differences between 1) no additive and heparin-treated blood tubes and 2) frozen and ethanol preserved muscle. Our results suggest petroleum ether and water rinses do remove urea from muscle, but alternative methods are necessary for blood. RBC $\delta^{15}N$ and muscle $\delta^{13}C$ values are modified with heparin and ethanol treatment, respectively, but the effects are minor and samples are adequate for ecological interpretation. These results will allow future isotopic studies to retrieve samples from archived collections and remote locations. Most importantly, this study initiates the standardization of stable isotope tissue preparation specific to elasmobranches.

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475 AES Physiology, Galleria South, Sunday 26 July 2009

Sora Kim, Dave Casper, Paul Koch

University of California, Santa Cruz, Santa Cruz, CA, United States

Assessing Fractionation Factors and Tissue Turnover Rates for Sharks

Superorder Selachimorpha (sharks) is globally distributed, with species ranging tropical to artic oceans. Traditional methods (gut analysis, tagging) offer snapshots into individuals' lives, but data integrated over spatial and temporal scales is difficult. Stable isotope analysis (SIA) offers data on diet, migration, and habitat preferences on a range of spatial and temporal scales. A crucial step in the application of SIA is calibration on animals in experimental or controlled settings. Commonly accepted fractionation factors

(FF) and tissue turnover (TTR) rates are calculated from mammals, birds, and teleosts. Sharks are distantly related to these taxa, and they have a unique physiology that includes osmoregulation using urea. Thus the assumption that FF and TTR measured on teleosts, mammals, or birds apply to sharks may not be valid. We will calculate diet-to-tissue FF and TTR through an experiment on leopard sharks (*Triakis semifasciata*). We switched the diets of sharks between two isotopically-distinct foods to assess turnover for plasma, red blood cells, and muscle. Results suggest that leopard sharks have FF similar to mammalian carnivores and TTR an order of magnitude less than homoeothermic animals. This experiment monitored these parameters for 9 individuals over the course of 3 years, allowing for comparisons within and between individuals. These results are the first robust diet-to-tissue FF and TTR calculated for elasmobranches in a natural abundance experiment. Our results will be important for the growing number of studies applying SIA to shark tissues to elucidate aspects of life history that are difficult to study using traditional methods.

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812 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Bethany Kimokeo[1], Zoltan Szabo[2], Robert Toonen[2], Healy Hamilton[3], Sara Lourie[4]

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Taxonomy and Phylogeography of *Hippocampus kuda* in Hawaii

The spotted seahorse *Hippocampus kuda* is widely considered a species complex with poor taxonomic resolution. In addition to the biological importance, the entire genus of *Hippocampus* is listed on CITES Appendix II, so accurate species identification is critical for conservational regulations. Preliminary molecular and morphological data do not support a species complex, but rather a single morphologically variable *H. kuda* with a deep evolutionary history. In Hawaii, debate on the taxonomy of *H. kuda* results from a range of opinions from recent aquarium introduction to endemic species. The purpose of this study was to determine if populations of *H. kuda* in Hawaii are in fact an endemic or not, and if not to generate hypotheses for the source and timing of Hawaiian colonization. Nineteen spotted seahorses were gathered from sites around the island of Oahu, Hawaii and sampled by tail biopsy. DNA was extracted and mitochondrial cytochrome *b* and 16S genes were sequenced to reveal that, unlike any other location sampled to date, all 19 seahorses were of an identical haplotype. Haplotype diversity (h) of *H. kuda* elsewhere throughout the Indo-Pacific averaged 0.72 compared to h=0 in Hawaii. Based on a range-wide survey, the Hawaiian haplotype appears unique to Hawaii, but well within the *H. kuda* lineage, and is one mutation removed from a common haplotype found in Japan and the Philippines. These data indicate that the Hawaiian spotted seahorse is *H. kuda*, but we cannot infer the age or origin of colonization.

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85 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Andrew Kinziger[1], Michael Hellmair[1], Damon Goodman[2]

[1]Humboldt State University, Arcata, CA, United States, [2]US Fish and Wildlife Service, Arcata, CA, United States

Long-term Isolation and Genetic Divergence Between Populations of the Threatened Rough Sculpin (*Cottus asperrimus*) Separated by Hat Creek Fault

The rough sculpin (*Cottus asperrimus*) is a state threatened species confined to about 80 km of stream in the Pit River system (California). Within this region, rough sculpin are restricted to cold spring-fed pools over sand and silt bottoms. An active fault traversing the mainstem Pit River, has created a series of steep rapids, cascades and waterfalls (some up to 12 m) potentially forming a long-term isolating barrier to rough sculpin migration. To determine if the fault zone has restricted gene flow between rough sculpin populations we compared variation in mitochondrial DNA ATPase 8 and 6 genes and two nuclear microsatellite loci from populations occurring on opposite sides of the fault zone. Analysis of microsatellite data indicated significant levels of genetic differentiation, F_{ST} = 0.30, between populations isolated by the fault. Similarly, analysis of mitochondrial DNA strongly supported reciprocal monophyly of populations from opposite sides of the fault zone. Populations from opposite sides of the fault zone differ by 0.83% sequence divergence, providing an estimated of date of divergence between these populations of approximately 0.8 to 1.6 million years ago. The initiation of faulting in the region has been dated to approximately one million years ago, consistent with the mtDNA molecular clock estimate. Patterns of genetic differentiation are paralleled by divergence in pectoral-fin rays and spawning time. Concordant divergence in multiple character types supports recognition rough sculpin populations on opposite sides of the fault zone as distinct management units.

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304 Poster Session I, Exhibit Hall, Friday 24 July 2009

Nicholas Kiriazis, Stephen Mullin

Eastern Illinois University, Charleston, IL, United States

Population structure and morphometrics of Northern Watersnakes (*Nerodia sipedon*) in an anthropogenic habitat

The current pattern of human population growth means that other organisms are faced with an increasing scope of anthropogenic influences. While such influences are typically viewed as having adverse effects on a species' life history, non-human

organisms can have stable population areas that have undergone some sort of anthropogenic modification. We present data from a 4-year mark-recapture effort of Northern Watersnakes (*Nerodia sipedon*) found in and around an artificial lake and an adjacent river that was channelized so that water could be diverted to the lake. Within this population, adult females (49.6 % of captures) have greater snout-vent lengths (SVL) and body mass than males (50.4 % of captures), but tail lengths were similar between the sexes. Subadult snakes (22.2 % of captures) experience an increased growth rate at around 250 mm SVL. Our recapture rate of marked individuals is less than 7 % indicating a large population exists at this site. We observed some form of injury on 10 % of the adult snakes, however, which we suggest is exacerbated by frequent snake-human (mostly people fishing) encounters at this site. The characteristics of our study population appear similar to those reported for other populations of this species elsewhere within their range. The long-term stability of this watersnake population can be assured by outreach programs with the humans using this site.

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617 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jaimie Klemish, Brooke Johnson, Chris Taylor, Angie Klish, Erik Wild

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A Long-term Study of the Community Ecology of an Amazonian Amphibian Fauna

Surveys of amphibian biodiversity were undertaken at a site in the lowland Amazonian rainforest of Madre de Dios, Peru during 1989-2009. Surveys took place during five biennial three-week field sessions during the rainy season (December-January) totaling 119 days in the field. A total of 39 observers (range 3-11) logged a sampling effort totaling 785 person days (63-242) and 2395+ person hours (246-759). A total of 1388 (123-430) records of amphibians, all anurans, was reported, documenting a total of 58 species (25-39). Species richness and abundance standardized by sampling effort were compared across sampling years and revealed little variation in species richness, but some pronounced variation in the abundance of individual species. Comparisons with other surveys at the site, including previous years and other times of the year (1071 person days, 7707 observations, and 66 species), revealed that in total the current surveys encountered 83% of the known anuran species, ranging form 36-56% per year. This includes four species not previously documented by the other surveys, thus increasing to 70 the known number of anurans at the site. The present study shows that even intensely sampled biotas remain incompletely documented. Nonetheless, this study provides no evidence of wholesale decline of the anuran fauna, yet a few individual species show declines. Furthermore, this study provides a clear baseline to which future survey work can be compared, which is particularly important for monitoring the health of the entire ecosystem as destructive pressures threaten to increase into the future.

1034 Herp Systematics, Pavilion West, Thursday 23 July 2009

Katy Klymus[1], Sarah Humfeld[1], David Cannatella[2], Carl Gerhardt[1], Vince Marshall[1]

[1]University of Missouri, Columbia, MO, United States, [2]University of Texas, Austin, TX, United States

The Canyon Treefrog, *Hyla arenicolor*, Unraveling a Cryptic Species

Cryptic species, morphologically indistinguishable taxa, are commonly identified based on molecular data and/or non-visual mating signals. We tested the hypothesis that the canyon treefrog may comprise a cryptic species complex, as previous work found three highly divergent, mitochondrial clades in the U.S. portion of the range. Expecting to see differences in male advertisement calls among populations, we compared advertisement calls from populations sampled throughout the U.S. and Mexican range. We also re-assessed phylogenetic relationships among populations of *H. arenicolor* and its sister species *H. wrightorum* using mitochondrial and nuclear sequences. Our acoustic analyses found no biologically significant variation in advertisement calls among the three U.S. clades, whereas Mexican populations show differences. Our phylogenetic data help explain our behavioral results. Incongruence between the two molecular data sets indicates mitochondrial capture between one U.S. population and *H. wrightorum*. Thus, U.S. populations are not as divergent from one another as once assumed, but Mexican populations are highly divergent. We conclude that canyon treefrog populations in the U.S. may not be a part of a cryptic species complex, but further analysis of southern Mexican populations may in fact reveal distinct lineages.

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510 Herp Physiology, Galleria North, Monday 27 July 2009; ASIH STOYE AWARD PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Zachary Kohl

Portland State University, Portland, OR, United States

Are Large RBCs Indicative of Decreased Vascular Resistance? A Test of the Snyder-Sheafor Hypothesis

The emergence of lungs as a gas exchange organ in teleost fishes was one of the key adaptations that opened the terrestrial world to invasion by vertebrates. The necessary transition from aquatic to aerial respiration was facilitated by increased reliance on lungs, and the associated pulmonary capillary beds. Gas transport to and from the exchange surfaces involves diffusion into the blood, convective transport of the blood to the target tissues, and diffusion into the tissues. Convective movement, or flow (Q), of a

fluid is accomplished via a pressure differential (ΔP) that must overcome resistance (R) to flow within the system, which is described by the equation:

$$Q = \Delta P\ (\pi r^4)\ (\ 8\eta L)^{-1} = \Delta P\ (R)^{-1}\ R = 8\eta L\ (\pi r^4)^{-1}$$

Where viscosity (η) is the resistance of blood and length (L) and radius (r) are the resistance of the vasculature. We have measured the in vivo resistance of pulmonary and systemic circuits in three anurans and three urodeles; selected to represent a broad range of life histories, red blood cell size, lung complexity, and aerobic capacities. Snyder and Sheafor (1999) proposed that large diameter capillaries, as evidenced by large RBC's, served to decrease cardiovascular resistances in early amphibians to minimize cardiac work. We hypothesize that low pulmonary resistances will correlate with higher capillary densities seen in more aerobic, aerial amphibians. We will present regressions of variation in red blood cell size, lung complexity, and aerobic capacity on vascular resistances. We revisit the Snyder-Sheafor (1999) hypothesis in light of our data.

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990 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Mark Kopeny, Vijay Panjeti, Daniel Sloan

University of Virginia, Charlottesville, VA, United States

Determination of the Native Range of the Orangefin Madtom (*Noturus gilberti*)

The geographic range of the Orangefin Madtom (*Noturus gilberti*) is limited to a small portion of Virginia and North Carolina. The species has a highly disjunct distribution in the Roanoke River drainage, occurring only in the upper Dan River and in the upper Roanoke River. *N. gilberti* also occurs in several tributaries of the adjacent upper James River drainage in Virginia, where it may be an introduced species. *N. gilberti* is state-listed in Virginia and North Carolina as threatened and federally listed as a species of concern. Knowledge of its status in the James River drainage (native vs. introduced) may be relevant to future management decisions for the species, including listing decisions. To determine the status of *N. gilberti* in the James River drainage, we performed a phylogenetic analysis based on sequence data from a ~1150 base pair region of the mitochondrial *cytB* gene. In a sample of 22 individuals, monophyly was established for all upper Dan River individuals (N=4) but not for individuals from the South Fork Roanoke River (N=12), or for individuals from the upper James River tributaries (N=6). Our results are consistent with the hypothesis that *N. gilberti* was introduced to a tributary of the upper James River from the Roanoke River or its north or south fork.

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915 Herp Biogeography, Galleria North, Saturday 25 July 2009

Kenneth Kozak[1], John Wiens[2]

[1]Bell Museum of Natural History, University of Minnesota, St. Paul, MN, United States, [2]Dept. of Ecology and Evolution, Stony Brook University, Stony Brook, NY, United States

Phylogenetic Niche Conservatism Drives High Montane Species Richness in Appalachian Salamanders

Many of the world's biodiversity hotspots are located in montane regions, and many plant and animal groups have their highest species richness at intermediate elevations. Yet, the explanation for this hump-shaped elevational diversity pattern has remained obscure. Recent phylogenetic studies suggest that this pattern is caused primarily by the time-for-speciation effect (i.e., more species occur in elevational zones that have been inhabited the longest) and also by variation in the rates of diversification of clades occurring at different elevations (i.e., faster speciation relative to extinction at intermediate elevations). However, the ecological processes that underlie these biogeographic and evolutionary explanations for elevational variation in species diversity have not been studied. Here, we address these processes for the first time in plethodontid salamanders from the Appalachian Mountains of North America. Using a time calibrated phylogeny and GIS-based climatic distributional data for nearly all the plethodontid species in eastern North America, we show that: (1) plethodontid species richness in eastern North America peaks at intermediate elevations, (2) this pattern is explained by both the time-for-speciation effect and higher diversification rates in clades that are distributed at intermediate elevations, and (3) the tendency for lineages to accumulate and diversify at a higher rate at intermediate elevations is driven by phylogenetic niche conservatism in their climatic distributions, which limits dispersal between elevational zones and drives allopatric speciation in montane endemics. Our results demonstrate how phylogenetic niche conservatism can influence the biogeographic and evolutionary processes (speciation, extinction, and dispersal) that ultimately generate patterns of species richness.

1015 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Joshua Kreitzer, Mark Belk, Eric Billman

Brigham Young University, Provo, UT, United States

Phenotypic Variation among Related June Sucker Induced by Habitat and Landscape Differences in the Early Life History

Understanding the early life history of the endangered June Sucker *Chasmistes liorus* is critical to the recovery of this species since poor recruitment to the breeding population limits population sustainability. We compared survival and growth of juvenile June sucker in Utah Lake at lake-wide and microhabitat scales. Utah Lake is a well-mixed shallow lake with a distinct, heavily vegetated extension known as Provo Bay. We placed four cages in each of the following five sites around the lake to represent its full character: Provo Bay; and Northwest; Northeast; Southwest; and Southeast regions. Each cage was stocked with 600 six-week-old June Sucker and left for five weeks. We also examined microhabitat effects in Provo Bay by placing four cages of 25 fish each in open water habitat and four in vegetated habitat for 8 weeks. We also assessed resource availability by independently sampling zooplankton. Survival was not significantly different between sites at either scale. Growth, determined by final standard length of juvenile fish, was significantly between the two most distant lake-wide sites with the largest fish found in Provo Bay and the smallest in the Northwest site. There was a gradient from East to West of decreasing size. At the microhabitat scale, growth was significantly greater in the open habitat than the vegetated habitat. We conclude that young June Sucker are able to survive the variation in conditions that may be encountered at both the microhabitat and landscape level. However, maximum growth can be achieved in Provo Bay in the open water habitat.

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276 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

Kerry Kriger

SAVE THE FROGS!, Manassas, VA, United States

The 2nd Annual Save The Frogs Day – April 30th, 2010

It is our duty as herpetologists to protect amphibian populations, and this will not be possible unless we rapidly and successfully educate the public about the amphibian extinction crisis. Only a small proportion of the world's citizens are aware that amphibians are in trouble, and we all have a vested interest in changing this: (1) an environmentally conscious society attempts to care for versus destroy the environment, and thus by educating the public regarding environmental issues we will help to ensure that our current hard work will not be laid to waste by the environmentally-destructive

actions of future generations; (2) increasing students' interest in herpetology will mean a larger pool of potential graduate students for us to choose from, and thus higher quality researchers working in our labs; and (3) issues that are engrained in the public's consciousness receive more monetary funding from governments, private foundations, and average citizens, and we all depend on this money. In an effort to raise awareness of the issue and make the amphibian extinction crisis common knowledge by the end of 2010, conservationists worldwide took part in the 1st Annual Save The Frogs Day (http://savethefrogs.com/day). On this day scientists gave free public lectures and radio interviews, students set up informational/fundraising tables on college campuses, and schools, zoos and museums focused on amphibian conservation. All herpetologists are invited to take an active part in the 2nd Annual Save The Frogs Day (April 30th, 2010), as environmental education is an integral part of successful amphibian conservation.

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281 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kerry Kriger

SAVE THE FROGS!, Manassas, VA, United States

How to Help SAVE THE FROGS!

It is our duty as herpetologists to protect amphibian populations, and this will not be possible unless we rapidly and successfully educate the public about the amphibian extinction crisis. Only a small proportion of the world's citizens are aware that amphibians are in trouble, and we all have a vested interest in changing this: (1) an environmentally conscious society attempts to care for versus destroy the environment, and thus by educating the public regarding environmental issues we will help to ensure that our current hard work will not be laid to waste by the environmentally-destructive actions of future generations; (2) increasing students' interest in herpetology will mean a larger pool of potential graduate students for us to choose from, and thus higher quality researchers working in our labs; and (3) issues that are engrained in the public's consciousness receive more monetary funding from governments, private foundations, and average citizens, and we all depend on this money. In an effort to raise awareness of the issue and make the amphibian extinction crisis common knowledge by the end of 2010, I have created an informational poster (http://savethefrogs.com/posters) that SAVE THE FROGS! Nonprofit Organization is distributing to schools, zoos, museums, government agencies and businesses. This poster summarizes the amphibian extinction crisis, lists threats to frogs and reasons frogs are important, and offers explicit ways in which average citizens can help save frogs from extinction. I welcome your input on ways to fund the mass distribution of this poster.

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180 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Randolph Krohmer

Saint Xavier University, Chicago, IL, United States

Neuroendocrine and Environmental Regulation of Courtship and Mating in the Male Red-Sided Garter Snake

Courtship and mating in the male red-sided garter snake (*Thamnophis sirtalis parietalis*) is initiated immediately after emerging from winter dormancy. At emergence, the gonads are completely regressed and sex steroid hormone production is quiescent. Initial studies reported that, upon emergence, circulating hormone levels were basal suggesting that, unlike the majority of vertebrates, initiation of reproductive behavior is independent of sex steroid hormones. To date, the only cue(s) identified that initiate courtship behavior in the male red-sided garter snake is a prolonged period of low temperature dormancy followed by exposure to warm temperatures. Several studies have now found that circulating androgen levels are elevated upon emergence. In addition, sex-steroid concentrating regions, located within neural pathways critical for the expression of courtship behavior, are hypertrophied at the onset of the mating season. Therefore, while the importance of low temperature dormancy cannot be discounted, the occurrence of elevated circulating androgens, in association with hypertrophied sex-steroid concentrating regions in the brain, suggests a more active role for sex steroid hormones in the control of reproductive behavior than previously considered. Studies conducted in my lab over the past 15 years provides an alternative to the long-held assumption that sex-steroid hormones play no role in the initiation of courtship behavior and mating in the male red-sided garter snake, a species exhibiting a dissociated reproductive pattern. Our data demonstrates that sex-steroid hormones (specifically testosterone) play a critical although indirect role in the initiation of courtship behavior and mating in the male red-sided garter snake.

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181 Poster Session I, Exhibit Hall, Friday 24 July 2009

Randolph Krohmer

Saint Xavier University, Chicago, IL, United States

Colocalization of Aromatase Immunoreactive Neurons and the Nitric Oxide Synthesizing Enzymes (NOS and NADPH) in the Forebrain of the Male Red-Sided Garter Snake

Nitric oxide (NO) first identified as an endogenous regulator of blood vessel tone, may also serve as a neurotransmitter. With a half-life of less than five seconds, NO is studied

by assessing the enzymes responsible for the formation of NO. These enzymes, nitric oxide synthase (NOS) and nicotinamide adenine dinucleotide phosphate (NADPH) are broadly distributed in mammalian and avian brains, particularly areas implicated in the control of reproductive behavior. In the Japanese quail, distribution of NADPH-d appeared to correspond to areas with dense populations of cells containing the aromatase enzyme (ARO). In a previous study, we found that aromatase immunoreactive (ARO-ir) cells occurred at all levels of the male garter snake brain. However, the highest density of ARO-ir cells appeared to be clustered in regions classically associated with the control of courtship behavior in most vertebrates. In this study, we examined the anatomical relationship between ARO and NO by labeling ARO-ir and NOS-ir (NOS or NADPH-d) cells. The distribution of ARO-ir cells was similar to that reported by Krohmer et al (2002). When tissues were labeled for both ARO-ir and NOS-ir cells, there appeared to be significant overlap in regions previously found to be vital for the expression of courtship behavior. When double labeled for ARO and the NO synthesizing enzymes a co-localization within the same cells was revealed. Based on these data, the close association of NOS-ir and ARO-ir cells suggests that input from NOS-positive neurons may modulate the expression of aromatase in the male garter snake brain.

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651 ELHS/LFC Ecology I, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Jenna Krug, Mark Steele

California State University, Northridge, Northridge, CA, United States

A Test For Correlated Recruitment Of Predator And Prey Species Of Kelp Forest Fishes

Many marine fishes have a pelagic larval stage whose transport is driven by oceanographic processes, such as currents. Shared exposure of larvae of predator and prey species seems likely to cause recruitment of demersal fishes to be spatially correlated. Correlations in recruitment of predators and prey could significantly affect prey population dynamics. We tested for correlations in recruitment of a predator (*Paralabrax clathratus*) and five prey species of fishes at Santa Catalina Island, California. Recruits were counted seven times from June to December along twenty-seven 30-m^3 transects at each of eight sites spread over about 30 km of coastline. Adults were also counted four times along similar transects. Density and canopy cover of giant kelp, *Macrocystis pyrifera*, as well as bottom substrate cover was quantified along transects at each site. Recruitment of all four fishes with pelagic larval stages was not correlated with that of the predator; however, density of young-of-year *Brachyistius frenatus* (a live-bearing surfperch) was positively correlated to the recruitment of Paralabrax. The correlation between recruitment of this live-bearing prey species and its egg-laying predator was likely caused by positive responses of each species to kelp abundance. The lack of correlated recruitment among the five species with larval stages implies that

shared exposure to ocean currents does not lead to similar spatial patterns of settlement for different species or that very early-postsettlement losses disrupt any correlated patterns of larval delivery.

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46 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Sarah Kupferberg[1], Amy Lind[2], Wendy Palen[3]

[1]Questa Engineering, Pt. Richmond, CA, United States, [2]USDA Forest Service, Sierra Nevada Research Center, Davis, CA, United States, [3]Simon Fraser University, Burnaby, British Columbia, Canada

Assessing Effects of Altered Hydrologic Regimes on Foothill Yellow-legged Frogs Using a Population Projection Model

The decline of the riverine-associated foothill yellow-legged frog (*Rana boylii*) has been attributed to the altered flow regimes and habitat fragmentation associated with water storage and hydroelectric power dams. Recent research has provided insights into the mechanisms for these declines by confirming that early life stages (especially embryos and tadpoles) are negatively affected by aseasonal pulses in water flows and the associated changes in local water velocities and depths in oviposition and rearing habitats. To understand how these effects on early life stages influence overall population viability, we developed a matrix population model for *R. boylii*. We collected new field data and analyzed data from other researchers on fecundity and life-stage specific survival rates to develop a life table and parameterize a reference matrix model. We then evaluated 20 scenarios based on documented effects of altered hydrologic regimes on different life stages. We also evaluated changes in population viability relative to modeled starting population size and quasi-extinction thresholds. The likelihood of extinction (projected for 30 years into the future) increased substantially with small starting population sizes and for scenarios that simulated stranding and/or scouring of egg masses and tadpoles. Sensitivity analyses demonstrated that adult and tadpole survival and embryo scour rates were the key factors in determining overall population growth rate (lambda). When parameterized with stream-specific survival rates, this model can be an important tool for evaluating proposed changes to flow regimes during hydroelectric power project relicensing and other water management planning.

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210 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Gen Kume, Keisuke Furumitsu, Atsuko Yamaguchi

Nagasaki University, Nagasaki, Nagasaki, Japan

Life History Characteristics of the Fanray *Platyrhina sinensis* in Japan

Age, growth and reproductive characteristics of the fanray, *Platyrhina sinensis*, were examined in Ariake Bay, Japan, from May 2002 until December 2006. Age determination was conducted by vertebral centrum analysis using soft X-radiography. The von Bertalanffy growth model best described the overall pattern of growth for both males and females [males L_∞ = 455.2, k = 0.56, t_0 = -1.09; females L_∞ = 555.8, k = 0.28, t_0 = -1.77; L_∞ is the theoretical asymptotic total length (TL) in mm, k is the growth rate coefficient and t_0 is the theoretical time at zero length.]. Age and TL at 50% maturity were 2.1 years and 393 mm for males and 2.9 years and 421 mm for females, respectively. Histological observations of testes showed that sexually active males occurred from August to November when monthly gonadosomatic index declined. Concomitantly, pre-ovulatory ova were observed in females collected from August to November. Near-term embryos, neonates and recent post-partum females also occurred from August to November. Additionally, all post-partum females possessed pre-ovulatory ova. These data indicate that parturition occurred from August to November followed immediately by mating, ovulation and fertilization. Females become pregnant every year and the gestation period is almost one year. Fertilized uterine eggs without macroscopic embryonic development were present throughout the year, indicating that *P. sinensis* utilizes embryonic diapause as its reproductive strategy. Both reproductive tracts of females were functional and fecundity ranged from 1 to 12 with a mean of 6.0, increasing with TL.

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291 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009

Mari Kuroki, Jun Aoyama, Michael Miller, Katsumi Tsukamoto

Ocean Research Institute, The University of Tokyo, Nakano, Tokyo, Japan

The Role of the Leptocephalus Larva in the Evolution of Anguillid Oceanic Migrations

Anguillid eel larvae, called leptocephali, migrate from spawning areas in the open ocean to their freshwater growth habitats, which are separated by distances up to 8,000 km in the case if the European eel *Anguilla anguilla*. The diversity and evolutionary origins of anguillid eel migration was examined by studying the morphology and otolith microstructure of twelve species of Indo-Pacific leptocephali, and nine species of glass eels from various parts of the world. Distributional analysis of leptocephali suggested

that the tropical species *A. celebesensis* and *A. borneensis* spawn near their growth habitats, and have short distance migrations in the Indonesian waters (small-scale migration). Other tropical species *A. marmorata* and *A. bicolor pacifica* migrate farther and inhabit wide regions in the Pacific Ocean (middle-scale migration). This contrasts with temperate anguillids with longer migrations that recruit to higher latitudes (large-scale migration). Tropical species of leptocephali typically showed shorter maximum lengths (~50 mm) and deeper body depths at metamorphosis than temperate eels (~60-75 mm). Leptocephali of small-scale migration species grew faster (0.53-0.57 mm/d) than mid-scale migration species (0.40-0.53 mm/d) and the Atlantic eels with large-scale migrations (0.38 mm/d). These results corresponded well with the mean duration of the larval period of tropical and temperate species estimated from the otolith microstructure of their glass eels (108.5-194.4 d in four tropical species, and 203.0-351.2 d in five temperate species), which indicates the leptocephalus phase may have been an important factor in the diversification into new populations or species and the establishment of anguillid eel geographic distribution.

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41 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER HERPETOLOGY AWARD

Megan Lahti

Utah State University, Department of Biology, Logan, UT, United States

Morphological Variation of Dwarfed Populations of Short-horned Lizards (*Phrynosoma hernandesi*) and Great Plains Toads (*Anaxyrus cognatus*) in the San Luis Valley, Colorado

Morphological measurements are reported for dwarfed populations of short-horned lizards and Great Plains toads inhabiting an isolated valley in south-central Colorado (the Valley). Since the initial reporting in 1968, no studies have investigated the extent or degree of body size reduction in these presumably isolated populations. Using both museum and live specimens, 16 morphological features of adult toads (n = 92 museum, 139 live) and 27 morphological features of adult lizards (n = 103 museum, 73 live) were measured. Females and males of both species were significantly smaller than their non-valley counterparts ($p < 0.05$); Valley toads were 34% smaller than non-Valley populations while Valley lizards are 30% smaller. Valley populations of both species are disproportionately dwarfed compared to populations adjacent to the Valley including significantly smaller head lengths in lizards ($p = 0.0004$) and significantly smaller head widths, parotoid lengths, and head lengths in toads ($p < 0.09$). A MANCOVA indicates that there is a both a locality and sex effect on the morphologies of both species ($p < 0.001$) and a sex*locality interaction for toads ($p = 0.04$). The morphological uniqueness among dwarfed populations of lizards and toads provides insight into the effects of their presumed isolation within the Valley, such as implications towards potential variation in their life/natural- histories and genetic diversity.

1011 Poster Session I, Exhibit Hall, Friday 24 July 2009

Trip Lamb, David Beamer

East Carolina University, Greenville, NC, United States

Digits Lost or Regained? A Molecular Phylogenetic Perspective on Dwarf Salamanders and the Genus *Eurycea*

Dwarf salamanders (*Eurycea chamberlaini*, *E. quadridigitata*) are characterized by a gracile habitus and a single digit loss on the pes. We sequenced 120 individuals representing 103 populations across the collective ranges of the two currently recognized species to update their respective distributions and assess possible phylogeographic structure. Bayesian analysis of one nuclear (Rag-1) and two mitochondrial (cytb, ND2) genes identified five independent lineages of dwarf salamander. Remarkably, these lineages are not monophyletic in a molecular phylogeny for *Eurycea* as a whole. We use this phylogeny to address competing hypotheses of digital loss (convergence, parallelism) among the dwarf salamander lineages versus digital gain in other species of *Eurycea*.

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302 Poster Session I, Exhibit Hall, Friday 24 July 2009

Stacey Lance[1], Tracey Tuberville[1], Ruth Elsey[2], Philip Trosclair[2], Travis Glenn[3]

[1]*University of Georgia, Savannah River Ecology Laboratory, Aiken, SC, United States,* [2]*Louisiana Department of Fisheries and Wildlife, Grand Chenier, LA, United States,* [3]*University of Georgia, Department of Environmental Health Sciences, Athens, GA, United States*

Multi-year Multiple Paternity and Mate Fidelity in the American alligator, *Alligator mississippiensis*

We examined multiple paternity during eight breeding events within an 11 year period (1997-2008) for a total of 114 wild American alligator nests in Rockefeller Wildlife Refuge in south-west Louisiana. In the current study eggs were sampled from 92 nests over six years and analyzed along with 22 nests from a previous two-year study. Genotypes at five microsatellite loci were generated for 1,802 alligator hatchlings. Multiple paternity was found in 51% of clutches and paternal contributions to these clutches were highly skewed. Rates of multiple paternity varied widely among years and were consistently higher in the current study than previously reported for the same population. Larger females have larger clutches but are not more likely to have multiply-sired nests. However, small females are unlikely to have clutches with more than two sires. For ten females, nests from multiple years were examined. Seven (70%) of these females exhibited long-term mate fidelity, with one female mating with the same male in 1997,

2002, and 2005. Five females exhibiting mate fidelity (71%) had at least one multiple paternity nest and thus are mating with the same male, but not exclusively. These patterns of mate fidelity suggest a potential role for female choice in alligators.

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612 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Maria Isabel Landim

MZUSP, São Paulo, Brazil

Darwin in Brazil

Darwin visited Brazil in two different ways and periods. The first was during the voyage of H.M.S. Beagle in 1832 and in 1836. The second was the arrival of Darwin's evolutionary ideas in the end of the 19th century. Brazil and Brazilians made a strong impression on the young Darwin. He experienced for the first time the chaos and delight at being in a tropical forest in Northeast Brazil. However, the Darwin of great ideas and observations was not yet fully developed. The biodiversity he encountered bewildered him. Still an inexperienced naturalist, Darwin was very conventional, using words from Humboldt and images from Rugendas to describe what he saw. However, the structure of the Brazilian society and slavery shocked him. The second visit of Darwin to Brazil was metaphorical and occurred many years later, through the arrival of his evolutionary theory. Darwin's ideas reached Brazil mainly indirectly, through the works of Ernst Haeckel and Herbert Spencer. These authors held different positions from Darwin's on several fundamental aspects. Because of that, evolution in Brazil was initially associated with positivism and social Darwinism and, therefore, attracted prejudice from society. This certainly had a great impact in the acceptance of evolution by society that can be observed even today. Evolutionary theory faces an additional challenge with the increase of religious fundamentalism. In the presentation, I will approach these visits of Darwin to Brazil, and analyze the impact Brazil had on Darwin, as well as the impact of Darwin's ideas in Brazil.

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790 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Kristen Landolt, Howard Whiteman

Murray State University, Murray, KY, United States

Predator Presence and the Facultatively Paedomorphic Mole Salamander, *Ambystoma talpoideum*

Larval amphibians exhibit induced morphologies and behaviors in response to predator presence. Facultative paedomorphosis in salamanders allows individuals to attain sexual maturity in either the terrestrial, metamorphic phenotype or the aquatic, paedomorphic phenotype. Predator presence may influence paedomorphosis by inducing behaviors and morphologies that affect individual growth rates, which are thought to be important in metamorphic timing. This study compared the behavioral, morphological and life history responses of larvae of the facultatively paedomorphic mole salamander (*Ambystoma talpoideum*) to three predators: bluegill, dragonfly naiads, and paedomorphic *A. talpoideum*. Metamorphosing salamanders generally had higher growth rates and body sizes than individuals that did not metamorphose. Bluegill and odonates induced significantly longer tails than conspecifics and significantly higher growth rates and body sizes than conspecifics and controls. While both sexes responded in similar fashion morphologically, only females exhibited a difference in the expression of paedomorphosis, in which the odonate treatment produced significantly fewer female paedomorphs than the other treatments. These results suggest that *A. talpoideum* can detect and respond to predators and that there is a sex-specific life history response. Through induced responses, community interactions may indirectly affect life history evolution. In addition, by exerting differential pressure on the sexes, such interactions provide a mechanism by which variation in life history is promoted and maintained.

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286 ELHS/LFC Hypoxia, Broadway 1&2, Sunday 26 July 2009

Lanora Lang[1], Frank Hernandez, Jr.[2], Jonathan Hare[3], John Govoni[4]

[1]University of South Alabama, Mobile, AL, United States, [2]Dauphin Island Sea Lab, Dauphin Island, AL, United States, [3]NOAA/NMFS/NEFSC, Narragansett, RI, United States, [4]NOAA Center for Coastal Fisheries and Habitat Research, Beaufort, NC, United States

The Effects of Hypoxia on the Vertical Distribution of Larval Fishes in the Northern Gulf of Mexico

Regions of hypoxia (low dissolved oxygen concentrations) occur seasonally in the northern Gulf of Mexico as a result of water column stratification and eutrophication

processes. Previous studies have demonstrated the displacement of adult fishes due to hypoxia, thus altering distribution patterns, migration pathways and interactions with predators and prey. However, relatively little is known about the effects of hypoxia on the distribution of early life stages. The objective of this study was to investigate larval fish vertical distributions with respect to measured environmental variables (including hypoxia), ontogeny and diel periodicity. Depth-discrete ichthyoplankton samples were collected off the coast of Louisiana in mixed waters (2002) and stratified (hypoxic) waters (2002 and 2003). The relationship between vertical distribution and hypoxia was examined for four taxonomic groups: Engraulidae, *Menticirrhus* spp., *Cynoscion* spp. and *Sciaenops ocellatus*. Weighted mean depth of ocurrence and mean concentration of larvae at depth were compared using parametric ANOVAs to examine differences between stages, time of collection and water column structure (stratified vs. mixed). In addition, a suite of models encompassing all possible combinations of measured variables to describe the mean and variance in larval fish vertical distribution was developed using the General Additive Models for Location, Scale, and Shape (GAMLSS) approach, and the best fit models were selected using Akaike's Information Criterion. Overall, differences in vertical distribution were observed with respect to ontogeny, diel periodicity and hypoxia, but not for all taxonomic groups.

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579 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Nicholas Lang, W. Leo Smith

Field Museum of Natural History, Chicago, IL, United States

Molecular Systematics of the Agonostomatine Mullets (Teleostei: Mugilidae)

The family Mugilidae contains over sixty recognized species, commonly referred to as mullets, distributed throughout the world's tropical and temperate waters. Although the mullets have been revised a number of times using morphological data, published hypotheses of higher-level relationships among mugilids based on phylogenetic methodology are lacking. While some phylogenetic studies of mullets have been undertaken using molecular characters, they have been geographically and/or taxonomically restricted. In general, the mullets have been separated into two groups, the Mugilinae, considered to include the "advanced" genera, and the Agonostominae, considered to comprise the "primitive" genera. Of the four agonostomine genera, two, *Aldrichetta* and *Joturus*, are monotypic, and, along with *Cestraeus*, which comprises two-three species in the Indo-Australian region, are geographically restricted. The remaining agonostomine genus, *Agonostomus*, contains three species that have a disjunct distribution in tropical waters of the Western Hemisphere and waters in and around Madagascar, Réunion, Mauritius, and the Comoros Islands. Using both mitochondrial and nuclear genes and a variety of phylogenetic methods, we will test the monophyly of the subfamilies of mullets, focusing on relationships within the Agonostominae, in order to more fully understand this unique distributional pattern.

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447 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Brian Langerhans

University of Oklahoma, Kingston, OK, United States

Livebearing Fish as Models for the Study of Genital Evolution

Genital morphology, particularly in males, is strikingly variable in animals with internal fertilization—but why? Three categories of hypotheses have been proposed to explain the remarkable degree of genital variation: sexual selection, natural selection, and neutrality. Owing to their dramatic diversity of genital morphology (most notably in male gonopodia), range of mating strategies, breadth of habitats occupied, ease of laboratory experimentation, and the existence of some fairly well-resolved phylogenies, poeciliid fishes represent a model system for studies of genital evolution. However so far, we have only scratched the surface in understanding the causes and consequences of genital diversification in poeciliid fishes. By reviewing and synthesizing existing data, and performing a number of new analyses, I show that genital evolution in poeciliids is quite complex, resulting from multiple processes. Evidence indicates that multiple forms of both sexual and natural selection play important roles, with a host of hypotheses yet to be formally tested. Interestingly, emerging patterns in the causes of genital evolution in poeciliids do not match mechanisms thought to be most important in other taxa. It is also evident that we badly need a stronger, functional understanding of the mechanics of copulation, which is particularly critical for guiding hypotheses and understanding patterns in gonopodial diversity. The study of genital evolution in poeciliids is an arena ripe with many important, but unanswered questions.

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868 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Thomas Lankford

University of North Carolina Wilmington, Wilmington, NC, United States

The UNCW Fish Collection: A Resource for Ichthyology Research and Education

The University of North Carolina Wilmington Fish Collection, established by the late Dr. David G. Lindquist, is maintained by the Department of Biology and Marine Biology and provides extensive material in support of ichthyological research and education. The research collection consists primarily of alcohol-preserved specimens and includes >32,000 cataloged and >20,000 uncataloged specimens representing >340 genera and >700 species. Entries (>1,500 lots) span the period 1975-present, providing extensive coverage of 1) marine fishes of the Carolinian province, 2) freshwater fishes of the lower

coastal plain of the Cape Fear River drainage, 3) larval fishes of the Onslow Bay mid/outer continental shelf and adjacent Gulf Stream, 4) juvenile fishes of estuarine and ocean surf habitats in southeastern North Carolina, and 5) freshwater endemics of Lake Waccamaw. Geographic coverage includes material from Ecuador, California, Mexico, Bahamas, Florida Keys and southern Appalachia. Also included is an undergraduate teaching collection of isopropyl-preserved juvenile and adult specimens representing >275 species common to marine, estuarine and freshwater habitats of coastal North Carolina, along with skeletal preparations, cleared and stained specimens, digital photographs and otolith reference sets. The collection catalog has recently been computerized with the goal of providing an on-line, searchable database. Housed within the UNCW Vertebrate Museum (Dr. David Webster, Director), the fish collection has now reoccupied newly-renovated facilities in Friday Hall. Ichthyologists interested in accessing the collection are invited to contact Dr. Tom Lankford, Curator of Fishes, at lankfordt@uncw.edu.

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866 Fish Ecology III, Pavilion West, Monday 27 July 2009

Thomas Lankford, Ian Lipton

University of North Carolina Wilmington, Wilmington, NC, United States

Fish Nursery Function of Ocean Surf-Zone Habitat: Response to a Human Disturbance Gradient

The ocean surf zone provides essential habitat for a variety of coastal marine fishes. Surf zones are particularly important as juvenile nursery habitat and as migratory corridors for adults. The nursery function of surf zone habitat may be compromised by human disturbances to adjacent beaches. Although shoreline development and protection are common practices on barrier island beaches of the southeastern U.S., their impacts on surf zone fishes are poorly described. We are investigating the response of fish nursery function to beach disturbance by comparing the assemblage structure, density and nutritional condition of juvenile fishes sampled from beaches selected to represent a disturbance gradient. Sampling sites include undisturbed (undeveloped and unnourished, n=3), moderately disturbed (developed but unnourished, n=2) and highly disturbed (developed and nourished, n=3) beaches in southeastern North Carolina. Nursery function is indexed based upon the compositional analysis (tissue lipid content, ash content, somatic condition) of two surf-dependent species: Florida pompano (*Trachinotus carolinus*) and Gulf kingfish (*Menticirrhus littoralis*). Preliminary results for 2008 indicate that the nursery function of undisturbed beaches was superior to that of both developed and nourished beaches.

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963 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Hilmar Lapp[1], Todd Vision[2]

[1]US National Evolutionary Synthesis Center (NESCent), Durham, NC, United States, [2]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

A Gentle Introduction to Ontologies for Biology

As biology has become increasingly data-rich, the reliance on databases and computation to integrate and mine the vast body of knowledge traditionally reported in the literature has grown dramatically. This has inspired the development of computational technologies to allow the exploration and linking of diverse types of data across biological databases at unprecedented scales. One of the most important technologies is an "ontology", a hierarchically structured, controlled vocabulary of well-defined terms and the logical relationships that hold between them. Ontologies have been applied with tremendous success to transform scientific results traditionally reported as free text into a digital representation that is unambiguous, uniform across disciplines, and readily computable. For example, ontologies of biochemical functions and biological processes are used to unambiguously record what is known about a gene's function. Anatomy ontologies are now being used to unequivocally describe the morphological characteristics visible in a specimen image. Efforts (including two in ichthyology and herpetology) are underway to develop ontologies that will ultimately span the breadth of biological knowledge, which will have a profound impact on the way that biologists interact with data collections in the future. In order to be useful community resources, ontologies must accurately capture the state of biological knowledge, which requires that the biological community through their experts play an active role in their development. Here, I will provide a beginner's guide to the world of ontologies and offer a roadmap for how biologists can best take advantage of, and contribute to, the growing suite of bio-ontology resources.

1036 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Shawn Larson, Jeff Christiansen, Joel Hollander, Denise Griffing

Seattle Aquarium, Seattle, WA, United States

Seattle Aquarium's Sixgill Shark (*Hexanchus griseus*) Conservation Ecology Project

The Aquarium's Sixgill Shark (*Hexanchus griseus*) Population Ecology project is a long-term conservation research program to address gaps in the body of scientific knowledge

on these relatively unknown animals. Living mainly at abyssal depths (2000-5000 feet) but also in shallow waters of Puget Sound, Washington, sixgills are thought to be long-lived and slow-growing, and appear to have established movement corridors and territories that remain relatively fixed over time. No information exists on how many sixgills are in Puget Sound, whether they are year-round or seasonal, local or migratory, or whether they use local water primarily for feeding or for recruitment. The Aquarium's sixgill population ecology research involves four interwoven techniques to determine aspects of basic sixgill biology using (1) genetics research, (2) visual marker tagging, (3) acoustic tracking and (4) video analysis. The aquarium began tagging and tracking these animals in 2003 and in 2008 began collecting data from our archived video taken since 2003. Here we present statistics on absolute numbers of sharks seen, number of sharks tagged, number of returned sharks, sex and size distribution from video analysis of sharks and tag return data. Population genetics parameters from analysis using 14 polymorphic microsatellite markers and summary statistics for sixgills within Puget Sound will also be presented. This research should substantially improve scientific understanding of abundance, relatedness and movement patterns in Puget Sound.

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258 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kelly Lasater, Hang Lee

Seoul National University, Seoul, Republic of Korea

Creating a Low Cost Digital Frog Logger: A Viable Alternative for Developing Countries

Frog loggers are bioacoustic recorders that record anuran calls at specific intervals. Previous frog logger designs have proven invaluable for monitoring anuran populations but possess a few significant drawbacks. Cost and availability of parts are major barriers for many researchers, particularly those in developing nations, to gain access to these tools. We present a new design that uses commonly available parts and is based on an open source microprocessor platform. With minimal changes, this system can interface to several types of audio recorders including the traditional cassette recorder, MD players, and digital audio recorders. This design adds the additional ability to record data from environmental sensors. At present, ambient temperature is recorded along with the audio time stamp on the audio recording but future work will add the ability to record data from up to six additional sensors (temperature, humidity, pressure, etc.) to a text file on an SD memory card. This new design can provide a low cost alternative with additional features, well suited for researchers and conservation groups with limited budgets.

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700 Poster Session I, Exhibit Hall, Friday 24 July 2009

Ian Latella, Steven Poe

University of New Mexico, Albuquerque, NM, United States

Traits Promoting Invasive Success In *Anolis* Lizards

Invasive species provide important opportunities for the study of natural biogeographic processes. For example, our knowledge of the factors constraining range size, speciation, and community structure and assembly has been greatly enhanced by the study of recent invasions. *Anolis* lizards are a model group for the study of invasion with 19 known invasive species and an evolutionary history of successful natural colonization. We used a combination of morphological, environmental, phylogenetic, and anthropomorphic characteristics to model invasive ability in this group. We compared models incorporating each of these classes of variables and developed a logistic regression model with excellent predictive ability. We conclude that invasive success of *Anolis* is facilitated not by any single characteristic but by a suite of characteristics and that a model based on environmental characteristics is superior to models incorporating exclusively intrinsic, phylogenetic, or anthropomorphic variables.

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77 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009

Benjamin Laurel[1], Thomas Hurst[1], Lorenzo Ciannelli[2]

[1]NOAA Fisheries - AFSC, Newport, OR, United States, [2]Oregon State University, Corvallis, OR, United States

An Experimental Examination of Temperature Interactions in the 'Oscillation-control' and 'Match-mismatch' Hypothesis for Pacific Cod Larvae

The Oscillation Control Hypothesis (OCH) and Match-Mismatch Hypothesis (MMH) have been used to predict how variable primary productivity impacts the survival of marine fish larvae. However, applied to Pacific cod larvae (*Gadus macrocephalus*), the OCH and MMH make opposite predictions as to which set of environmental conditions best contribute to cohort success. To resolve this conflict, we designed an experiment examining how Pacific cod larvae respond to changes in the timing and magnitude of prey availability under two different temperature environments. At 3° and 8°C, cod larvae were exposed to 1 of 5 different food treatments over a 6-wk period: (1) high food (HF) (match); (2) low food (LF), (3) HF then LF (HF-LF), and (4) LF then HF (LF-HF) (2-4 mismatch); and (5) no food (NF) (complete mismatch). Results showed that cold environments lessen the consequences of prey availability (i.e., timing and magnitude), but may expose larvae to longer periods of size-dependent predation. Under warmer conditions, mismatches in prey significantly impacted growth and survival. However, mismatches during the first 3 wks of development were less severe, mostly due to

buffering effects of remaining yolk reserves and the ability of larvae to use compensatory growth mechanisms when the prey environment improved. Our results demonstrate a clear need to amend food-limitation models for marine larvae (e.g., OCH or MMH) so that they consider the physical environment, both as a driver of lower level productivity and as a major factor influencing the physiology and food requirements of larvae interacting with their prey.

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504 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jolene Laverty, Jacqueline D. Litzgus

Laurentian University, Sudbury, Ontario, Canada

Effects of Human Recreation on the Population Ecology and Spatial Behaviour of Turtles in an Ontario Park

Provincial parks are considered protected areas for species at risk, but parks also provide areas for recreational activities for people. Eco-tourism has led to an increase in the use of areas such as The Massasauga Provincial Park (MPP) in Georgian Bay, Ontario which provides boating and camping opportunities on remote islands only accessible by air or water. The purpose of our project is to determine if human recreation is having an effect on turtle populations in The MPP. The project will have two components: a study of the population ecology of all turtle species in the park; and an analysis of the spatial behaviour of Stinkpot Turtles (*Sternotherus odoratus*). Data will be collected from three replicates of each of two site treatments: impacted bays (high activity) and non-impacted bays (low activity). Mark-recapture and visual surveys will be used to determine the abundance, biodiversity and sex ratios of turtle populations. Radio telemetry and Geographical Information Systems (GIS) will be used to estimate home range sizes and average daily movements of Stinkpots in impacted and non-impacted sites. Demographic and spatial data will be compared between site treatments. We predict that if human recreation is negatively affecting turtles, then abundance and biodiversity will be lower in impacted sites compared to non-impacted sites, and that stinkpot home range sizes and movements will be greater in impacted areas as turtles try to avoid people. Information gathered will assist in park management planning and increase the knowledge the impact of water-based recreational activities on turtles.

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140 Herp Biogeography, Galleria North, Saturday 25 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Lucinda Lawson

University of Chicago, Chicago, IL, United States

Hyperolius Diversification in Fragmented Montane Forests: An Investigation into the Accumulation and Persistence of Biodiversity in the Eastern Arc Mountains of Tanzania

Geological barriers, geographic distance between populations, and climatic fluctuations are all recognized as important forces underlying speciation patterns in the tropics. The cessation of gene flow caused by the formation of river systems and mountains ranges have been credited with shaping current species boundaries in a number of systems. Likewise, climate fluctuation cycles in the past ~5 million years also have been shown to restrict ancestral ranges into refugia, thus leading to divergence and speciation in allopatry. Knowing how to correctly identify which forces may have led to current phylogeographic patterns and organismal divergences remains a major issue in evolutionary biology. In this study I compared phylogeographic patterns of three species of of *Hyperolius* frogs throughout the Eastern Arc Mountains of Tanzania under three different evolutionary scenarios to determine the underlying causes of divergences between populations on different mountain blocks. Two classic hypotheses of barriers were investigated (a major river system and a shift from montane to highland ecosystems) along with a simple "isolation by distance" and a modification of that: a climate cycle scenario. To statistically test the explanatory power of each possible scenario, I compared the phylogenetic patterns documented in multi-locus gene trees of each species to simulated patterns under all four options.

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154 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Tyler Lawson, Allison Welch, Martin Jones

College of Charleston, Charleston, SC, United States

Habitat Effects on Chytridiomycosis Infection in the Critically Endangered *Agalychnis moreletii*

The past several decades have seen amphibian populations around the world vanishing at an alarming rate due to factors such as habitat destruction, pollution, and infectious diseases. During the summer of 2008, I examined how factors such as these are affecting a critically endangered amphibian, *Agalychnis moreletii*, in shaded coffee plantations, technified coffee plantations, and natural areas in El Salvador. Nocturnal surveys of calling adult males were conducted to estimate relative abundance. Larvae were

inspected with a hand lens for mouthpart deformities, which may be indicative of infection with *Batrachochytrium dendrobatidis*, a fungal pathogen of amphibians that can be lethal. Samples of inspected tadpoles were preserved and PCR was used to test for presence of *B. dendrobatidis* in order to determine the effectiveness of hand lens screening and to compare infection prevalence among habitats. Odds of infection were lower for technified plantations than for non-technified sites. However, these results were influenced by two heavily infected non-technified sites. Results of chorus surveys suggest that *A. moreletii* populations in shaded plantations may be larger than in technified plantations or natural areas. External mouthpart abnormalities were found to predict presence of chytrid infection with relatively good success (86%) across several sites; however, predictive ability varied among sites. Future studies should investigate whether chytridiomycosis is the primary cause of decline in *A. moreletii*, as proposed by the IUCN, or if habitat destruction and pollution are also contributing factors.

1014 Herp Systematics, Pavilion West, Thursday 23 July 2009

Dean Leavitt[1], Brad Hollingsworth[2], Angela Marion[1], Tod Reeder[1]

[1]San Diego Sate University, San Diego, CA, United States, [2]San Diego Natural History Mu, San Diego, CA, United States

Phylogenetic Relationships Among Alligator Lizards of the Genus *Elgaria*: A Multi-locus DNA Sequence Approach

The phylogenetic relationships among the alligator lizards of the genus *Elgaria* have been addressed by morphology, allozymes and mitochondrial DNA sequence data with discordant results. As part of our goal of understanding the spatial and temporal aspect of the diversification of the desert Southwest squamate fauna, we are investigating the evolutionary relationships among species of *Elgaria* using DNA sequence data from multiple nuclear genes. Specifically, we test whether these new data support the purported sister relationship between *E. kingii* and *E. panamintina* recovered by the previously published allozyme data, as well as the phylogenetic position of two lesser studied species from Baja California (*E. cedrosensis* and *E. velazquezi*). Contrary to a previous hypothesis, the Baja California species *E. cedrosensis* and *E. velazquezi* are not recovered as sister species; rather, *E. cedrosensis* is recovered as being more closely related to southern populations of *E. multicarinata*. Additionally, DNA sequence data fail to support *E. kingii* and *E. panamintina* as sister species, despite their striking morphological similarity. Consistent with published mtDNA data, these nuclear data suggest most *Elgaria* species diverged within a relatively short period in the late Miocene.

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840 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jennifer Lee

Southeastern Louisiana University, Hammond, LA, United States

Stress, Reproduction and Adrenal Modulation in the Red-Eared Slider Turtle (*Trachemys scripta elegans)*

Adrenal modulation is the change in amount and rate of release of glucocorticoids in vertebrates in response to stress. Affects of adrenal modulation include initiation of escape behavior, increase carbohydrate metabolism and suppression of reproduction. This project will determine if red-eared slider turtles (*Trachemys scripta elegans*) exhibit adrenal modulation. In order to determine if adrenal modulation is present, the hormones coticosterone, estradiol, and testosterone will be measured. These adrenal and gonadal steroids and the protein vitellogenin will be measured to establish a yearly basal profile and help determine the reproductive status. Turtles will be caught monthly and blood samples taken within ten minutes of retrieval from hoop nets in order to ensure basal hormone levels. In addition to monthly sampling the turtles will be subjected to immobilization stress three times during the year - before, after and during the breeding season. During these periods of stress corticosterone will be measured to determine if adrenal output is affected by reproductive status. Hormone and protein concentrations will be measured using an Enzyme-Linked Immunosorbent Assay (ELISA). This project has yet to be completed and this poster will only present results about adrenal modulation. The months of February, pre-breeding and May, during breeding, will be compared. This study will produce previously unknown information about the yearly fluctuation of stress and reproductive hormones, protein concentrations and the presence or absence of adrenal modulation in the red-eared slider turtle. This study will provide base line data for future studies of turtles and the affects of stress.

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384 Herp Ecology, Galleria North, Monday 27 July 2009

Jose Lefebvre, Tom Herman

Acadia University, Wolfville, Nova Scotia, Canada

Does Size Matter? Sexual Size Dimorphism in Three Populations of Blanding's Turtles (*Emydoidea blandingii*) in Nova Scotia

Female-biased sexual size dimorphism is common in turtles. Blanding's turtles provide an exception to this rule, with males slightly larger than females. Blanding's turtles are among the longest-lived freshwater turtles for which data are available from wild populations. Some individuals in Nova Scotia first captured as adults nearly 40 years ago are still reproductive. Nova Scotia's populations are disjunct from the main range in south central Canada and north central United States. This study examines sexual size

dimorphism in the three known populations within Nova Scotia, comparing it with populations within the main range of the species. Size differences among the three populations, and a sub-population, may reflect the influence of environment, since habitats and environmental pressures differ among them. Indeterminate growth, which remains a controversial subject in chelonian life-history, was apparent in males. Sexual size dimorphism was consistent across populations, with habitat exhibiting a significant effect on males, and a partial effect on females.

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804 Herp Genetics, Galleria North, Saturday 25 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Adena Leibman

University of South Carolina, Columbia, SC, United States

Natal Beach Contributions to a Southeastern United States Subadult Loggerhead Sea Turtle (*Caretta caretta*) Feeding Assemblage

Loggerhead sea turtles are a cherished natural treasure, especially along the Southeastern US coastline where they nest and feed. Utilizing polymerase chain reaction (PCR) amplification and sequencing, mitochondrial DNA (mtDNA) haplotypes were determined for 927 subadult loggerhead sea turtles (*Caretta caretta*) collected over a 9-year in-water survey. An AMOVA and mixed stock analysis were conducted for each of the sample years to identify temporal variation in natal beach contributions to the subadult feeding assemblage. Haplotypic diversity did not alter significantly between sample years (F_{st}=0.001, p>0.1). Within year variation accounted for 99.89% of the total variation while between year variations only accounted for the remaining 0.11%. The South Florida and Northeast Florida-North Carolina nesting beach regions were consistently the greatest contributors to the feeding aggregate. Preliminary analyses reveal interesting trends related to natal beach origin variation between the sexes.

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79 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Jeffrey Leis

Australian Museum, Sydney, NSW, Australia

How Do Biogeography and Study Species Influence Connectivity?

Cold and warm water marine systems differ, not only in taxonomic diversity, but also in composition. For example, in the coastal tropics, Perciform species of the suborders

Percoidei, Labroidei, Blennioidei, Gobioidei, and Acanthurioidei dominate, whereas, few species of these suobrders occur in high latitude, cold water. In high latitude coastal ecosystems, species of the orders Gadiformes, and Salmoniformes, and Scorpaeniform suborders Hexagrammoidei and Cottoidei, and Perciform suborders Zoarcoiodei and Notothenioidei dominate: few of these occur in tropical waters. Does this make a difference to connectivity? Limited data suggest that Percoid larvae are better swimmers, and they reach developmental and behavioural milestones at smaller sizes and younger ages than Gadiform and cold-water Scorpaeniform larvae. This could differentially influence larval dispersal outcomes by differences in behavioral abilities, and lead to real differences in connectivity between high and low latitudes. Research on larval fishes and connectivity tends to focus on different taxonomic groups in cold than warm water. Much of this parallels the biogeographic differences noted above, but Clupeiform and Pleuronectiform species receive proportionately more attention in cooler than in warmer marine systems, even though they are abundant in both. This difference in species emphasis may lead us to perceive greater differences in connectivity between environments than really exist.

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80 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Jeffrey Leis[1], Jean-Olivier Irisson[2], Claire Paris[2], Michelle Yerman[1]

[1]Australian Museum, Sydney, NSW, Australia, [2]University of Miami, Miami, FL, United States

With a Little Help from your Friends: Group Navigation in Larval Reef Fish

Theory and some empirical evidence suggest animal groups should be better than individuals in detection of, or response to, cues that aid orientation. If so, schools of pelagic larval fishes may be better at navigation to settlement sites than individuals. We tested this hypothesis by comparing *in situ* behaviour of individuals with that of groups of settlement-stage larvae of the pomacentrid *Chromis atripectoralis* (8-10 mm) at Lizard Island, Great Barrier Reef. In the ocean, we measured swimming speed, direction and depth of individual larvae and of larvae in small groups (10-14). Groups swam in loose schools, spread roughly along a horizontal line normal to swimming direction. Groups swam significantly faster (by about 15%) than individuals. Swimming of all larvae was directional (i.e., each had a significant mean direction), but directionality of groups was significantly more precise than of individuals. Both groups and individuals had overall orientation to the south, but orientation of the population of groups was more precise than it was for the population of individuals. Finally, swimming depths of groups were less variable than those of individuals. Groups of larval fish had more precise horizontal and vertical navigation and faster swimming, thus supporting the hypothesis that groups have better navigation than individuals. We discuss the implications of this for orientation in pelagic environments and for dispersal. Applying these findings to

understanding larval dispersal is handicapped by very limited data on whether and when pelagic larval reef fishes actually do school prior to settlement.

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800 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Niels Leuthold[1], Michael Adams[2], John Hayes[3]

[1]Oregon State University, Corvallis, OR, United States, [2]USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR, United States, [3]University of Florida, Gainesville, FL, United States

Short-Term Response of Stream Amphibians to Forest Management in a Second Growth Forest

As part of the Hinkle Creek paired watershed study we collected pre- and post-harvest data on stream amphibians at the watershed scale. Several species of stream amphibians were detected, but the Pacific giant salamander (*Dicamptodon tenebrosus*) was the only species we found in sufficient numbers for analysis. We used mark-recapture techniques to estimate Pacific giant salamander densities that account for variations in detectability. We analyzed the resulting data using a mixed effects modeling approach that accounts for the repeated measures at each site. Initial analysis found an effect of timber harvest units, but this effect was present in both the pre- and post-harvest data and appears to be a location effect rather than a harvest effect. There was not support for a difference between the control and treatment basins or an interaction with basin and time. This indicates that salamander density did not differ between basins and that timber harvest did not change this relationship. We used a Monte Carlo technique to assign densities to sites with no captures based on the capture probabilities from the mark-recapture data. We fit the same models to the updated data and repeated the entire process 1000 times. Preliminary analysis indicated little or no effect of the failure to detect any individuals when some were present. This was due to high salamander detection probabilities.

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871 Fish Biogeography, Pavilion East, Monday 27 July 2009

Eric Lewallen[1], Robert Pitman[2], Nathan Lovejoy[1]

[1]University of Toronto Scarborough, Toronto, Ontario, Canada, [2]NOAA Southwest Fisheries Science Center, La Jolla, CA, United States

Does the Eastern Pacific Barrier Limit Epipelagic Fish Dispersal? A Population Genetic Analysis of 3 Flyingfish Species (Exocoetidae) in the Pacific

The Eastern Pacific Barrier (EPB) is a 5000 km expanse of open-ocean separating the West coast of South America from the Islands of the Central and South Pacific, and is known to prevent the dispersal of many marine organisms. Flyingfishes are a family of 52 epipelagic fish species, found in all tropical Oceans, and are often the predominant mid-sized (<1m) fishes in offshore surface habitats. Morphological and ecological diversity within the family makes it a particularly interesting group for both inter- and intra-specific population genetic comparisons. Currently, the genetic structure is unknown for any of the Pacific flyingfish species, and therefore the potential role of large biogeographic barriers (such as the EPB) remains unresolved. This study aims to test whether the EPB influences the population genetic structure of flyingfishes found in the Eastern and Central Pacific Ocean. Our specific objectives were to: (1) collect representatives of every transPacific flyingfish species from four locations, (2) quantify the population genetic structure of these species with particular attention to patterns associated with the EPB, and (3) test specific hypotheses about how certain ecological characteristics of flyingfishes are correlated to their population structure. We present genetic sequence data for 3 flyingfish species (from the genera *Exocoetus*, *Cheilopogon* and *Hirundichthys*) suggesting that flyingfishes are not panmictic across the EPB.

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18 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Daniel Lewis[1]

[1]Huntington Library, San Marino, CA, United States, [2]University of Southern California, Los Angeles, CA, United States

Darwin's Ship: H.M.S. Beagle from Bow to Stern

The history and details of the HMS Beagle -- the actual ship that carried Darwin around the world on his famous voyage of discovery between 1831 and 1836 -- is one of the lesser-known but key pieces in the broad fabric that comprises the history of Darwin's work on evolution, natural selection and descent with modification. This talk will detail all things Beagle - its construction, history, layout, and use as Darwin's portable natural history laboratory and specimen storage system.

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104 Snake Ecology, Pavilion East, Monday 27 July 2009

Harvey Lillywhite, Joseph Pfaller

University of Florida, Gainesville, FL, United States

Prey Utilization of Neonatal Insular Cottonmouth Snakes: Is there an Evolved Prey Preference?

Florida cottonmouth snakes (*Agkistrodon piscivorus conanti*) residing on Gulf coast islands feed largely by scavenging fish that are dropped or regurgitated by colonial nesting birds. Because of the relative isolation of these snakes and their long association with bird rookeries, it is of interest to inquire whether there is an evolved preference for fish carrion, or whether consumption of fish remains opportunistic without an evolved preference. We report that both insular and mainland snakes accept a range of similar prey items including fish, mice, and lizards. These behaviors reflect the polyphagic habits of this species and are probably important for long-term survival in environments where resources can be unpredictable. We also report that naïve insular neonates tend to accept fish earlier than their littermates accept mammalian prey. When littermates are fed only a single specific prey item, fish or mammal, individuals develop a preference (and possibly imprint) to follow odors associated with the sole dietary prey to which they have been exposed. However, individuals having long association with either prey category (fish or mice) also eat the non-dietary prey (mice or fish, respectively) when presented with the opportunity. Our results suggest that young cottonmouths might adjust foraging strategy to match prey availability, while retaining flexibility in feeding behavior based in inherent dietary breadth. Thus, the insular population can occupy a broad trophic niche while fine-tuning foraging efficiencies to match the local conditions.

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696 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009; ASIH STOYE AWARD PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Craig Lind

California Polytechnic State University, San Luis Obispo, CA, United States

The Reproductive Cycle of the Northern Pacific Rattlesnake, *Crotalus o. oreganus*, in Central California: A Description of Hormones, Behavior, and Anatomy

I described the breeding season of *Crotalus o. oreganus* using three methods: measurement of anatomical reproductive structures in preserved museum specimens, observation of behaviors in free-ranging snakes, and quantification of steroid hormone levels in free-ranging snakes. *Crotalus o. oreganus* follows the bimodal pattern of

breeding observed in many other temperate rattlesnake species, with spring and fall breeding periods separated by a period of summer inactivity. This was supported by elevated testosterone concentrations in males in both the spring and late summer and observation of breeding behaviors during these times. Female hormone data and analysis of follicle size in museum specimens indicate that *C. o. oreganus* initiate vitellogenesis in the fall in central California, with ovulation and parturition occurring in the following summer. In addition to estradiol (E2) and testosterone (T), corticosterone (B) and dihydrotestosterone (DHT) were also quantified throughout the season in both male and female snakes. There was no discernable seasonal trend in B concentrations. There was also no correlation between B concentrations and any of the other hormones measured. DHT and T concentrations were positively correlated in males and females, but the sexes differed in their T to DHT ratios. Males had T concentrations over thirty times higher than DHT, and females had comparable T and DHT concentrations. Male DHT concentrations were over twice those of females.

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720 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Charles Linkem[1], Arvin Diesmos[2], Rafe Brown[1]

[1]*University of Kansas, Lawrence, KS, United States,* [2]*National Museum of the Philippines, Manila, Philippines*

Systematics of Philippine Skinks in the Genus *Sphenomorphus* (Reptilia: Scincidae: Lygosominae)

Sphenomorphus is a widespread genus of lygosomine skinks with high levels of species diversity in Southeast Asia (ca. 140 species). The genus is part of the larger *Sphenomorphus* Group, which includes 30 genera and over 470 species. Phylogenetic analyses have been completed for portions of this group, but no phylogeny has been proposed for the genus *Sphenomorphus*, and many taxonomic problems are suspected. In the Philippines, there are 25 species in the genus *Sphenomorphus*, some species with multiple sub-species. Morphological examination has organized Philippine *Sphenomorphus* into six non-phylogenetic groups (Brown and Alcala, 1980) that are useful for species identification. The utility of these groups to organize Philippine *Sphenomorphus* in a phylogenetic context has not been examined. We examine a large diversity of *Sphenomorphus* Group species using molecular sequence data with the aim of presenting the first complete phylogeny of Philippine *Sphenomorphus*. Preliminary results of this study show that the *Sphenomorphus* genus is not monophyletic and has close relationships with many other skink genera. Additionally, many widespread species are complexes of multiple, undescribed, cryptic species. Philippine *Sphenomorphus* represent a large radiation that diversified early in the history of the islands. We expect that the results of this study will double the number of species in Philippine *Sphenomorphus*.

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111 Poster Session I, Exhibit Hall, Friday 24 July 2009

Marisa N. C. Litz

OSU/NOAA CIMRS, Newport, OR, United States

Spawning Timing and Growth Rates of Post-larval and Juvenile Northern Anchovy (*Engraulis mordax*) in the Northern California Current

This study compares characteristics of recruitment for northern anchovy (*Engraulis mordax*), from late larval and juvenile life history phases sampled in shelf waters off Oregon and Washington during September 2006. A total of 217 fish were assigned to one of three developmental stages based on the degree of guanine deposition on their surface, and then their saggital otoliths were removed for microstructure analysis of daily increments to test the hypothesis that anchovy spawned earlier in the season have higher growth rates, leading to increased probability of survival. Characteristics for comparison include spawning timing, body length-otolith radius relationships, weight-length relationships, Gompertz growth curves, hatch dates, increment widths, and back-calculated daily records of size-at-age using the biological intercept method. Results confirm protracted spawning in the northern subpopulation of northern anchovy from mid-June through mid-August 2006. Late-stage larvae (Gu-0) displayed compensatory growth in their first 50 days, obtaining significantly larger sizes-at-age than early juvenile (Gu-1) and juvenile (Gu-2) anchovy (27.37 ± 2.13, 26.05 ± 3.67 and 23.71 ± 3.63 mm, respectively). But beginning at metamorphosis from the larval to juvenile phase at 60 days (or ~35mm standard length) older Gu-2 anchovy gained more weight and grew faster than younger fish. Gu-2 anchovy also had wider mean increment widths, and higher mean and recent growth rates (0.56 and 0.78 mm/day respectively) than either Gu-0 or Gu-1 congeners, suggesting that northern anchovy spawned earlier in the season have higher probability of recruitment to the fishery.

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243 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Joel Llopiz, Robert Cowen

University of Miami/RSMAS, Miami, FL, United States

Variable Trophic Strategies of Planktonic Coral Reef Fish Larvae: Shining Some Light into the 'Black Box' of Connectivity Research

The successful transport of larval coral reef fishes to juvenile habitat inherently requires surviving the planktonic journey. Yet, the processes governing survival of coral reef fish larvae—particularly those processes related to feeding—are not well known. Monthly

sampling across the Straits of Florida allowed for analyses of the diets and diet variability of several co-occurring taxa of coral reef fish larvae from the families Serranidae, Lutjanidae, Mullidae, Pomacentridae, Labridae, Scaridae, and Acanthuridae. The percentages of larvae with food present in the gut were high (94–100%) for all taxa except scarids (4%). Relative to prey availability, diets were very narrow and specific to the larval taxon. *Serranus* spp. diets changed little with growth and were composed almost entirely of calanoid copepods, while the labrids *Thalassoma bifasciatum* and *Xyrichtys* spp. consumed harpacticoid and cyclopoid (Farranula and Oncaea) copepods almost exclusively throughout ontogeny. Lutjanine and acanthurid larvae relied increasingly upon appendicularians with growth, and mullids exhibited an ontogenetic shift from nauplii to calanoid copepodites and appendicularians. The trophic niche breadth of four taxa decreased significantly with growth, while other taxa exhibited no significant change. Together these results highlight distinct differences between high and low latitude regions. Most notable are the taxon-specific trophic roles and the apparent niche partitioning of larval fishes in the diverse planktonic food webs of this ecosystem, in addition to the evidence supporting highly successful feeding despite the presumed nutritional constraints of the low-latitude open ocean.

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248 General Herpetology, Galleria South, Sunday 26 July 2009

Rosemary D. Lombard

Chelonian Connection, Hillsboro, OR, United States

Mirror Self-Recognition in Chelonians

We compared mirror responses in captive chelonians to responses in other taxa. 1) Twenty-one box turtles (*Terrapene* spp.) and pancake tortoises (*Malacochersus tornieri*) were observed in initial and subsequent responses to mirrors, with and without contextual cues of a human face in the reflection. Adult male box turtles attacked a mirror as if it were a male conspecific but modified behavior in the presence of the researcher's face. All turtles (including first-week hatchlings), after seeing the researcher's face in the mirror, watched their images and performed unusual behaviors from the researcher's hand while observing the mirror, including: winking alternate eyes, moving limbs and head, opening the mouth, and rolling over. 2) A species-adapted mark test used unnoticed bits of food retained on the head and out of reach. When exposed to the mirror, each turtle adopted a different strategy to remove the food. One tortoise used the mirror as an object to push it off; she positioned her head under the bottom edge of the mirror and retracted her head into her shell, checking the mirror each time until the food was gone. These behaviors suggest that turtles, given contextual reflections, can devise experimental procedures to explore and use their reflections. Self-recognition and self-awareness seem possible, since agonistic responses are extinguished in the presence of a familiar context and turtles can notice and remove body marks by using a mirror. The responses are comparable to those reported in captive apes, dolphins, elephants, and grey parrots.

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923 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Zachary Long, Ellie Prepas

Lakehead University, Thunder Bay, ON, Canada

Assessment of Intracoelomic Implantation and Waistband Harness Radiotransmitter Attachment for Wood Frogs (*Lithobates sylvaticus*) and Boreal Toads (*Anaxyrus boreas boreas*)

Radiotelemetry is a well-established method for studying the movement patterns and spatial dynamics of reptiles and amphibians. However, transmitter attachment remains problematic for anurans (eg. stress, process, equipment). The relative stress associated with surgical implantation or chronic exposure to harnesses has not been rigorously documented. Harnesses, which are most often used to study anurans, are known to cause lesions that likely change animal behaviour and reduce fitness. Contrarily, surgical implantation is invasive and potentially hazardous. These methodological considerations have implications for animal care, and also raise the issue of data quality; which attachment method provides the least biased dataset? To assess the relative influences of intracoelomic implanted and waistband harnessed radiotransmitter attachment methods, radiotelemetry was conducted in 2007 and 2008 on a total of 111 wood frogs (49 internal, 62 external) and 38 boreal toads (16 internal, 22 external) in four wetlands around Whitecourt (AB), Canada. Injuries were most often associated with external transmitters, and influenced boreal toad mean tracking period ($P = 0.005$). Transmitter attachment did not affect the movement parameters of either species, although tracking period influenced wood frog home range ($P < 0.001$) and linear distances ($P = 0.036$). Boreal toads appear to be better able to withstand the perturbation of either attachment method. Although internal transmitters can be difficult to use with species prone to moving large distances, surgical implantation appears on impose less stress to study animals and might be most appropriate for seasonal studies on anurans.

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354 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Ashley Longoria, Brain Fredensborg

University of Texas Pan American, Edinburg, TX, United States

Transmission Ecology of Brain-Encysting Trematode in Killifish from a South Texas Hypersaline Lagoon

Parasites are ubiquitous organisms in soft-bottom intertidal ecosystems. The most abundant parasites are often trematodes (flukes) that greatly impact the animal community by affecting host survival, reproduction and behavior. The trematode

Euhaplorchis sp. was recently observed encysting on the brain of the long-nose killifish, *Fundulus similis* in the mangal of Lower Laguna Madre, South Texas. To examine the distribution and abundance of this species, we surveyed the parasite fauna of *F. similis* and the related species, *Cyprinodon variegatus* in Lower Laguna Madre in December 2008. Both of these fishes are abundant members of the animal community of the Texas mangal where they serve as an important food source of several bird species. The two species were caught adjacent to a stand of *Avicennia germinans* (black mangrove) on South Padre Island using a bag seine hauled parallel to the shoreline. They were subsequently dissected in the laboratory to identify and count the number of parasites present. Our results showed that *Euhaplorchis* sp. infected just under 90 % of *F. similis* and infection levels ranged from 0 - 437 metacercariae per fish. The number of *Euhaplorchis* metacercariae increased linearly with host length indicating a constant recruitment rate of infective stages throughout the life span of the host. No *Euhaplorchis* sp. was observed in *C. variegatus* suggesting a high host specificity of that parasite. The wide distribution of *Euhaplorchis* sp. indicates an important role of this parasite in the mangal community of Laguna Madre which will be the subject of future studies.

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826 Poster Session III, Exhibit Hall, Sunday 26 July 2009

J. Andres Lopez[1], Rebecca Blanton Johansen[2], Lawrence Page[2]

[1]University of Alaska Museum of the North, Fairbanks, AK, United States, [2]Florida Museum of Natural History, Gainesville, FL, United States

Genetic Variation in *Micropterus* and the Taxonomic Status of *Micropterus floridanus*

Bailey & Hubbs (1949) were the first since the description of *Cichla floridana* in 1822 to recognize the Florida Bass taxonomically. They recognized the "gigantic largemouth bass of peninsular Florida" as *Micropterus salmoides floridanus* and described scale count differences that separated it from *M. s. salmoides* except in a zone of intergradation extending from the Choctawhatchee/Pensacola Bay divide (Gulf Slope) to the Savannah River (Atlantic Slope). Based on fixed enzyme differences, Phillip et al. (1983) also recognized *M. s. salmoides* and *M. s. floridanus* and showed evidence for a much broader zone of intergradation that extended North to Virginia and Illinois. In recent molecular studies on the phylogenetic relationships of basses, Kassler et al. (2002) and Near et al. (2003) recognized the Florida Bass as *M. floridanus* and assumed its distribution to be that of *M. s. floridanus* as described by Bailey & Hubbs. Populations from the putative zone of intergradation were assumed to be the Largemouth Bass, M. salmoides. We examined genetic variation at the ND2 mitochrondrial and S7 nuclear DNA loci to establish the extent of genetic isolation among populations of Micropterus in the southeastern U.S. and to better understand the distribution and taxonomy of the Florida Bass. Our data are consistent with two well-delineated mitochondrial lineages whose geographic distributions coincide with the presumed ranges of *M. salmoides* and *M. floridanus*. Perhaps surprisingly, patterns of genetic variation are in good agreement with

geography pointing to limited effects of widespread transplantation of *Micropterus salmoides*.

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695 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

J. Andres Lopez[1], Jian-Li Cheng[2], E Zhang[3]

[1]University of Alaska Museum of the North, Fairbanks, AK, United States, [2]Graduate School of the Chinese Academy of Sciences, Beijing, China, [3]Institute of Hydrobiology, Wuhan, China

Systematics of the Asian Bagrid Genus *Pseudobagrus*

The geographic distribution of the bagrid genus *Pseudobagrus*, as currently defined, extends from the Amur River in Russia south to the Song Vinh Thanh drainage in Vietnam and from Japan west to eastern Sichuan and Yunnan provinces of China. Within this range, species of Pseudobagrus are primarily restricted to low gradient terrains in both rivers and lake habitats. Most of the 39 species of *Pseudobagrus* considered valid at present are characterized by an elongate body, well-developed spines on the dorsal and pectoral fins and body coloration of various brown shades and patterns. However, characters to confidently support the monophyly of the genus have yet to be identified. Recent taxonomic and phylogenetic treatments have significantly increased species membership in the genus by the synonymization of *Pelteobagrus*. Wholesale nomenclatural reassignment of the species in the genus may also follow the designation of a neotype for an Asian catfish known only from the illustration accompanying its description. Ongoing examination of existing museum material, recent collections and available literature has allowed us to identify uncharacterized species diversity within the group (e.g. our studies suggest five distinct forms are grouped in *P. crassilabris*) and to uncover a high frequency of errors in species reports in current faunal checklists from China. We summarize the current status of *Pseudobagrus* systematics with special emphasis on recent taxonomic changes, undescribed and recently described diversity, classification and phylogeny.

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624 Poster Session I, Exhibit Hall, Friday 24 July 2009

Pamela Lopez, Evan Bredeweg, Angie Soken, Dylan Taylor

Pacific University, Forest Grove, OR, United States

Does Kinship Composition or Group Density Affect Tadpole Fitness in the Pacific Treefrog (*Pseudacris regilla*)?

Kinship composition has been shown to affect various aspects of tadpole fitness in several species, but this has not been studied in the Pacific treefrog (*Pseudacris regilla*). From eight newly oviposited clutches of different parentage we established and maintained six replicates of each kinship group of tadpoles. Each kinship group consisted of eight tadpoles originating from either one or multiple egg masses and housed at either low (0.5 L water) or high (0.25 L water) density. The four kinship groups were: full siblings—all eight tadpoles from the same egg mass; mixed siblings A—four tadpoles from each of two egg masses; mixed siblings B—two tadpoles from each of four egg masses; and mixed siblings C—one tadpole from each of eight egg masses. We measured body mass, body length and tail length, determined stage of development, and measured nearest neighbor distance for each tadpole every seven days until each tadpole reached metamorphic climax (MC). Body length and body mass was measured for each individual at MC. Neither kinship composition nor group density affected mean body length or body mass at MC or the mean number of days to reach MC. The mean proportion of tadpoles that reached MC was significantly higher in full sibling, low density groups than in any other combination of kinship and density. Carnivory was only observed in mixed sibling groups. These results may suggest that P. regilla tadpoles have the ability to recognize kin. Preliminary results of our current work on this issue will also be presented.

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941 Herp Systematics, Pavilion West, Thursday 23 July 2009

Jonathan Losos[1], Anthony Herrel[2]

[1]Harvard University, Cambridge, MA, United States, [2]CNRS, Paris, France

The Geography of Adaptive Radiation: Island vs. Mainland Diversification in *Anolis* Lizards

West Indian anoles have radiated independently on each island in the Greater Antilles, producing in each case species morphologically and behaviorally adapted to use a wide variety of different ecological niches. Less well known is the fact that the diversity of anoles in mainland Central and South America is equally rich, both in terms of species number and ecomorphological disparity. In this study, we compare the extent of morphological variation. We demonstrate that mainland anoles occupy different parts of morphological space than that occupied by West Indian anoles; mainland anoles belong

to two clades and have convergently evolved to occupy overlapping portions of morphological space. Comparison between mainland and island anoles indicates that the habitat specialists, termed ecomorphs, that have evolved repeatedly in the West Indies have not, for the most part, evolved in the mainland. Moreover, the relationship between morphology and habitat use differs between mainland and island forms. Greater predator richness and diversity in the mainland than on the islands may account for the different evolutionary trajectories experienced in these two areas.

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658 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Karen Lovely, Luke Mahler, Liam Revell

Harvard University, Cambridge, MA, United States

The Rate and Pattern of Tail Autotomy in Five Species of Puerto Rican Anoles

In lizards, tail autotomy is used as a defense mechanism in the face of a predatory attack. As such, the study of tail autotomy in natural populations of lizards can yield interesting information about the predation environment. We examined the rate and pattern of tail autotomy in five species of common Puerto Rican anoles to infer predation regime. Using Monte Carlo simulation based likelihood optimization, we identified and compared alternative models for tail loss while incorporating some biologically realistic aspects of lizard tail autotomy. Our autotomy models exhibited good fit to the data, and our parameter estimates had sensible values. The estimated rate of mortality associated with injury-producing predation events was quite high for all species. In three out of five species, a model incorporating heterogeneity in the strength of the tail over its length fit better than models ignoring such heterogeneity. The two species lacking tail strength heterogeneity in the best-fit models are ecologically similar. These two also had the most similar mortality rates. The model estimation approach employed in the present study has the potential to yield significant insights in this and other complex ecological systems.

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508 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Robert Lovich[1], Ron Carter[1], Lee Grismer[2], William Hayes[1], Ford Robert[3], Penelope Duerksen-Hughes[1]

[1]Loma Linda University, Loma Linda, CA, United States, [2]LaSierra University, Riverside, CA, United States, [3]National University of Rwanda, Butare, Rwanda

Mitochondrial Evolution and Phylogeography of the Endangered Arroyo Toad (*Anaxyrus californicus*)

The Arroyo Toad, *Anaxyrus californicus*, is an endangered bufonid found in rivers draining to the Pacific Ocean in California, USA, and Baja California, México, as well as a few drainages flowing into the Mojave Desert. This study analyzed mitochondrial DNA sequence variation across the range of the species. The ND1 gene and Dloop regions of mtDNA were sequenced (859 and 451 bp, respectively), and aligned sequences were analyzed using maximum likelihood, maximum parsimony, and Bayesian inference. Despite the conservation status of *A. californicus* as endangered in the United States, mitochondrial gene relationships have never before been constructed for this species. Herein, DNA sequence data are compared across its range to determine gene relationships and infer evolution. Two well supported clades are resolved for northern and southern populations, excepting a few northern haplotypes being identified within the range of the southern group. Phylogeography, congruence with other regional studies, and biogeographic comparisons are explored, and provide further evidence for the complex biodiversity of the southern California and northern Baja California region. These findings are important to better understand relationships among extant populations of the endangered Arroyo Toad.

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392 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Ben Lowe, Matthew Gifford, Tricia Markle, Kenneth Kozak

University of Minnesota, St. Paul, MN, United States

Speciation, Species Delimitation, and the Systematics of Slimy Salamanders (Plethodontidae: *Plethodon glutinosus* Group)

The *Plethodon glutinosus* species group is a clade of fully terrestrial salamanders that are widely distributed in forested habitats across eastern North America. While the monophyly of the group is not contentious, the number of species lineages that exist and their evolutionary relationships remain uncertain. This group of salamanders represents a textbook example of the difficulties associated with speciation delimitation. Sympatry among species is uncommon; most of the genetically differentiated forms

have allopatric or parapatric distributions. Morphological conservatism has made it difficult to independently corroborate species delineations based on allozyme data. Furthermore, the rate at which lineages have originated seems to have outpaced the evolution of intrinsic reproductive isolation. Consequently, discordances between geographic patterns of genetic variation and the most recently proposed species-level taxonomy are not uncommon. To evaluate the status of species and to reconstruct their evolutionary relationships, we employ new coalescent-based approaches that can detect the signal of lineage splitting and reconstruct the phylogenetic relationships of species in the presence of incomplete lineage sorting and post-divergence gene flow. Our results suggest that despite widespread discordance among different datasets (allozymes, mtDNA, nDNA), many species that have not been universally accepted are in fact recovered as distinct lineages. In addition, our results suggest novel relationships among species of the *P. glutinosus* group. Our findings have important implications for resolving a contentious species-level taxonomy. Given that many of the lineages in the group have highly restricted ranges and have sustained population declines in recent years, our results also have important implications for conservation.

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936 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Brian Lowe, Jack Feminella

Auburn University, Auburn, AL, United States

Does Hydrologic Permanence Affect Larval Salamander Assemblages in Small Piedmont Streams?

Hydrologic permanence in small intermittent streams can influence biotic communities, and drought, both seasonal (within years) and supraseasonal (among years), may affect biota by modifying food and habitat resources and species interactions. Biotic effects of intermittence have been well studied for benthic invertebrates and fishes, not for larval salamanders, an important component of many southeastern piedmont streams. We conducted larval salamander surveys within 13 headwater streams in the Talladega National Forest, Alabama, over an extreme drought (Summer/Fall 2007), a re-wetting period (Winter/Spring 2008), and a more normal seasonal baseflow period (Summer 2008). The Southern Two-Lined Salamander, *Eurycea cirrigera*, was numerically dominant in all streams and seasons surveyed. Ten of the study streams ceased flowing during the drought, with at least 4 streams drying completely, so conditions for larvae were severe. There was a significant relationship between hydrologic permanence, as indicated by mean wetted area of stream channel during Summer 2007, and post-drought density of *E. cirrigera* larvae. In addition, analysis of larval size (as SVL) showed that most individuals in Spring 2008 hatched prior to Summer 2007, indicating larval presence during drought. These data suggest that larval salamander assemblages are related to permanence, but in many streams the presence of refugia, either in small surface pools and/or interstitial water, allows larval persistence during drought.

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817 General Ichthyology, Parlor ABC, Sunday 26 July 2009

Christopher Lowe, Kim Anthony, Carlos Mireles

California State University Long Beach, Long Beach, CA, United States

Site Fidelity, Homing and Movements of Fishes Associated with Offshore Platforms in Southern California

To assess the ecological importance of offshore petroleum platforms for economically important groundfishes, we quantified the degree of site fidelity and homing ability of platform associated fishes using acoustic telemetry. Nineteen species were acoustically monitored at offshore platforms in the Santa Barbara Channel and the San Pedro Shelf for periods up to 2-years. Degrees of site fidelity vary widely among and within species. Initial declines in detections of individuals, suggest post-release mortality or rapid emigration away from the platform likely influenced by capture and tagging. There was evidence of movement between platforms, typically from shallow to deeper platforms. Of the 98 fish translocated from platforms to natural rock reef habitats or from natural habitats to platforms, over 24% returned to their original sites of capture. Homing distances exceeded 18 km across deepwater channels (>230 m). Fish translocated from platforms to natural habitat took an avg. of 15 d to return, the fastest being 10.5 hrs. However, fewer fish translocated from natural habitat to platforms homed back and those that did took longer to return. These findings suggest that reef associated groundfish show relatively high site fidelity to platforms; in some cases, it may be higher than their fidelity around natural habitat. This may also indicate that platform habitat may be of higher quality than natural habitat, despite the higher densities of fish found around offshore platforms.

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161 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Kyle Luckenbill, John Lundberg

Academy of Natural Sciences, Philadelphia, PA, United States

The Extrordinary Weberian Apparatus and Occiput of *Hypophthalmus* (Siluriformes, Pimelodidae)

South American *Hypophthalmus* rank very high among the world's oddest catfishes. Although *Hypophthalmus* is now unquestionably placed in the family Pimelodidae, the genus has been often isolated in its own family or even in its own suborder. Many of the singular characteristics of *Hypophthalmus* are related to feeding by straining zooplankton and locomotion in a continuous pelagic existence in large rivers and lakes. In addition, the gas bladder (GB), Weberian apparatus (WA) and occipito-temporal skeleton (OTS) of

Hypophthalmus are extraordinarily complex: entire WA foreshortened and closely contacting OTS; GB reduced to pair of separate bladders each encapsulated by parts (GBC) of WA and contorted, reoriented posttemporal-supracleithrum (ptt-scl); transformator process of tripus and claustrum absent. Previous descriptions of this anatomically difficult complex of Hypophthalmus are variously inaccurate or incomplete. We used CT scan imagery, cleared & stained and dry skeletal preparations to decipher and more accurately redescribe the GB, WA and OTS. Results: Supraneural 3 sutured between supraoccipital and neural arch 3+4. GBC double-walled - outer GBC wall (4th transverse process) thin, trabeculated, expanded around GB; inner GBC wall (superficial ossification) densely mineralized, cup-shaped, holding proximal end of GB. Tripus contacts GB at anterior edge of inner GBC. 4th transverse process and ptt-scl broadly united and forming lateral canal of outer GBC. 5th vertebra large, sutured anteriorly to compound vertebra and posteriorly to 6th vertebra; neither 5th nor 6th transverse processes contacting ptt-scl. 6th vertebra with first pair of ribs; normally-jointed to 7th. Fate of 1st vertebra remains obscure.

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169 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Nathan Lujan

Auburn University, Auburn, AL, United States

The Physics and Chemistry of the Loricariid Trophic Radiation

The Neotropical-endemic catfish family Loricariidae is globally significant for its tremendous taxonomic diversity. With over 700 described species, Loricariidae encompasses approximately 20% of fish species known from the Neotropics, the most species-rich ichthyofaunal region of the world. Most trophic ecological studies inclusive of loricariids have described them only as detritivores or herbivores, and have provided few indicators of trophic differentiation among species. In contrast, loricariid jaw morphologies have been demonstrated to be highly diverse, but patterns of jaw morphological and functional diversity within the family have received little attention. To begin to address these knowledge gaps, I measured several putatively functionally relevant attributes of the loricariid lower jaw across 25 species, 12 genera, and five tribes of loricariids from tributaries of the upper Amazon Basin in Northern Peru; and I measured stable isotopes of carbon and nitrogen from 79 species distributed across 19 sympatric loricariid assemblages in the Casiquiare, Essequibo, Marañon, Orinoco, Rupununi, Tacutu, Tapajós, Ventuari, and Xingú Rivers, as well as a number of smaller creeks and streams. Principle component analysis of the combined jaw morphometric dataset revealed considerable coincidence between jaw morpho-functional diversity and taxonomic diversity down to the species-level, and considerable jaw morpho-functional diversity across closely-related species previously described as specialists on the same resource (e.g. species of the wood-eating genus *Panaque*). Stable isotope analyses revealed trophic structure within sympatric assemblages, and trophic niche packing at a

lower rate than would be predicted by chance alone, supporting the existence of trophic competition and segregation among sympatric loricariids.

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828 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Daniel Lumbantobing

The George Washington University, Washington, D.C., United States

Freshwater and Estuarine Fishes of Southeastern Borneo (Kalimantan Selatan), Indonesia

An ichthyological survey was conducted throughout the southeastern coast of the island of Borneo in the Province of Kalimantan Selatan, Indonesia, in August 2007. Kalimantan Selatan lies largely to the east of the Negara River, a tributary of the Barito River, and is divided into a western and eastern region by the Meratus mountain range. A total of 109 fish species in 24 families were collected from 32 field stations in the inland and estuarine waters or purchased from seven fish markets throughout the Province. At least 12 undescribed species were collected. Nearly all of the new species are in the Ostariophysi, genera *Gastromyzon*, *Glyptothorax*, *Hemibagrus*, *Homaloptera*, *Nemacheilus*, *Paedocypris*, *Pangio*, *Rasbora*, and one new species is in the Southeast Asian atherinomorph genus *Phenacostethus*. The collection also included two widespread atherinomorphs, the beloniform *Oryzias javanicus* and the cyprinodontiform *Aplocheilus panchax*, and confirmed that they are native to Borneo. This preliminary collection contributes important new knowledge to the fish biodiversity of Borneo, especially the southeastern region which has been poorly studied. The fieldwork also demonstrates the high endemism of the lowland, coastal region that is geographically isolated from the rest of the island by the Meratus mountain range: nine of the 12 new species are endemic to the region east of that range.

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829 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Daniel Lumbantobing

The George Washington University, Washington, D.C., United States

Phylogenetic Analysis of *Rasbora* (Teleostei: Cyprinidae) Based on Morphological Characters

The genus *Rasbora* sensu lato has been widely viewed as a "catch all group" and its systematics is poorly resolved. A phylogenetic analysis of 31 of the 79 valid species

using 46 morphological characters demonstrates that three of the eleven species complexes recognized in the last revision by Brittan (1954) are paraphyletic. Two major clades are recognized: Clade A diagnosed by a slightly elongated maxilla, greatly exposed premaxilla, and absence of cleithral pigmentation; and Clade B diagnosed by a short maxilla, sphenotic bone exposed above the pterotic canal of the lateral line system, and a semicircular process on the posterior edge of body scales. Clade A comprises two of Brittan's (1954) species complexes: the monophyletic *R. daniconius* complex is nested within the paraphyletic *R. einthovenii* complex. Clade B comprises five of Brittan's (1954) species complexes, two of which are paraphyletic (*R. argyrotaenia* and *R. trifasciata*), the other three monophyletic (*R. caudimaculata*, *R. pauciperforata*, *R. sumatrana*), and also includes the genus *Trigonostigma*. Several osteological structures are highly variable and provide a number of informative characters supporting particular clades: the maxilla (shape and number of processes), the kinethmoid (shape, processes, and fossae), the ethmoid block (anteromedial "opening" between vomer and mesethmoid, and anteromedial process of mesethmoid) and the gill arches (shape of the basihyal and shape and relative position of the urohyal to the pectoral girdle). Based on a parsimony analysis of the phylogenetic data, a taxonomic revision is needed for *Rasbora* sensu lato to resolve its problematic classification.

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311 AES Systematics I/AES General Ichthyology, Parlor ABC, Saturday 25 July 2009

Richard Lund[1], Eileen D. Grogan[2]

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Helicoprion and Tooth Whorls in Chondrichthyes

Extremely large tooth whorls of the Edestoid and Helicoprionid Chondrichthyes (Euchondrocephali; Pennsylvanian-Triassic) bear triangular serrated teeth. The whorls, approaching 1 meter in length or diameter, present as either toothed arches or multi-revolution spirals. Virtually no head or postcranial information accompanies these specimens. Past restorations have suggested various placements for the whorls on the body before settling in the mouth. Most recently, they have been theorized to be part of a pharyngeal apparatus. Yet, abundant Carboniferous evidence reveals the placement and sheds light on the homologies of these structures. Tooth whorls are mounted anterior to the mandibular arch on parasymphysial cartilages and on an intermandibular symphysial cartilage. They are absent in Elasmobranchii but found in virtually all known Euchondrocephali (Holocephali), and most basal chondrichthyans that plesiomorphously lack mandibular arch teeth. Analyses suggest the whorls are under the control of developmental fields separate from that of mandibular arch teeth. Thus, even the anterior upper dental positions of the cochliodont Holocephali, which are also under control of separate developmental fields, are hypothesized to be parasymphysial elements fused to the neurocranium. Multiple upper and lower whorls

or families are found in some Iniopterygians and other basal Chondrichthyes, but the basic euchondrichthyan pattern is for one paired upper and one median lower whorl. This is also the condition in the few known edestoids, including *Edestus mirus*. Outgroup comparisons reveal tooth whorls in *Onychodus* and acanthodians and suggest that tooth whorls are the plesiomorphous condition for toothed gnathostomes.

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44 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

John Lundberg[1], John Sullivan[1], Marcelo Rocha[2], Michael Hardman[3], Janice Muriel-Cunha[4], Michael Littmann[5], Flávio Bockmann[6]

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South American Pimelodoid and Pimelodid Catfishes: Species Diversity and Phylogeny

The South American catfish superfamily Pimelodoidea includes three families (Pimelodidae, Pseudopimelodidae, Heptapteridae) and two genera currently listed as incertae sedis (*Conorhynchos*, *Phreatobius*). Monophyly of the three families is firmly supported by morphological and molecular data. Monophyly of the superfamily, and exclusions of *Conorhynchos* from Pimelodidae and *Phreatobius* from Heptapteridae are strongly indicated by a large amount of nuclear and mitochondrial sequence data, and, at least for *Conorhynchos*, not contradicted by morphological data. Results show that *Conorhynchos* and Heptapteridae are a sister-group pair, and *Phreatobius* forms a monophyletic group with Pimelodidae and Pseudopimelodidae, but relationships among these three taxa remain unresolved. In the family Pimelodidae 30 genera and 111 extant species are presently recognized. Descriptive and phylogenetic work in progress will increase both. A climb through a taxon-rich phylogenetic tree will illustrate iconic, fossil and previously unseen pimelodid species, the family's major subclades and some of the knotty conflicts between morphology- and molecular-based results. The major subclades of Pimelodidae in order of their phyletic branching sequence are: *Steindachneridion*, *Phractocephalus*, *Leiarius*, "sorubimines", "*Pimelodus ornatus*"-group, *Calophysus*-group, and *Pimelodus*-group. The present diversity of Pimelodidae will be mapped across the major tropical American river basins from Panama, through trans-Andean Colombia and Venezuela, and throughout cis-Andean South America from Venezuela and the Guianas southward to Argentina. The time-course of the family's roughly 100 million-year diversification will be estimated using a paleontologically informed molecular approach.

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604 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Paula Mabee

University of South Dakota, Vermillion, SD, United States

Phenoscape: Using Ontologies to Link Comparative Morphology to Genes

Decades of comparative anatomical studies in ichthyology and herpetology have resulted in a rich body of 'free-text' data. As these data grow, they are increasingly hard to align and synthesize across taxonomic groups, and synthetic questions concerning the developmental and genetic basis of evolutionary changes in morphology cannot be easily or efficiently addressed. In order for this volume of comparative anatomical data to be analyzed in a developmental genetic context, it must first be rendered computable. One way to achieve this is to use ontologies. Using ostariophysan fishes as a prototype, the Phenoscape project has developed a system that includes ontologies representing expert knowledge of anatomy and taxonomy (the Teleost Anatomy Ontology and the Teleost Taxonomy Ontology), software for data curation (Phenex), and a knowledgebase that supports ontology-based reasoning about evolutionary phenotype data (PhenoscapeKB, http://phenoscape.org/kb). To date, over 5,000 characters from the phylogenetic literature have been annotated for 8,300 species, resulting in over eight million annotated phenotypes. PhenoscapeKB combines these evolutionary phenotypes with information about genetically characterized phenotype from ZFIN, the zebrafish community database. Through ontology-based reasoning over expert knowledge in taxonomy, comparative anatomy and developmental genetics, PhenoscapeKB can be used to address a host of questions spanning the domains of genetics, development and evolutionary biology, such as the nature of the genetic changes underlying phenotypic variation among taxa in nature.

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606 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Paula Mabee[1], James Balhoff[2], Wasila Dahdul[1], Cartik Kothari[2], Hilmar Lapp[2], John Lundberg[3], Peter Midford[4], Todd Vision[5], Monte Westerfield[6]

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Phenoscape: Evolutionary Morphology Linked to Genes Using Informatics

Decades of comparative anatomical studies in ichthyology and herpetology have resulted in a rich body of 'free-text' data. As these data grow, they are increasingly hard to align and synthesize across taxonomic groups, and synthetic questions concerning the developmental and genetic basis of evolutionary changes in morphology cannot be easily or efficiently addressed. In order for this volume of comparative anatomical data to be analyzed in a developmental genetic context, it must first be rendered computable. One way to achieve this is to use ontologies. Using ostariophysan fishes as a prototype, the Phenoscape project has developed a system that includes ontologies representing expert knowledge of anatomy and taxonomy (the Teleost Anatomy Ontology and the Teleost Taxonomy Ontology), software for data curation (Phenex), and a knowledgebase that supports ontology-based reasoning about evolutionary phenotype data (PhenoscapeKB, http://phenoscape.org/kb). To date, over 5,000 characters from the phylogenetic literature have been annotated for 8,300 species, resulting in over eight million annotated phenotypes. PhenoscapeKB combines these evolutionary phenotypes with information about genetically characterized phenotype from ZFIN, the zebrafish community database. Through ontology-based reasoning over expert knowledge in taxonomy, comparative anatomy and developmental genetics, PhenoscapeKB can be used to address a host of questions spanning the domains of genetics, development and evolutionary biology, such as the nature of the genetic changes underlying phenotypic variation among taxa in nature.

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Molecular Phylogeny of the Cardinalfishes (Apogonidae) and non-monophyly of *Apogon* sensu lato

Cardinalfishes (Apogonidae) are one of the most numerically dominant reef fish families, mostly nocturnal, and many known to be mouthbrooders. The family contains about 333 valid species with 24 genera and 15 subgenera recognized to date within the family. The genus *Apogon* sensu lato, historically, has been the most speciose genus. Some lists estimated the number of species to be about 200 species. Taxonomy of *Apogon* is currently unsettled. Ten subgenera were recognized in 1972. A few authors elevated some subgenera to genera following a doctoral dissertation on the cephalic lateralis system in 2004. While a molecular paper in 2006 indicated the non-monophyletic nature for the subgenus *Ostorhinchus*, monophyly of *Apogon* sensu lato is yet to be evaluated. Thus, we conducted a molecular phylogenetic analysis using about 100 species representing about 23 genera. Over fifty species of *Apogon*, representing about nine subgenera, were included in this study. Using three gobioids as collective outgroups, the monophyly of *Apogon* was evaluated phylogenetically based on DNA sequence data. Preliminary molecular phylogeny inferred by Bayesian method based on ca. 1500bp of mitochondrially encoded 12S and 16S rRNA genes demonstrated that the genus Apogon was polyphyletic with over 10 well-supported monophyletic groups being recognized from the genus. While some of the monophyletic groups corresponded to existing subgenera (e.g. *Pristiapogon*, *Zoramia*), some subgenera (e.g. *Ostorhinchus*, *Apogon*) were respectively divided into multiple independent groups, some forming well-supported monophyletic groups with non-*Apogon* species. The result supports revising the generic/subgeneric framework for the family.

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686 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Laura Macesic[1], Adam Summers[2], Stephen Kajiura[1]

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Functional Morphology of Pelvic Fin Locomotion in Batoids

"Punting" is a form of benthic locomotion wherein a batoid (skate or ray) digs its pelvic fins into the substrate and thrusts itself forward. It was thought to be restricted to skates, but we have shown that it is widespread in Batoidea. By examining kinematic and pelvic fin musculature we previously revealed a continuum of punting ability with a corresponding continuum of pelvic fin musculature. True punters, such as *Narcine brasiliensis* and *Raja eglanteria*, use only their pelvic fins and possess more specialized and more robust muscles. Augmented punters, such as *Urobatis jamaicensis* and *Dasyatis sabina*, punt with assistance from their pectoral fins, and possess fewer and less substantial muscles. We also used three-point bending tests of the main skeletal element involved in punting, the propterygium, to test if flexural stiffness correlates with punting style. We found that propterygia of the true punters have approximately 80% greater flexural stiffness than the augmented punters ($p<0.05$). Moreover, propterygia of the augmented punters have almost twice the flexural stiffness of the non-punting pelagic stingray (*Pteroplatytrygon violacea*) ($p<0.05$). The concordance of musculature and skeletal stiffness with punting ability provides us with predictive power regarding the punting kinematics of other elasmobranchs based gross muscular examinations and skeletal material properties. By pairing our results with phylogenetic information, we can also gain a better understanding of the evolution and radiation of batoids.

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175 Snake Ecology, Pavilion East, Monday 27 July 2009

Stephen Mackessy

University of Northern Colorado, Greeley CO, United States

Natural History and Den Site Fidelity of Prairie Rattlesnakes (*Crotalus viridis viridis*) in Northeastern Colorado

Historically, Prairie Rattlesnakes on the eastern plains of Colorado relied on natural fissures and prairie dog towns as hibernacular sites, often reaching very high densities. With wide-scale changes to the habitat and loss of large dog towns, rattlesnakes now often utilize anthropogenic structures as retreats. On a large private ranch, two metapopulations of Prairie Rattlesnakes utilize railroad burms and culverts as den sites. From 2002-2008, in spring and fall, we collected as many snakes as possible, and PIT

tagged, measured and extracted venom. Of 497 captures, 406 unique individuals were tagged, and 96 repeat captures were recorded. The sex ratio was slightly male biased (1.06:1), and neonates are born in late August-early September. Snakes emerge from hibernacula in mid-March and return to den sites in mid-September; snakes remain in the vicinity of the den site and are surface-active until at least mid-October. The two den sites are approximately 1.5 km apart, but there was >95% site fidelity observed in recaptured snakes. Recorded predators include owls, badgers and humans. In summer 2004, the railroad blocked one of the culverts in an attempt to keep snakes away from the railroad right-of-way; shortly thereafter, snakes began to take up residence (hibernate) under a Level 3 communications building (approximately 100 m SE of the west den site). Prairie Rattlesnakes can respond relatively rapidly to negative changes in critical resource availability, provided that a suitable substitute is available. However, because snake:human interactions are now more frequent, the long-term stability of this population is uncertain.

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227 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Anne Maglia[1], Jennifer Leopold[1], Susan Gauch[2], Analia Pugener[1]

[1]Missouri University of Science and Technology, Rolla, MO, United States, [2]University of Arkansas, Fayetteville, AR, United States

Development of an Anatomical Ontology for Amphibians

Herein, we describe our ongoing efforts to develop a robust ontology for amphibian anatomy (www.amphibanat.org) that accommodates the diversity of anatomical structures present in the group. We discuss the design and implementation of the project, current resolutions to issues we have encountered, and future enhancements to the ontology. We also comment on efforts to integrate other data sets with the amphibian anatomical ontology.

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400 Herp Biogeography, Galleria North, Saturday 25 July 2009

James Mahaffy

Dordt College, Sioux Center, IA, United States

Historic Extensions of Rattlesnake Ranges (Timber Rattlesnake, *Crotalus horridus* and Massasauga, *Sistrurus catenatus*) from Five Counties in South-eastern and South-central Minnesota

Historic evidence suggests that the range of Minnesota rattlesnakes was originally more extensive than it is today. While their current (or recent historic) range is limited to eight counties along the Mississippi River, in the 1800's their range likely extended from those counties all the way to Mankato in south-central Minnesota. Strong historic evidence from the late 1800's was found for rattlesnake populations in Dodge, Waseca, and Blue Earth Counties of Minnesota. Newspapers and an early history (Smith 1884) record several bites in Dodge County and also give descriptions of rattlesnakes (including the number of rattles) and their habitat. In many cases, these Dodge County snakes are clearly timber rattlesnakes. Waseca's early history (Child 1905) and newspapers record several bites and one rattlesnake death. Also, two reports of fatal bites and descriptions of dense rattlesnake populations on the prairie were found in early newspapers from Blue Earth County. The rattlesnake populations in Mower County extended into eastern Freeborn County since newspapers record rattlesnake bites from London, Moscow, and Riceland Townships. In Dodge and Rice Counties, evidence suggests that some of the rattlesnakes were massasauga. Smith's 1884 history indicates that massasauga were found in Dodge County, and the Mantorville Express of 1858 records a "massasauger bite" near Wasioja in Dodge County. Evidence for massasauga also comes from Rice County, where the description of an 1870 fatal rattlesnake bite in a marshy area is most consistent with a massasauga bite.

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645 Herp Development & Morphology, Galleria North, Sunday 26 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

D. Luke Mahler

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Convergence and Parallelism in the Evolution of *Anolis* Tail Length

In *Anolis* lizards, similar environments have spurred the evolution of similar species numerous times. But have these species evolved to look the same via the same mechanisms (parallelism), or has similarity been achieved through different evolutionary pathways (convergence)? Using data on a broad diversity of neotropical anoles, I investigated the relative roles of convergent and parallel processes in the

evolution of long and short tails. Typically, in *Anolis*, grass dwelling lizards have relatively long tails whereas twig and branch specialists have short, but semi-prehensile tails. These repeated patterns are thought to reflect common locomotor solutions to similar ecological conditions. However, anole tail length may change as a result of two different developmental processes, namely serial addition (or subtraction) of vertebrae versus elongation (or shortening) of individual vertebrae (henceforth referred to as 'addition' versus 'elongation'). I generated radiographs from more than one hundred Caribbean and mainland anole species to determine whether relatively long and short-tailed species achieved their tail lengths via addition or elongation. I examined these traits in the context of the anole phylogeny to ask: 1.) Is tail length convergence achieved through developmental convergence or parallelism? 2.) Are the strategies of addition versus elongation associated with particular clades? 3.) Do addition and elongation correspond with particular ecological or morphological specializations? This study has important implications for understanding the processes underlying the repeated evolution of ecomorphological similarity in anoles, and provides one assay of whether superficially convergent species have arrived at similar endpoints through similar or unique developmental means.

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64 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Laura Mahrt

Eastern Oregon Univeristy, La Grande, OR, United States

If you Build it, they will Come. Oviposition of Columbia Spotted Frogs in Man-Made Ponds in Eastern Oregon

Columbia Spotted frogs (*Rana luteiventris*) were once abundant throughout Oregon. Prior to 1940, it was found in portions of the Puget Sound. They now appear to be virtually eliminated from these areas. Major factors contributing to their loss include: modification to their habitat and introduction of non-native aquatic species. Columbia Spotted frogs prefer cold quiet waters in which to lay their eggs and to forage. McCoy creek, an upper tributary of the Grande Rounde River (located in Northeast Oregon) was canalized approximately 25 years ago. Farm crops were planted and cattle were grazed there until 1995. Beginning the summer of 1997, McCoy creek has been under active restoration. Between 1997-2000 work was preformed to restore the creek to its original path. The old channel was dammed and a series of "swimming pool" shaped ponds were established. During the summer of 2002, these ponds were reshaped. Starting in the 2003 spring breeding season, frogs began exploiting these ponds. Of the 12 ponds created, frogs deposited eggs in 8. Before this time, no oviposition occurred in the "swimming pool" shaped ponds. The only pond that was utilized by the frogs prior to the reshaping was one small Oxbow pond. Since 1999, the number of egg masses has increased from 5 egg masses to 183 egg masses.

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399 AES GRUBER AWARD II, Parlor ABC, Friday 24 July 2009

Anabela Maia

University of Rhode Island, Kingston, RI, United States

Escape Responses in Young of the Year Spiny Dogfish

Most species encounter greater predatory pressure early in life, before maturation. To evade predators, the most common behavior an animal will use is an escape response. In this study, escape behavior is investigated in young of the year spiny dogfish, *Squalus acanthias*. Escape responses were elicited by gentle nudging of the tail region to represent a possible predatory event in seven individuals. The results were compared with published data on adult spiny dogfish escape responses. Similar to adult spiny dogfish, the young of the year exhibited C-type escape responses, characterized by a bend into a C shape in stage 1, followed by a return to a natural position in stage 2. Duration, center of mass speed, snout speed, turning rate, and turning angle were quantified for stages 1 and 2. Unlike spiny dogfish adults, young of the year spiny dogfish do not show a bimodal distribution in response type. Size corrected maximum velocity of the escape response is faster in the young of the year dogfish, with absolute values close to the values reported at the lower end of the spectrum of adult dogfish. Mean angular velocities in young of the year dogfish are similar to the faster values reported for adults, and maximum angular velocity was faster than in adults. This is consistent with previous reports on greater maneuverability in smaller sized fish. Overall, young of the year spiny dogfish are competent in fast starts although modulation of response type is absent.

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796 Fish Genetics II, Parlor ABC, Monday 27 July 2009

Tuuli Makinen[1], Gloria Arratia[2], Richard Broughton[3], Chenhong Li[4], Guillermo Ortí[4], Andres Lopez[1]

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Molecular Clocks and the Timing of Ostariophysan Radiations

Modern molecular clock methods allow the estimation of clade divergence times despite the problems posed by variable rates of molecular evolution. These methods have the potential to enrich biogeographic and evolutionary interpretations of biological lineage histories, but there is still disagreement over the applicability and limitations of different models. Application of these methods to the ostariophysan radiations have produced new hypotheses on the timing of the origin and diversification of ostariophysan fishes.

Initial molecular clock estimates of the age of the Ostariophysi and major ostariophysan clades have indicated that these groups originated significantly earlier than the first fossil occurrences of members assigned to the relevant lineages would suggest. Estimates based on mitochondrial DNA sequences place the origin of the group at 251 mya, while all identified fossils of this group are younger than 150 my. Differences of similar magnitude are found between the estimated ages of extant ostariophysan subgroups and their earliest fossil occurences. We examine the evidence and methods underlying the new proposals. In our review of fossil records ascribed to the Ostariophysi, we found that some fossil calibrations points chosen for previous divergence time estimates were incorrect or of uncertain affinity. We conducted a series of divergence time analyses to show that choice of analysis method, fossil calibration points and taxon sampling have major effects both on the phylogenetic hypothesis and the estimated divergence times under a particular phylogeny. We discuss the choice of fossil calibration points and other possible ways of improving the analyses.

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250 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Aleksandra Maljkovic, Isabelle Côté

Simon Fraser University, Burnaby, BC, Canada

Hey, Where's My Dinner Gone? Fishing and the Trophic Consequences for Caribbean Reef Sharks

Across marine ecosystems, the selective removal of large quantities of high trophic level species has been termed 'fishing down the food web'. While the direct consequences of these fisheries are receiving much attention, the indirect impacts on the structure and functional integrity of marine communities remain far from understood. In this study, we quantify the indirect effects of coral reef-based fisheries on the trophic ecology of Caribbean reef sharks (*Carcharhinus perezi*) over a gradient of fishing pressures in the Bahamas. Using a combination of prey availability surveys, stable isotope analysis and remote acoustic telemetry, we show that reef sharks inhabiting un-fished and lightly fished sites feed at significantly higher trophic levels, and over smaller ranges, than sharks at heavily fished sites. The results suggest direct competition between reef sharks and fishers for the same resources, with potential costs to the sharks in terms of maintaining minimum energy requirements and/or optimal foraging. Human-mediated depletion of preferred prey species is likely to have wider ecosystem consequences than previously thought.

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309 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Aleksandra Maljkovic, Isabelle Côté

Simon Fraser University, Burnaby, BC, Canada

The Shark Feeding Debate: What Can the Sharks Tell Us?

Feeding sharks as a tourist attraction is a hotly debated issue, yet many of the arguments both for and against the activity are based soley on anecdote and opinions alone. Shark-related tourism is a non-extractive alternative to other forms of commercial exploitation of sharks, and is often touted as an economic incentive promoting the conservation of many coastal species. However, to be sustainable in the long term, shark feeding activities must be undertaken with due regard for the ecology of both sharks and their habitat. As such, detecting changes in the feeding ecology and spatial dynamics of provisioned sharks is integral in predicting the potential effects of this activity on their functional role within the community. In this study we attempt to quantify the trophic and behavioural consequences of shark feeding for Caribbean reef sharks (*Carcharhinus perezi*) in the Bahamas. By combining 100+ hours of direct observation at shark feeds, stable isotope analysis of muscle tissue from fed and unfed sharks, and a remote acoustic telemetry study, we show that provisioned sharks exhibit significantly different trophic signatures and behavioral patterns than their un-provisioned conspecifics. The implications of these findings for the conservation of coastal shark species will be presented.

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599 AES Physiology, Galleria South, Sunday 26 July 2009

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Study Of The Velvet Belly Lantern Shark, *Etmopterus spinax*, Luminous System

Bioluminescence is the ability of living organism to produce visible light thanks to a chemiluminescent reaction. Widely distributed among marine organisms, this property is observed from bacteria to fish, the only luminous vertebrates. In fish, luminous osteichthyes and chondrichthyes representatives are known. Production of light in chondrichthyes is still poorly understood in terms of physiology, ethology and biochemistry mainly because of the difficulties to obtain living specimens. One species, the velvet belly lantern shark, *Etmopterus spinax* has recently attracted a lot of interest at ecological and populational levels. A new research program developed in our lab focused on various aspects (physiology, ethology and biochemistry) of bioluminescence of this shark. First biochemical results reveal that light production is based on a luciferin called coelenterazine. Repartition of the luminous compounds, luciferine and luciferase,

in different organs of sharks of differents sizes and sex were analysed. Test were carried out on free-swimming specimens as well as on embryos. Further characterisation of luminous compounds are required in order to confirm the hypothesis that (i) luminescence capabilities might be acquired by food chain; (ii) maternal transfert of luminescence to the embryo.

1022 ELHS/LFC Ecology II, Broadway 1&2, Saturday 25 July 2009

Mark Manuel[1], Jim Beets[1], Brian Tissot[2], Mark Hixon[3], Stephen Thompson[4]

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Factors Influencing Success of a Marine Protected Area Network in Hawai'i

As Marine Protected Area (MPA) Networks gain management support, the importance of documenting factors that affect their effectiveness increases. Previous work has revealed greater abundance of juvenile and adult fishes harvested for the aquarium trade in individual MPAs compared to adjacent control sites within the MPA Network on the western coast of the island of Hawai'i (Tissot et al. 2004). The present study evaluated the relative contribution of habitat characteristics, adult abundance, and recruitment exposure to the greater juvenile abundances observed within MPAs. Geographic, substrate, and habitat complexity were sampled. Juvenile and adult fish abundances at five pairs of MPA vs. control sites on the western coast of the island of Hawai'i. Although factors contributing to greater juvenile abundance of the study species, but differed in relative contribution among sites. We demonstrated the importance of multiple factors to the effectiveness of a MPA network. Based on our results we emphasize the value of consideration of several factors that potentially influence success of the defined goals for specific MPAs or networks.

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440 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009; AES GRUBER AWARD

Kyle R. Mara, Philip J. Motta

University of South Florida, Tampa, FL, United States

Evolution and Function of the Hammerhead Cephalofoil I: The Evolution of Cranial Form

The head must contain structures associated with feeding, respiration, neural integration, sensory reception, and musculoskeletal support. Functional and

morphological trade-offs are particularly important within spatially limited structures such as the head. The sphyrnid head presents an excellent model for investigating these potential trade-offs. *Carcharhinus acronotus*, *Eusphyra blochii*, *Sphyrna lewini*, *S. mokarran* and *S. tiburo* were chosen to represent differences in head form through phylogeny. A combination of surface based geometric morphometrics and computed tomography volumetric analysis was utilized to investigate implications of change in head form. The more basal *E. blochii* has small anteriorly positioned eyes. Through phylogeny the relative size and position of the eyes changes, such that derived species have larger more medially positioned eyes. The position of the external nares is highly variable, showing no phylogenetic trend. Mouth size and position are conserved, remaining largely unchanged, however upper and lower jaw volume is variable. Relative to carcharhinid outgroups, the feeding muscles, nasal capsule, olfactory tract, braincase, and chondrocranium all increase in relative volume in the hammerhead sharks, potentially indicating a release in spatial constraint. However, within sphyrnid sharks jaw cartilages and jaw closing muscles show variable yet parallel changes in volume, and the volumes of the upper jaw protruding muscles increase while the volumes of the braincase, nasal capsule, and eye remain constant through phylogeny. These data indicate that much of the head is morphologically conserved, however the jaw cartilages and their associated muscles vary and account for much of the internal morphological diversity within the clade.

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372 Poster Session I, Exhibit Hall, Friday 24 July 2009

Karla Marlow[1], Kevin Wiseman[1], Clara Wheeler[2], Joseph Drennan[1], Ronald Jackman[1]

[1]Garcia and Associates, San Francisco, CA, United States, [2]Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, CA, United States

Photographic Identification of Individual Foothill-yellow Legged Frogs (*Rana boylii*) Using Chin Mottling Patterns: An Effective Method for Long-term Studies

We identified individual foothill yellow-legged frogs (*Rana boylii*) using pattern mapping of chin mottling patterns by visually matching digital photographs from two separate field studies in California. Photographs were collected from adult (>40 mm SUL) and subadult frogs from Hurdygurdy Creek (Humboldt Co.; 2002-2004) and the North Fork Feather River (Butte Co.; 2004-2008). A total of 1,239 individuals have been identified to date from both studies; PIT-tags were inserted into a subset of 341 individuals, 78 of which were recaptured and verified that no two individuals had identical markings and that markings did not change with growth. We found this method useful for determining movement and breeding patterns and estimates of longevity; preliminary results indicate that females live at least 8 years in the wild and may breed for at least 5 years. This method offers a reliable, non-invasive way to

conduct mark-recapture studies on *R. boylii*, and has great potential to be applied to other western ranid species.

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551 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

J. Fernando Marquez-Farias(1)[4], Maya S. Rubio Lozano[2], Luis Vicente Gonzalez-Ania[3], Ricardo Rojas Peraza[1]

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Observations on the Reproductive Biology of the Chilean Round Ray, *Urotrygon chilensis* From the Southern Gulf of California, Mexico

The Gulf of California (GOC) is a highly productive area with considerable ichthyofaunal diversity that forms the basis of several commercial fisheries. The largest batoid fishery in Mexico operates in the GOC, and bycatch in the regional shrimp trawl fishery is also substantial and may rival directed landings as a source of mortality. Close monitoring of this and other of non-commercially important batoid species is necessary to update or confirm their conservation status (i.e., IUCN Red List assessment). Despite the great diversity of elasmobranchs in the GOC, little life history information is available for most species. To address this lack of critical biological information, the reproductive biology of the Chilean round ray, *Urotrygon chilensis*, was investigated based on specimens obtained by fishery independent trawl surveys of the Instituto Nacional de Pesca. Maturity stages were assigned by visual inspection of the development of claspers and testes for males, and by measurements of the oviducal gland, largest ovum diameter, and uterus width for females. Fitting a logistic regression to binomial data (0=immature, 1= mature) yielded median size at fifty percent maturity values of 15.2 (15.1-15.7 cm) cm DW and 14.6 (14.1-15.3 cm) cm DW for males and females, respectively. Pups typically born during spring after a gestation period of approximately 5-6 months. Mean fecundity was estimated to be 1.8 (range 1-5, s.d. = 1.0) with a 1:1 sex ratio. Size at birth ranged from 6 to 9 cm DW. Gravid females were typically found in shallow subtidal waters (< 10 meters).

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51 Herp Ecology, Galleria North, Monday 27 July 2009

David Marsh

Washington and Lee University, Lexington, VA, United States

Season and Size-specific Demography of a Terrestrial Salamander

Northern red-backed salamanders (*Plethodon cinereus*) have been important models for the study of community ecology and sociobiology, and they are regularly monitored to assess forest health. However, because Red-backed salamanders are often underground and are recaptured infrequently, surprisingly little is known about their demography. I used a mark-recapture dataset from over 3000 animals to estimate demographic parameters for *P. cinereus* and to examine variation in these parameters among seasons, sexes, and size classes of salamanders. Survival was strongly size-dependent, with larger animals having much higher survival rates. Almost all growth of salamanders occurred between the spring and the fall, but almost all the mortality also occurred during this period. Mortality was surprisingly low over three successive winters. These findings generally confirm the suggestions of previous researchers about the demography of terrestrial salamanders though this study is the first to rigorously quantify these parameters.

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103 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Edie Marsh-Matthews

University of Oklahoma, Norman, OK, United States

Clark Hubbs' Contribution to Fish Life History Ecology

Among his many contributions to fish ecology, Clark Hubbs published numerous papers on reproductive ecology of darters, silversides, poeciliids, and other species. His studies of fish life history ecology were particularly important because they not only described basic reproductive and early developmental characteristics of the individual species, but also focused attention on variation within species. This emphasis on intraspecific variation and its underlying causes provided invaluable data on geographic variation, maternal effects, and phenotypic plasticity. These topics were barely acknowledged (and mostly ignored) in the 1970s and early 1980s when modern life history theory was emerging, but their importance is now widely recognized and they have become foci of modern studies. Clark's approach to life history ecology of fishes was to become a standard for the field.

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102 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Edie Marsh-Matthews

University of Oklahoma, Norman, OK, United States

Incipient Matrotrophy: Potential Roles in Offspring Provisioning in Lecithotrophic Poeciliids

Many poeciliid species that were once thought to provision offspring solely through yolk sequestered in a large egg have been found also to transfer nutrients to developing embryos. This typically low level of nutrient transfer has been called "incipient matrotrophy" and has been largely ignored as part of the overall offspring provisioning. Recent studies, however, have demonstrated that levels of incipient matrotrophy vary with maternal and embryo characteristics and with resources available to the mother. These findings suggest that incipient matrotrophy may allow females to alter post-fertilization provisioning to affect both maternal and offspring fitness. Potential roles of incipient matrotrophy range from supplementation of yolk stores, to maternal manipulation of offspring size or gestation time, to cryptic female choice. Evidence for these and other potential roles of incipient matrotrophy in *Gambusia* species will be discussed.

1040 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

F. Douglas Martin, Adam Cohen

University of Texas, Austin, TX, United States

Amazon Molly: Is It An Invasive Species?

The gynogenetic species, *Poecilia formosa*, is thought to be native from the Nueces River of Texas to Río Tuxpan in Mexico. This species is known to have been introduced into upper reaches of the San Antonio River and the San Marcos River where it has become very abundant. Recent sampling has found this species in the Aransas River drainage, the Mission River and coastal plains reaches of the Brazos River in Texas. We have begun a program to examine whether these new records are the results of recent introductions, natural range extension or whether they have simply been overlooked in the past.

959 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Karen Martin, Alexander Martin, Brad Cupp, Melissa Studer

Pepperdine University, Malibu, CA, United States

Stock Assessment With Citizen Scientists: Trends and Trajectories for Populations of California Grunion

Sandy beaches in California are prime recreation areas for humans, and they are also critical habitat for many unique endemic species. One of these, the beach spawning California Grunion, is a marine silverside that completely emerges from the waves to spawn on shore. Its Essential Fish Habitat is in some of the most populated coastal areas of California. Human impacts on this species include a popular recreational fishery, shoreline armoring, habitat loss, and vehicular traffic over the intertidal nesting sites. California Grunion, *Leuresthes tenuis*, cannot be assessed with traditional fishery methods. The unique spawning behavior provides a vital window onto the population size, because this fish is rarely seen at any other time. As a result there have been few attempts to understand the population size or dynamics over time for this species. Over the past 8 years, local residents of coastal communities have volunteered to be citizen scientists, monitoring spawning runs of this charismatic silverside. The volunteer Grunion Greeters have provided substantial data on locations, strength, and duration of spawning runs over much of the species habitat range. These data show changes over the course of the year and over the course of different tide series. Runs reported across different beaches on the same night are highly variable, and the runs change over the course of the season. Comparisons are made across the years of the program, and to historical accounts of grunion runs, in order to improve management of this vulnerable natural treasure.

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528 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jon Martin

University of Alaska, Sitka, AK, United States

Phylogenetic Survey of Urinary Bladder Compliance in Anurans

Relatives of amphibians were the first tetrapods to make the transition from an aquatic to the terrestrial world. Occupying a terrestrial environment meant that free water sources may be limited and evaporative water losses would be high. It is well known that the dilute urine contained within the urinary bladder, a ventral out-pocketing of the cloaca, can be used to replenish water lost by evaporation and the urine volume stored is greater in terrestrial species (Ruibal 1962; Shoemaker 1964; Bentley 1971; Jorgensen 1997). Previous assessments of bladder capacity have used either periodic bladder draining or in vitro bladder filling to make interspecific comparisons. Each of these

methods has intrinsic difficulties with assessing actual interspecific anatomic differences. Urinary bladder compliance (D volume/D pressure), determined in vivo, is an objective measure of bladder anatomic differences since it eliminates behavior, yet includes the impingement of other anatomic organs (lungs, reproductive and digestive organs) and body wall musculature on bladder volume. In a comparison of *Chaunus marinus*, with *Lithobates grylio*, the more terrestrial toad had a significantly more compliant urinary bladder than the more aquatic frog 4440 and 2050 ml kPa^{-1} min^{-1} respectively (Martin and Hillman 2009). A more comprehensive phylogenetic analysis of bladder compliance needs to be conducted to understand what fraction of known interspecific differences in stored urine volume is the result of differences in bladder compliance, an integrated measure of bladder anatomy in concert with the organs and pleuroperitoneal cavity that surround it versus behavioral differences.

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825 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Natalie Martinez-Takeshita, Michael P. Franklin, Larry G. Allen

California State University Northridge, Northridge, CA, United States

The Global Genetic Diversity of *Seriola lalandi* (Yellowtail)

The Yellowtail (*Seriola lalandi*), one of the most important sport and commercial species off southern California, is the largest member of the Jack family (Carangidae). These cosmopolitan fish can be found in subtropical and temperate waters. *Seriola lalandi* are commercially fished, recreationally fished, and farm raised in the regions they occupy, thus providing an important food source and a sizeable economic impact for the people in these countries. DNA samples were collected from California (Channel Islands, Catalina Island & San Clemente Island), the Pacific Coast of Baja California, the Gulf of California, New Zealand, and Chile. Further sampling will also include Japan and South Africa. A mitochondrial DNA analysis using the d-loop will be used to determine the population structure and genetic variation between distinct sites. It may also be possible to identify subspecies and changes in population structure due to fishing pressures, as well as, migratory patterns of this global species. The genetic analysis will provide valuable information to help properly manage and sustain these fish populations in the future.

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218 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Glenn Marvin

University of North Alabama, Florence, AL, United States

Sexual and Seasonal Dimorphism in the Cumberland Plateau Woodland Salamander (*Plethodon kentucki*)

Previous studies revealed sexual dimorphism in terrestrial plethodontid salamanders of the genus *Plethodon* for greater snout-vent length (SVL) at first reproduction and maximum SVL in females, presence of a mental gland in males, larger vomeronasal organ (VNO) in males, and greater internarial width in males. Here I describe additional sexual dimorphism as well as seasonal (i.e., breeding versus non-breeding) dimorphism in *Plethodon kentucki*. I measured morphological variables on preserved specimens of adult individuals that were collected during the breeding season (n = 26 females and 30 males) and non-breeding season (n = 29 females and 30 males). Residuals from regressions of morphological variables on SVL (all $\log_{10}$-transformed) and a principal component analysis on the residuals demonstrate that body mass, trunk length, and tail width are greater in females. These female features may be associated with selection for greater fecundity and increased fat storage to enhance reproductive success. The head is relatively larger in males and has a longer snout with a broader tip. Such dimorphism for the snout increases during the breeding season. Sexually dimorphic features in males may be associated with selection for increased mating success in terms of finding reproductive females (i.e., the enlarged snout may be related to a larger VNO and enhanced chemosensory function) and increased competitive ability during competition for mating opportunities (i.e., the larger head may result from selection for better fighting ability). An increase in vent length for both sexes may facilitate the indirect transfer of sperm during the breeding season.

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538 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Robert Mason

Oregon State University, Corvallis, OR, United States

Chemical Ecology of Snakes: From Pheromones to Receptors

We study chemical communication systems in vertebrates by examining both the diversity of chemical signals and underlying physiological mechanisms mediating their production, expression, and reception. Reproduction in reptiles, snakes in particular, is dependent on the production and perception of sex pheromones. One of the few vertebrate pheromones isolated, characterized, and synthesized is the sex pheromone of

the Red-sided Garter Snake, *Thamnophis sirtalis parietalis*. When males encounter females expressing pheromones, they exhibit stereotyped courtship behaviors including chin-rubbing and rapid tongue-flicks. The pheromone, a nonpolar, hydrophobic blend of 13 long-chain (C_{29}-C_{37}) saturated and monounsaturated methyl ketones, is insoluble in aqueous solutions. This pheromone is detected by the vomeronasal organ (VNO), which is specialized for the reception of nonvolatile chemical cues. Male garter snakes deprived of a functional vomeronasal (VN) system are unable to detect or respond appropriately to pheromones. But the mechanism by which the hydrophobic pheromone gains access to the aqueous environment of the VNO remained unknown. Results to date indicate that the Harderian glands' (HG) secretions, which duct exclusively into the VNO in snakes, contain pheromone-binding proteins. For over 300 years, the function of the cephalic HG of vertebrates has been the subject of speculation. Our studies in garter snakes demonstrate that the HG serves as a mediator in providing access for the female sex pheromone to the VNO of male garter snakes. In addition, feeding involves detection of prey chemicals by the vomeronasal system as well, and may require carrier molecules to deliver prey proteins to the vomeronasal organ.

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784 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Megan Masonek[1], Sierra Sisk[1], Molly Thompson[1], William McCall[1], Sarah Del Paine[1], Tag Engstrom[1], Don Heacock[2]

[1]California State University Chico, Chico, CA, United States, [2]Kauai Department of Aquatic Recources, Lihue, HI, United States

Ecology and Conservation of the Introduced Endangered Asiatic Softshell Turtle, *Palea steindachneri*, on the Island of Kaua'i, HI USA

The wattle-necked softshell turtle, *Palea steindachneri*, is IUCN listed as Endangered in its native China and Vietnam where its survival is doubtful due to continued exploitation. *Palea steindachneri* was introduced to Kauai and Oahu by Chinese immigrants during the mid 1800s, and appears to be established in Kauai. This creates an interesting conservation puzzle, as this species is both endangered in its native range and a potentially harmful invasive outside its native range. Little is known about the distribution, abundance and effects that *P. steindachneri* may have on Hawaiian aquatic ecosystems. In 2007 CSU Chico biology classes began research with two goals: 1) to evaluate the Kauai population as a viable option to prevent the global extinction of this species; and 2) to understand the impact that this and other invasives have on Hawaiian aquatic ecosystems, which have no large native predators. Here we present preliminary results on the status and ecology of *P. steindachneri* on Kauai based on data collected by CSU Chico biology classes between 2007-09 and compilation of two decades of observations by Kauai DAR personnel. DAR observations and DNA sequences confirm the widespread establishment of *P. steindachneri*. CSU classes captured, PIT tagged and released ten turtles from three watersheds recapturing one and have collected tissue samples for DNA and stable isotope analysis and feces for diet studies. These limited

data indicate that the turtle is locally abundant but has a spotty distribution, and feeds on a wide variety of invasive prey. Isotope analysis is ongoing.

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637 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Jodi Massie[1], Brian Smith[1], Ben Blake[1], Michael Westphal[2]

[1]Black Hills State University, Spearfish, SD, United States, [2]Kansas State University, Manhattan, KS, United States

Reproductive Effort of the Common Garter Snake (*Thamnophis sirtalis*) in South Dakota

In late May 2008 we collected 50 gravid common garter snakes (*Thamnophis sirtalis*) from one den site located at Lake Traverse, South Dakota. These snakes were kept in the Black Hills State University animal care facility until they gave birth to their offspring beginning on August 21st until the project was terminated on September 10th. Snout-vent length, weight and sex were recorded for the offspring. Mothers were measured once and weighed several times during their pregnancies and immediately following birth of the young. A total of 1406 neonates from 44 mothers were recorded for this project. I calculated SVL and mass means for the live, developed offspring (n=1217), as well as clutch size and relative clutch mass (RCM) of all offspring from mothers that completed birth (mothers = 40, offspring =1368). Mean SVL +/- 1 std. dev. for live, normal young was 156.370 (+/- 9.899) mm with a mean mass +/- 1 std. dev. of 1.782 (+/- .029) grams. The clutch size +/- 1 std. dev. for the 40 mothers that completed birth was 34.2 +/- 9.97. Litters ranged in size from 16 to 64 young. Mean RCM +/- 1 std. dev. was .67 (+/- .1576), ranging from .3911 to 1.065.

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533 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Ann C. Matarese, Morgan S. Busby, Deborah M. Blood

NOAA/NMFS/Alaska Fisheries Science Center, Seattle, WA, United States

Identification of Larvae and Early Juveniles of Pricklebacks (Perciformes: Stichaeidae) in the Northeastern Pacific Ocean and Bering Sea

Fishes of the family Stichaeidae, commonly known as pricklebacks, are mostly intertidal and subtidal fishes occurring in the North Pacific Ocean (NPO) and Bering Sea (BS) with a few species in the Arctic and North Atlantic Oceans. Aspects of the early life histories of these fishes are poorly known mostly due to their lack of commercial importance, small size, inshore distribution, and cryptic habits. In this ongoing study, we examined larvae and/or juveniles of 23 of 27 species reported from the NPO and BS. Of these,

developmental series of 12 species are described for the first time. For comparative purposes, 11 more are added, incorporating additional illustrations and augmented descriptions of new specimens. As available, representative larvae for each taxon have been measured and cleared and stained for morphological, meristic, and osteological analyses. Based on 30 + years of ichthyoplankton sampling in the NPO and BS, abundance and distribution maps are provided for many taxa. Stichaeid larvae can be distinguished from other slender-bodied zoarcoid/percomorph larvae by a combination of characters including counts of median fin-elements and vertebrae (myomeres), morphology, and pigmentation. Snout to anus length is a particularly useful morphological character for distinguishing stichaeid genera. Distinguishing larvae of the tribe Lumpenini, comprising the nominal genera *Lumpenus*, *Anisarchus*, and *Leptoclinus*, remains problematic using pigment characters alone, but meristic features appear to be helpful in distinguishing the species. The potential utility of larval characters in phylogenetic analyses of stichaeid fishes will also be discussed.

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468 Poster Session I, Exhibit Hall, Friday 24 July 2009

Ann Matarese, Ingrid Spies, Morgan Busby, James Orr

NOAA/Alaska Fisheries Science Center, Seattle, WA, United States

Early Larvae of *Zesticelus profundorum* (family Cottidae) Identified Using DNA Barcoding

Genetic information obtained using DNA barcoding methods has been used successfully in recent years to answer some complex issues regarding taxonomic identification of species and phylogenetic relationships of fishes. Combining morphological characters with these powerful genetic tools can be helpful in solving difficult problems in the identification of early life history stages. For more than 10 years, we have been collecting a rare, unknown larva during ichthyoplankton surveys in the Gulf of Alaska and Bering Sea. Based on general morphological characters, it resembles other scorpaeniform larvae, but assigning a family level identification has been problematic. Major gaps still persist in our knowledge of the early life history stages of the Scorpaeniformes, especially of larvae among the families Scorpaenidae, Liparidae, and Cottidae. In this study, we sequenced 605 bp of cytochrome c oxidase subunit I to positively identify preflexion larvae of *Zesticelus profundorum*, the flabby sculpin; a rare deep-water member of the family Cottidae. Adults of *Z. profundorum* occur in marine waters from the Bering Sea and Aleutian Islands to northern Baja California and to southeastern Kamchatka, but only a few specimens have been reported from waters of Alaska where these larvae were collected. Preflexion larvae of *Z. profundorum* are heavily pigmented over the entire head, gut, body, and dorsal and anal finfolds, and have 26 or 27 myomeres. This work provides the first description of preflexion larvae of *Z. profundorum* and is an example of our success applying genetics in our field program.

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99 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Ivan Mateo[1], Edward Durbin[1], Richard Appeldoorn[2], Aaron Adams[3], Richard Kingsley[1], Peter Swart[4], Francis Juanes[5]

[1]University Rhode Island, Kingston Rhode Island, United States, [2]University Puerto Rico, Mayaguez, Puerto Rico, [3]Mote Marine Laboratory, Pineland, FL, United States, [4]University Miami, Miami FL, United States, [5]University Massachussetts, Amherst MA, United States

Variation in Otolith Microchemistry Fingerprints of French Grunt (*Haemulon flavolineatum*) and Schoolmaster (*Lutjanus apodus*) in Nursery Habitats in Puerto Rico and St. Croix (USVI)

Juveniles of French grunt (*Haemulon flavolineatum*) and schoolmaster (*Lutjanus apodus*) were captured in mangrove and seagrass habitats in St. Croix and Puerto Rico in 2006 and 2007 to determine if their nursery areas can be discriminated by otolith chemical signatures. Concentrations of Rb, Co, Na, Mg, Ca, Mn, Mg, Sr, Ba, Pb, and Cu were determined in regions of YOY fish otoliths representing the post-settlement period (30-60 days) using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS). (^{18}O) and (^{13}C) isotopic signatures were also analyzed. Elemental signatures for both species differed significantly ($P<0.001$) among distinct mangrove and seagrass nurseries within Puerto Rico and St. Croix. Concentrations of six elements (Sr, Ba, Cu, Mg, Co, Na) and the two stable isotopes (^{18}O and ^{13}C) for both species within each year differed significantly among mangrove and seagrass nurseries within islands (ANOVA, $P<0.001$). Classification success for French grunt and schoolmaster nursery stations within St. Croix for 2006 and 2007 ranged from 87 to 92% and from 76 to 77%, respectively, whereas in Puerto Rico, classification success for French grunts and schoolmaster for the two years ranged from 80 to 84% and 84 to 87%, respectively. When stations were combined among habitats, classification success between mangrove and seagrass habitats in Puerto Rico for French grunt ranged from 84 to 91%, and for schoolmaster ranged from 94 to 99%. In St. Croix, classification success for French grunt was 95 to 96%, and for schoolmaster was 86 to 89%.

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338 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Mariana Mateos

Texas A&M University, College Station, TX, United States

Phylogeography of Poeciliids in Western Mexico

The Trans-Mexican Volcanic Belt (TMVB) is recognized as a dispersal barrier for freshwater and other taxa. Phylogeographic studies of freshwater fishes have identified

vicariant events in the western TMVB. Herein, I review our current knowledge of phylogeography of this region and examine the phylogeography of additional Poeciliid taxa. My results indicate that the TMVB is either a permeable barrier to some species or that there has been recent human mediated-dispersal. Implications for the study of Poeciliid biogeography are discussed.

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282 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

William Matthews, Edie Marsh-Matthews

University of Oklahoma, Norman, OK, United States

Clark Hubbs' Contributions to Ichthyology in Oklahoma

From 1970 to 1984, Clark Hubbs taught in summers at the University of Oklahoma Biological Station at Lake Texoma. Approximately 200 students from high schoolers to senior graduate students gained extensive experience from him in lectures and on field trips, and from individual research projects under his direction. Clark did his own research in Oklahoma on ecology of *Menidia*, and combined with students for studies on Lake Texoma or its fishes. His important papers from Oklahoma addressed diel activity of fish; stratification of Lake Texoma; and (with Jimmie Pigg) a thought-provoking review on the effects of reservoirs on endangered fishes. Numerous students published papers from their projects in Clark's Oklahoma classes, and many students in those classes went on to make important contributions in ichthyology. As Clark's GTA in Biology of Fishes in 1976, WJM was introduced to many new concepts in fish biology, and to field locations in Oklahoma that we continue to sample to assess long-term changes in fish assemblages. Late in his life we had the privilege of accompanying him to streams in south Oklahoma where we and our graduate students helped run "the machine", seined fish for him to count, and witnessed his uncanny ability to record all these data on voluminous yellow pads. Clark Hubbs left an indelible impression on all who experienced him, and his legacy to fish biology in Oklahoma is indeed large.

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391 Poster Session II, Exhibit Hall, Saturday 25 July 2009

George M. T. Mattox

Instituto de Biociências - Universidade de São Paulo, São Paulo, SP, Brazil

Historical Biogeography of Neotropical Characiformes (Teleostei, Ostariophysi): an Approach Using Brooks Parsimony Analysis

Neotropical freshwater fishes include a vast species diversity representing interesting models for historical biogeography because of their life histories restricted to freshwater environments. Although this diversity is not completly known, general biogeographic patterns can be accessed using appropriate analytical tools and phylogenetic data published in the last 25 years. Brooks Parsimony Analysis was used to infer relationships among 29 Neotropical drainages, based on systematics and distribution datasets of 17 clades of Characiformes, totalizing 247 characters representing the distribution of extant taxa and their hypothetical ancestors. The analysis yielded 282 equally most parsimonious trees (L=466; CI=0.53, RI=0.65). The strict consensus cladogram presents a basal dicotomy between transandean (Madalena, Maracaibo and Western drainages) and cisandean clades. The latter has a basal politomy involving rivers of the Atlantic Coast and Rios Paraguay, Paraná, São Francisco, Uruguay, and a clade with the northern drainages of the continent. The latter is composed by sequencial less inclusive clades separating Northeastern Atlantic drainages, Guyanas coastal rivers, Essequibo, Branco, a clade with Rios Negro and Orinoco, and a clade with the remaining Amazonian drainages. Some nodes could be related to known geomorphological events and their vicariant effects while homoplasies were investigated to find general patterns of dispersion and extinction. The complex diversity of the Neotropical region is once again attributed to a mosaic of historical events including terrain uplifts, headwater capture, fluctuations in sea level, among others. Although different taxa are expected to respond differently to environmental changes, it seems that general patterns can be detected.

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390 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

George M. T. Mattox

Instituto de Biociências - Universidade de São Paulo, São Paulo, SP, Brazil

Phylogenetic Study of the Characinae (Ostariophysi, Characiformes, Characidae): Preliminary Results

One of the main challenges in modern Neotropical ichthyology regards the systematics of Characidae, a family with approximately 950 species, two-thirds of the diversity of Characiformes. It was recently suggested that subunits of Characidae should be first recognized for a better understanding of the its systematics. Characinae is one such

subunit holding special importance for including *Charax*, type-genus of Characidae. Twelve genera and 78 species have been assigned to Characinae, but the subfamily still lacks a proper phylogenetic definition. A preliminary cladistic analysis of Characinae based on 126 characters from external morphology, myology and skull osteology resulted in 48 most parsimonious trees (L=583; CI=0.30; RI=0.72). In the strict consensus cladogram, Characinae as traditionally recognized is not monophyletic. Alternatively, these genera resulted in two separated clades, each one more closely related to different subunits of Characiformes. Seven genera form the first clade (*Phenacogaster*((*Charax Roeboides*)(*Acanthocharax*(*Acestrocephalus*(*Cynopotamus Galeocharax*))))) with eight synapomorphies, sequentially more related to *Tetragonopterus*, *Gymnocorymbus* and *Astyanax*. The second clade includes the Heterocharacini ((*Heterocharax Hoplocharax*)*Lonchogenys*), which is sister-group to *Gnathocharax* followed by *Roestes*, a genus of Roestinae currently included in Cynodontidae. The clade (*Roestes* (*Gnathocharax* Heterocharacini)), with six synapomorphies, is more related to the clade (*Aphyocharax* (*Exodon*(*Bryconexodon Roeboexodon*))). The twelfth genus, *Priocharax*, comprises two miniature species related to the Heterocharacini based on morphology of pseudotympanun and teeth. Due to its highly modified anatomy potentially related to ontogenetic truncations, *Priocharax* could not be confidently positioned in the cladogram, but ongoing anatomical studies of *Priocharax* may provide additional evidence regarding its phylogenetic relationships.

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288 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Jasmine Maurer[1], Lisa Natanson[2], Dave Ebert[1], Gregor Cailliet[1]

[1]Pacific Shark Research Center, Moss Landing Marine Laboratories, Moss Landing, CA, United States, [2]National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center, NOAA, Narragansett, RI, United States

Life History Aspects of Two Bering Sea Skate Species, *Bathyraja lindbergi* and *B. maculata*

The eastern Bering Sea is an area of high skate abundance and diversity. Relative to their abundance, however, little is known about the basic life history traits for most of the skate species living there. Researchers from the Pacific Shark Research Center are continuing their efforts to collect, analyze, and synthesize important life history information, including age, growth, and reproduction, used for fisheries management. The two species in the current study are the Commander Skate, *Bathyraja lindbergi*, and Whiteblotched Skate, *Bathyraja maculata*. Samples were collected during NOAA Fisheries survey cruises in the eastern Bering Sea and through the National Marine Fisheries Service Alaska Fisheries Science Center observer program. Age estimates from two vertebral preparation techniques, gross sectioning and histology, will be compared. Preliminary results indicate histological preparation of vertebrae may be the preferred technique for these two species. Therefore, the following results are based solely on counts from histological preparation. Maximum age estimates for *B. lindbergi* females is

33 years and for males is 31 years, and for *B. maculata* females and males, 33 and 36 years, respectively. Thorns will be examined as a possible non-lethal ageing structure. Age at 50% maturity for *B. lindbergi* females is 21 years and for males is 20.7 years, and for *B. maculata* females and males, 26 and 24 years, respectively.

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389 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

William Mautz[1], Richard Hughes[2], Paul Klawinski[3], Rebecca Ostertag[1]

[1]University of Hawaii at Hilo, Hilo, HI, United States, [2]USFS Pacific Institute of Pacific Island Forestry, Hilo, HI, United States, [3]William Jewell College, Liberty, MO, United States

Tracking a Nitrogen Fixing Tree δ15N Signature Through a Hawaiian Coqui Frog Population

On Hawaii Island, a continuously distributed population of invasive coqui frogs (*Eleutherodactylus coqui*), is layered on an earlier ongoing invasion of albizia tree (*Falcateria moluccana*) dominated forest in the process of outcompeting a native ohia tree (*Metrosideros polymorpha*) dominated forest. In contrast to ohia, albizia is a nitrogen fixer, its forest type is host to many additional invasive plant species, and the invasive forest has increased primary productivity. The $\delta^{15}N$ isotope signature of albizia forest litter was shifted 4.0 ‰ units from ohia-dominated forest litter across a forest boundary with an average of 250 m between sample sites. $\delta^{15}N$ increased through trophic levels in each forest type, and the difference between forest types persisted with 2.7 ‰ units between herbivorous invertebrates, 2.2 ‰ units between predaceous invertebrates, and 3.2 ‰ units between coqui frogs. Organisms in the food chains of these forest types were relatively sedentary, remaining isotopically well distinguished across the boundary of these two forests. Although albizia-dominated, compared to ohia-dominated, forest was characterized by increased litterfall and increased nitrogen content of litter, these differences did not fuel significant differences in coqui frog population densities between the forest types. Supported by NSF DEB-0445267.

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550 Cypriniform Tree of Life, Pavilion East, Sunday 26 July 2009

Richard Mayden[1], Susana Schönhuth[1], Angelo Bufalino[1], Andrew Simons[2], Kevin Tang[1], Casey Dillman[1], Robert Wood[1], Phillip Harris[3], Bernard Kuhajda[3], Hector Espinosa[4]

[1]Saint Louis University, St. Louis, MO, United States, [2]University of Minnesota, St. Paul, MN, United States, [3]University of Alabama, Tuscaloosa, AL, United States, [4]Universidad Nacional Autonoma de México, Mexico City, DF, Mexico

Cypriniformes Tree of Life: A Supermatrix Approach to Inferring the Phylogenetic Relationships of the North American Species of the Family Cyprinidae

Species of the North American Cyprinidae comprise the most diverse family and are attractive to various fields of comparative biology for in-depth investigations. Severely limiting researchers from pursuing such studies is a continuing lack of a historical framework of species relationships within which to cast such studies. While this cyprinid fauna is one of the best known cypriniform faunas of the world and has received attention from various researchers since the early 1980's with respect to species relationships using phylogenetic methods and morphological and/or molecular characters, considerable uncertainty remains as to species relationships and classification of some members of the fauna. Various studies have produced a variety of separate molecular studies involving mitochondrial and/or nuclear genes. In this study we employ a supermatrix approach using variation in these genes to approximate the phylogenetic relationships of most of the fauna. The approach we use provides a more comprehensive view of the fauna and clearly identifies where new research is needed for a comprehensive study to finally resolve a classification for the family. Our analysis involves an initial first-level phylogenetic reconstruction of only those taxa for which all genes are available. This is followed by a second-level analysis, including all taxa wherein sequences for at least one gene are available, with a constraint tree from the first-level analysis. The latter analysis necessarily contains many samples with missing data. These different analyses are compared and a proposal for a future approach involving both morphological and molecular characters is advanced.

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544 Herp Conservation III, Grand Ballroom II, Monday 27 July 2009

Malcolm McCallum[1], Jamie McCallum[1], Stanley Trauth[2]

[1]Texas A&M University-Texarkana, Texarkana, TX, United States, [2]Arkansas State University, State University, AR, United States

Predicted Climate Change May Spark Box Turtle Declines

How will organisms deal with climate change? Ectotherms such as reptiles and amphibians are especially at risk due to their metabolic ties to the environment and their general inability to migrate with changing climates over short time frames. We modeled the growth response of Three-toe Box Turtles (*Terrapene carolina triunguis*) to fluctuations in ambient temperature and precipitation. Then we extrapolated this model to climate conditions expected in 2100. We predict that there is less than 20% possibility of hatchling turtles growing during their first year. Reduced annual growth rates during later years may cause earlier termination of growth, smaller standard carapace lengths, and reduced fecundity. These responses are typical of those that stimulate an extinction vortex. These findings provide for a general understanding of how this species and other terrestrial reptiles may respond to climate change. Without reduction in greenhouse gas emissions we could face catastrophic declines in many ectotherms as temperature and rainfall patterns.

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226 Fish Ecology II, Pavilion East, Sunday 26 July 2009

Jennifer McClain, Steve Ross

University of North Carolina Wilmington, Wilmington, NC, United States

Trophic Structure of Midwater Fishes over Cold Seep Areas in the Gulf of Mexico

Midwater fishes provide insight into energy utilization and movement through the water column. This study examined whether cold seep chemosynthetic communities impacted the trophic structure of fish species in the overlaying water column. Intensive discrete depth sampling was conducted in August 2007 over three cold seep habitats (> 1000 m) in the north-central Gulf of Mexico using Tucker trawls, yielding 8,703 juvenile and adult fishes from 27 families. Zooplankton and phytoplankton were also collected using plankton nets and by filtering seawater, providing reference material for stable isotope analyses (SIA). Stomach contents were analyzed for the most abundant species collected (18 species from 5 families: Gonostomatidae, Myctophidae, Phosichthyidae, Sternoptychidae and Stomiidae). Fishes mainly consumed copepods and ostracods, with the exception of *Chauliodus sloani* (Stomiidae) whose diet was dominated by fishes. SIA ($\delta^{13}C$ and $\delta^{15}N$) complimented stomach analyses and aided efforts to determine the

potential for chemosynthetic input into the water column. A total of 246 isotope samples were analyzed, from 5 fish families (same as stomach contents), 13 invertebrate families, phytoplankton, Sargassum and detritus. Isotope results supported findings from stomach analyses, with most diets composed of zooplankton. No distinct chemosynthetic signature was detected in SIA; however, *Myctophum affine* (Myctophidae), exhibited a stable isotope range slightly lower than phytoplankton and values for *C. sloani* were inconclusive, requiring further investigation. Despite the current lack of evidence supporting midwater fishes utilization of chemosynthetic energy, midwater fishes are important components of the midwater community, providing a trophic link between the surface and lower depths.

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517 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Shawn McCracken, James Gaertner, Michael Forstner, Dittmar Hahn

Texas State University, San Marcos, TX, United States

Detection of *Batrachochytrium dendrobatidis* in Amphibians from the Forest Floor to the Upper Canopy of an Ecuadorian Amazon Lowland Rainforest

Eighty-six individuals from 31 species of amphibians were collected from the forest floor (~0 m), the shrub/sub-canopy (0-4 m) and mid- to upper canopy (4-38 m) of a Neotropical lowland rainforest near the Tiputini Biodiversity Station (TBS) - Universidad San Francisco de Quito in the Upper Amazon Basin of eastern Ecuador, and analyzed for *Batrachochytrium dendrobatidis* (*Bd*) using a nested PCR protocol. *B. dendrobatidis* was detected on 17 of the 86 individuals (20%), with positive samples collected from each of the vertical strata. Infection was found to be significantly higher in the fossorial/floor and canopy groups, showing 25% and 33% of individuals infected, respectively, than in the shrub/sub-canopy group with only one individual (3%) infected. Thus, *Bd* was non-randomly distributed along the vertical axis, suggesting that microhabitat conditions in the different strata can potentially have an influence in host-pathogen dynamics. To our knowledge this is the first examination of *Bd* infection in amphibians found in the forest canopy and the first record of a symptomatic anuran infected with *Bd* in lowland tropical rainforests of the Upper Amazon Basin.

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779 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Sara McCutcheon[2], Dave McGowan[1]

[1]Florida Fish and Wildlife Conservartion Commission, FL, United States, [2]Florida Atlantic University, Boca Raton, FL, United States

Characterizing the Private Boat Recreational Fishery for Highly Migratory Species in Florida

In 2008, approximately 5,700 private recreational vessels in Florida were federally permitted to fish for Highly Migratory Species (HMS), which include billfish, sharks, tunas, and swordfish. Despite the popularity of HMS fishing, catch and effort estimates for most HMS species remains poor due to a lack of accurate fisheries statistics data. The primary method for monitoring recreational fisheries in Florida is the Marine Recreational Fisheries Statistics Survey (MRFSS); however, observations for many HMS species in this survey are rare. One potential reason is that substantial portions of HMS trips are not covered by MRFSS dockside sampling because many return at night and are operated out of private access sites. These temporal and spatial biases create a significant data gap that precludes managers from accurately assessing the impact of the recreational fishery on these species. This pilot study was conducted as part of the Marine Recreational Information Program to estimate the relative scope and magnitude of HMS recreational fishing by private anglers. Additionally, we collected baseline information on unknown aspects of this segment of the recreational fishery to guide implementation of an improved data collection method in the southeastern United States. The 12-month study entailed a bi-weekly telephone survey that utilized the HMS permit registry as a sample frame. Effort estimates for each HMS species group were produced and each permit-holder's fishing activities were characterized to determine HMS species preference, estimate directed catch and bycatch rates of HMS species, and ascertain the spatial and temporal patterns of the HMS-directed fisheries.

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639 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Robert McDowall

National Institute of Water and Atmospheric Research, Christchurch, New Zealand

Diadromy, Recruitment, Expatrial Dispersal and Colonization in the Fish Faunas of Island Streams

Diadromy is a fundamental attribute of the life histories of most of the stream fishes of small oceanic islands, especially in the tropics and subtropics. The mechanisms that permit self recruitment to the fish populations of streams on small, isolated, oceanic

islands are poorly understood, but appear likely to involve massive amounts of expatrial dispersal. The stream fish populations of some islands may be ecological sinks that make no contribution to maintenance of the populations. It would intuitively seem likely that such expatrial dispersal would attract very strong negative selection but this may be compensated for by the role of diadromy in providing for the 'rescue effect' that rejuvenates populations adversely affected by perturbations such as active volcanism and historic dewatering that may be characteristic of island streams. Very inefficient recruitment may be the cost of these islands having any stream fishes at all. A corollary of this is the potential that such expatrial dispersal has for populating the streams in newly formed islands. The benefits of the ability of diadromous species to (re)colonise island streams may counterbalance the high populations costs of persistent expatrial dispersal.

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993 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Jan McDowell, John Graves

Virginia Institute of Marine Science, Gloucester Point, VA, United States

Genetic Analysis of Bluefin Tuna (*Thunnus thynnus*) Population Structure

Atlantic bluefin tuna (*Thunnus thynnus*) are thought to comprise two distinct stocks with spawning grounds in the Gulf of Mexico and Mediterranean Sea. Previous genetic studies using both mitochondrial and nuclear gene regions have shown significant heterogeneity between young-of the-year (YOY) bluefin taken from the western and eastern Atlantic, as well as adults taken from the Gulf of Mexico and Mediterranean Sea during the spawning season. Recent electronic tagging studies and investigations of otolith stable isotopes indicate considerable mixing of the two stocks throughout the North Atlantic. In this study, we use genetic signatures of YOY and spawning bluefin tuna from the Gulf of Mexico and Mediterranean Sea to estimate the contribution of eastern and western stocks to collections of school bluefin tuna (1 – 4 year old) and giant bluefin tuna (8+ years old) collected off the U.S. Atlantic coast in multiple years. Complete microsatellite genotypes have been obtained for more than 800 samples at 14 variable loci and control region sequences have been generated for about 650 individuals. Using YOY bluefin tuna as well as adults taken from breeding grounds during spawning season as baseline samples, we are assessing the utility of various methods for assigning individuals to and excluding individuals from source populations based on their multilocus genotypes. We are also performing maximum likelihood estimates of mixture proportions in different age classes. Finally, we are using a cluster analyses to test the assumption of two stocks based on genetic data without prior information about location of capture.

1038 Herp Physiology, Galleria North, Monday 27 July 2009; ASIH STOYE AWARD PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Matt McElroy

University of California, Berkeley, Berkeley, CA, United States

Comparative Thermal Ecology and Physiology of Two Cryptic Skinks on Mo'orea, French Polynesia

The thermal dependency of physiological function is crucial to the ecology of any ectothermic organism. Comparative studies of thermal ecology are important to understand species-specific responses to climate warming and subsequent effects on community structure and competitive interactions. I studied the habitat selection and thermal ecology of two cryptic South Pacific skinks (*Emoia cyanura* and *Emoia impar*) in order to determine whether or not differences in physiology influence habitat partitioning. Several measurements of field and laboratory-based thermal ecology point towards physiological differences between the species. Compared to *E. impar*, *E. cyanura* primarily inhabited areas with open canopy cover, and selected significantly warmer substrates in both field and laboratory settings. *E. cyanura* also had a significantly higher preferred body temperature than E. *impar*. While there was no statistical difference between the species' critical thermal minimum, *E. cyanura* had a significantly higher critical thermal maximum. *Emoia impar* ran faster at cool temperatures relative to *E. cyanura*; a finding consistent with it being more common at higher elevations. These results indicate that differences in physiology underpin habitat partitioning between *E. impar* and *E. cyanura*, and are consistent with the emerging view that climate warming will affect the community structure (i.e. habitat selection, competition, fitness) of tropical ectotherms.

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742 Poster Session III, Exhibit Hall, Sunday 26 July 2009

David McGowan

Florida Fish & Wildlife Conservation Commission, Tequesta, FL, United States

Characterization of the Swordfish Recreational Fishery of Florida

A popular recreational fishery for swordfish once existed in the Florida Straits during the 1970s. Interest in the fishery declined rapidly as catches decreased by the early 1980s, with the fishery essentially becoming dormant over the next two decades. The closure of the Florida Straits to pelagic longlining in the spring of 2001 marked a significant event in the revitalization of the recreational fishery. Within 6 months of the closure, anecdotal reports of recreational swordfish catches quickly spread throughout the recreational fishing community of southeast Florida, stimulating renewed interest in the fishery. Over the next several years, the fishery was actively promoted throughout

the state via a wide range of media outlets. Development of new fishing methodologies expanded the initially night-only fishery to daytime fishing, further increasing participation. It is estimated that several thousand vessels now actively participate in the swordfish recreational fishery, resulting in significant landings. Monitoring the recreational fishery has been extremely difficult due to the limitations in the primary monitoring program conducted in Florida, the Marine Recreational Fishing Statistics Survey (MRFSS). Compliance with mandatory reporting requirements with NOAA fisheries has also been poor and difficult to enforce. As a result, pilot studies that entailed targeted telephone and field intercept surveys were initiated in 2008-2009 through the Marine Recreational Information Program (MRIP). Their objectives were to address sampling biases associated with the MRFSS and improve the collection of catch and effort data for swordfish and other highly migratory species. Preliminary data for these pilot studies are presented.

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737 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

David McGowan

Florida Fish & Wildlife Conservation Commission, Tequesta, FL, United States

Evolution of the Recreational Shark Fishery of Florida, 1981-2008

Over the past 30 years, recreational anglers have accounted for a substantial proportion of the total shark harvest throughout the United States. Florida has been the epicenter for both recreational and commercial fisheries targeting large coastal sharks (LCS) and small coastal sharks (SCS) in the western Atlantic and Gulf of Mexico. After peaking in the early 1990s, commercial shark landings have steadily decreased due to more restrictive quotas and increased number of prohibited species. Recreational landings have decreased concomitantly; although this decline may be attributed less to regulatory changes, and more to social changes throughout the recreational fishing community. Catch disposition data collected by the Marine Recreational Fishing Statistics Survey (MRFSS) from 1981 to 2008 show a significant shift towards catch and release by recreational anglers. Throughout the 1980s, recreational anglers historically landed 54.1 and 58.5% of the total recreational LCS and SCS catches, respectively. The proportion of the total recreational shark catch that was harvested declined to 26.7 and 22.5% during the 1990s when management actions were first implemented, and further declined to 14.2 and 11.4% through the current decade. Despite these changes, segments of the recreational fishery continue to target sharks with sufficient regularity that their impact may not be adequately accounted for by the MRFSS. These directed recreational fisheries may result in significant mortality for some shark species, including blacktip, bull, scalloped hammerhead, great hammerhead, and bigeye thresher. Recommendations for improvements in monitoring efforts and public outreach are presented.

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67 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

David McLeod

University of Kansas, Lawrence, Kansas, United States

Of Least Concern? Cryptic diversity in the *Limnonectes kuhlii* complex

Widely distributed throughout East and Southeast Asia, the dicroglossid frog, *Limnonectes kuhlii*, has been informally considered a complex of species by multiple authors, but no study has explicitly evaluated the taxonomy of *L. kuhlii*, nor estimated relationships among lineages within this group. I will present a phylogenetic analysis of molecular and morphological characters to define the major lineages within the *Limnonectes* "*kuhlii*" complex. Results of this study reveal that *Limnonectes* "*kuhlii*" is not one widely distributed taxon but most likely a diverse clade of numerous species, some of which are range-restricted and probably in need of attention by conservation biologists.

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375 General Ichthyology I, Pavilion East, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Caleb McMahan

Southeastern Louisiana University, Hammond, LA, United States

Molecular Systematics of the Mountain Mullet, *Agonostomus monticola* (Teleostomi: Mugilidae)

The mountain mullet (*Agonostomus monticola*) represents an understudied species that is allopatrically distributed along the Pacific and Atlantic Coasts of North, Central, and northern South America, as well as the Caribbean. Populations occur in inshore and freshwater habitats from the Gulf of Mexico to Venezuela in the Atlantic Basin, and from Baja, Mexico to Colombia in the Pacific Basin. This species is also found throughout the West Indies. No study has assessed morphological or genetic variation throughout the range of this monotypic taxon. However, multiple researchers have suggested that the species is more diverse than currently recognized. The objective of this study was to conduct a phylogeographic study of *Agonostomus monticola*. Sequence data (cytochrome *b*) has been gathered from 37 sites and nearly 60 individuals from throughout the distribution of this species. Phylogeographic relationships strongly support the monophyly of three distinct clades: a Gulf of Mexico clade, a Caribbean Sea clade, and a Pacific clade. Genetic distances between each of the clades are high (> 7.0% cytochrome *b*; 3% S7-intron 1) which is indicative of a long period of isolation. Future work will

include the addition of additional nuclear markers as well as assessing morphological variation between the three divergent clades recovered for this species.

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259 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Kelton McMahon[1], Marilyn Fogel[2], Travis Elsdon[3], Simon Thorrold[1]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA, United States, [2]Carnegie Geophysical Laboratory, Washington, DC, United States, [3]University of Adelaide, Adelaide, SA, Australia

Patterns in Carbon Isotope Fractionation of Amino Acids Between Diet and Consumer in a Model Fish Species

Stable isotope analysis has become a routine component of diet and trophic studies in ecology. However, significant variability in the trophic fractionation ($\Delta^{13}C$) of bulk tissue between diet and consumer has prompted a call for studies that examine the biochemical and physiological underpinnings of stable isotope ratios of specific tissues. We reared the mummichog (Fundulus heteroclitus) on four isotopically distinct diets to examine $\Delta^{13}C$ of bulk muscle and individual amino acids for a model fish species. Consumer muscle exhibited a range of diet-specific bulk $\Delta^{13}C$ values, with the plant diet treatment ($\Delta^{13}C$ = 3.0 ± 0.1‰) having significantly larger $\Delta^{13}C$ values than the animal diet treatments (1.0 ± 0.4‰). Modest bulk muscle $\Delta^{13}C$ values represented an averaging of large trophic fractionations for many non-essential amino acids (NEAAs) and little to no fractionation for most essential amino acids (EAAs). $\Delta^{13}C$ values of NEAAs from the animal diet treatments suggested a greater reliance on lipid-derived carbon for biosynthesis, while carbohydrates likely dominated the bulk carbon pool for NEAA biosynthesis in the plant diet treatment. NEAA $\Delta^{13}C$ values showed evidence of both biosynthesis and direct isotopic routing from dietary protein, providing significant insight into the metabolic processing of amino acids through the tricarboxylic acid cycle. EAAs are acquired directly from diet and have $\delta^{13}C$ values that reflect the dietary isotope signatures. EAA $\delta^{13}C$ values provide a promising way to determine carbon sources when reconstructing diets in studies of trophic dynamics.

1050 Storm Symposium, Pavilion West, Friday 24 July 2009

Brian K. McNabb

University of Florida, Gainesville, FL, United States

Resources and Energetics Determined Dinosaur Maximal Size

Some dinosaurs reached masses that were about 8 times those of the largest, ecologically equivalent terrestrial mammals. The factors most responsible for setting the maximal body size of vertebrates are resource quality and quantity, as modified by the mobility of the consumer, and the vertebrate's rate of energy expenditure. If the food intake of the largest herbivorous mammals defines the maximal rate at which plant resources can be consumed by an individual in terrestrial environments and if that limit applied to dinosaurs, then the large size of sauropods occurred because they expended energy in the field at rates extrapolated from those of varanid lizards, which are ca. 22% of the rates in mammals and 3.6 times the rates of other lizards of equal size. That is, of two species having the same energy income, the species that uses the most energy for mass-independent maintenance of necessity has the smaller body size. The presumptively low energy expenditures of dinosaurs permitted Mesozoic communities to support dinosaur biomasses that were about five times those found in mammalian herbivores in Africa today. The maximal size of predatory theropods was approximately 8 tons, which if it reflected the maximal capacity to consume vertebrates in terrestrial environments, corresponds in predatory mammals to a maximal mass less than a ton, which is what is observed. A preoccupation with the distinction between ectothermy and endothermy is inappropriate at the masses found in large dinosaurs because these states may be difficult to distinguish in resource-limited environments.

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984 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Tamara McPeek, Michelle Boone

Miami University, Oxford, OH, United States

Effects of Atrazine and Carbaryl on Spotted Salamander (*Ambystoma maculatum*) Embryo Hatching and Survival

Chemical contaminants, such as pesticides, are considered to be a great risk to amphibians, but their impact on salamander species is poorly understood. Atrazine is the second most commonly used herbicide in the U.S. agricultural market and carbaryl is the second most commonly used insecticide in the U.S. home and garden market. Pools that spotted salamanders (*Ambystoma maculatum*) rely upon for reproduction are being threatened by contamination with these pesticides. This study aims to determine how spotted salamander embryos are affected by atrazine and carbaryl. Ten spotted

salamander egg masses were collected in Oxford, Ohio. The jelly coat of the egg mass was removed, but the sac surrounding the embryo was left intact. Embryos were housed in beakers in 1.5L of dechlorinated water at a density of 5 embryos per beaker. We exposed half of the larvae to 0, 5, 50, or 500 μg/L of atrazine and the other half to 0, 20, 200, or 2000 μg/L of cabaryl. These concentrations represented a realistic exposure concentration in the environment. Salamanders' hatching success, time to hatching, and mass at hatching were monitored; additionally, we monitored the presence or absence of a symbiotic algae on the embryonic sac. We hypothesize that hatching success and mass at hatching will decrease in embryos that are exposed to pesticides and that time to hatching will increase in animals that are exposed. Understanding how pesticides may affect amphibians in the embryonic stage will help determine which amphibian life stage is at greatest risk to contaminants.

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222 Fish Ecology III, Pavilion West, Monday 27 July 2009

Mark McRae, Lori McRae

University of Tampa, Tampa, FL, United States

Coexistence of Kuhliid fishes in the Hawaiian Islands is Facilitated by Differences in Juvenile Habitat Use

Patterns of juvenile habitat use and selection by two species of Kuhliid fishes on the Island of Hawai'i were examined. These fishes, which are of considerable importance in Hawaii's recreational fishery, were recently split taxonomically. Their habitat use has not been previously studied, but Kuhliid species are often euryhaline. *Kuhlia xenura* were observed in freshwater streams, low-salinity estuaries, on reef flats, along rocky shorelines, and in tidepool habitats. *Kuhlia sandvicensis* only occurred in marine habitats. Principal components analysis indentified non-random microhabitat selection by juvenile *K. sandvicensis* only; juveniles selected microhabitats that were higher in temperature and salinity and nearer to the open ocean than were areas randomly available to them. *Kuhlia sandvicensis* also showed nonrandom microhabitat selection of relatively deep microhabitats with higher water velocities. Although the distributions of juvenile *K. sandvicensis* and *K. xenura* overlapped in marine habitats, the microhabitat use patterns of each species were distinct. Along rocky shorelines, *K. sandvicensis* used microhabitats that were characteristic of high energy surge zones - deep areas with high water velocities and high salinities. Conversely, *K. xenura* typically inhabited protected rocky shorelines with relatively low water velocity, shallower depths, and low salinities. A similar pattern was observed in tidepool habitats, with *K. sandvicensis* using microhabitats typical of surge zones, while *K. xenura* utilized protected tide pools located relatively long distances from crashing waves. Marked differences between the two species with respect to the habitats they utilize as juveniles likely facilitate their coexistence in Hawaii. The information presented highlights a variety of inshore habitats as important for the conservation of juvenile Hawaiian kuhliid fishes.

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678 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

John McVay, Bryan Carstens

Louisiana State University, Baton Rouge, LA, United States

Evaluating Methods of Estimating Species Trees: An Empirical Approach Using the Thamnophiini

Phylogeny is central to evolutionary biology, and an accurately estimated phylogeny is a crucial requirement for understanding the evolution of any clade, as well as for comparative studies to account for biases due to relatedness among taxa. Homoplasy due to convergence and reversal events can bias estimates of phylogeny, and thus comparative studies using these estimates. An example of a well-studied group whose phylogeny remains to be confidently resolved is the Thamnophiini, the North American garter snakes, water snakes, and their allies. Here, we present a novel estimate of phylogeny for the Thamnophiini, using several approaches that account for discordance among gene trees due to stochastic, coalescent processes, incorporating multiple unlinked nuclear loci. Results of this data are broadly concordant with current estimates, however some relational and taxonomical issues remain unresolved. Our estimation will ultimately benefit comparative analyses, and adds to the body of evidence that suggests widespread convergence and reversal in this taxonomic group.

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634 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Philip Medica, Kenneth Nussear, Todd Esque, Mary Saethre

US Geological Survey, Henderson, NV, United States

Long-term Growth and Natural History of a Population of Desert Tortoises (*Gopherus agassizii*) in Southern Nevada

We measured the growth of a cohort of 17 semi-wild desert tortoises (*Gopherus agassizii*) located in Rock Valley, Nevada over a 47 year period beginning in 1963. The tortoises were initially marked as hatchling and juvenile animals between 1963 and 1965 and ranged in size from 47 to 77 mm in plastron length. We assigned ages of 1-4 at initial capture based on their body size. These tortoises were recaptured, measured, and weighed approximately annually since their initial capture. Growth of male and female tortoises did not differ until animals began to reach sexual maturity (17-20 years of age). Annual tortoise growth was correlated with the production of ephemeral vegetation ($P < 0.01$) while accounting for size, sex and repeated measurements of the animals, and the interval between measurements. However, the production of annual plants was likewise

highly correlated (non-linearly) with "winter rainfall" (October-March) $R^2 = 0.92$, $P < 0.001$. Stochastic predation events over the past 5 years have decimated this cohort of tortoises. The tortoises suffered from mountain lion predation in 2003 and 2007 and smaller predators likely kit fox and/or coyotes preying upon individual tortoises during 2005. The average age of the long-term surviving tortoises from this cohort was 43 years with a range of 39-47 years. Twelve of the tortoises survived to the age of 39 years and 11 of the 12 reached 40 years at which time predation began to take a toll on the population.

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761 Herp Biogeography, Galleria North, Saturday 25 July 2009

Jesse Meik[1], A. Michelle Lawing[2], Andre Pires da Silva[1]

[1]The University of Texas at Arlington, Arlington, TX, United States, [2]Indiana University, Bloomington, IN, United States

Phenotypic Evolution in Insular Speckled Rattlesnakes (Viperidae: *Crotalus mitchellii)*

Populations of speckled rattlesnakes are known to occupy multiple islands off the coast of Baja California, Mexico. Two of these populations (Angel de la Guarda and El Muerto) have been recognized as subspecies based primarily on size divergence from putative mainland ancestral populations; however, a survey of morphological variation from other islands inhabited by these snakes has not previously been reported. We examined variation in body size, size-adjusted multivariate phenotype, and island physical parameters among two mainland clades and 12 island populations and demonstrate through partial set correlations that speckled rattlesnakes tend to dwarf as an inverse function of island area on islands smaller than approximately 20 km^2. Body size was not significantly related to measures of island isolation. Furthermore, divergence in size-adjusted multivariate phenotype was associated with divergence in body size rather than any of the island physical parameters. These results suggest that overall morphological divergence in insular speckled rattlesnakes with respect to putative mainland source clades resulted primarily from directional selection for body size evolution. With one exception (Isla Partida Sur), island populations were more similar in phenotype to their geographically most proximate mainland clade. Morphological divergence in this dwarfed population is best explained by convergence towards a similar morphospace with other dwarfed populations.

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403 Poster Session I, Exhibit Hall, Friday 24 July 2009

Manuel Mendoza-Carranza[1], Juan Carlos Pérez-Jimenez[2], Christian Carolina Hernández-Lazo[1], Iván Mendez-Loaeza[2]

[1]El Colegio de la Frontera Sur, Villahermosa, Tabasco, Mexico, [2]El Colegio de la Frontera Sur, Campeche, Campeche, Mexico

The San Pedro´s Artisanal Fishery: a Non Regulated Activity in a Shark Nursery Ground in Western Campeche Bank

Gulf of Mexico shallow waters, specially the Campeche Bank, seems to present optimal characteristics to function as nursery ground for several shark species. This area sustains the fishery activity of the artisanal fleet of San Pedro's Port in Tabasco State, composed by 150 fiberglass outboard motor vessels (8m long). The bottom long-line (500-3000 hooks) is the most common fishing gear. Monthly samplings, during 24 months, determinate that captures were composed by 13 shark species, 6 rays and 18 teleosts, from a 531 km^2 fishing area (10-50m depth range). All shark species were captured as neonates and/or juveniles (77% of all individuals sampled), most abundant juvenile were *Rhizoprionodon terraenovae* (65±10cm) and *Sphyrna lewini* (78±24cm), which account for the 76% of all juvenile sharks. Seven percent of the total sample were neonates of: *Carcharhinus falsiformis* (79±9cm), *C. leucas* (72±7cm), *C. limbatus* (66±7cm), *C. plumbeus* (65±3cm), *R. terraenovae* (36±0cm) and *S. lewini* (51±4cm). Twenty three percent of total sharks recorded were adults, S. tiburo (80±10cm) were the most abundant adult (72% of adults) with the 30% being pregnant females. The western Campeche Bank is a important nursery ground for sharks, and is necessary to intensify and extend the geographic area of sharks' research to generate information that support management programs.

1004 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Manuel Mendoza-Carranza[1], Edith Ramírez-Mosqueda[1], José Alfredo Hernández-López[1], Christian Carolina Hernández-Lazo[1], Juan Carlos Pérez-Jiménez[2]

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Does Southern Stingray *Dasyatis americana* Sustain the Artisanal Elasmobranch Fisheries in Western Campeche Bank?

The diminishment of shark volume captures has conducted to a crescent capture of less valuable commercial elasmobranch species like several rays species. This increases is reflected in official statistics. However, exist a scarce knowledge about fisheries,

population dynamics and biology of this species, which precludes the generation of management programs. In western Campeche bank, specifically in the San Pedro's port fleet, (composed by 150 fiberglass outboard motor vessels of 8m long) the stingray *Dasyatis americana* is the second in abundance among 18 teleost, 13 sharks and 3 ray species. *Dasyatis americana* CPUE (kg/100 hooks*hour) show no significant differences among depth range (5 to 50m). Seasonal *D. americana* CPUE variation was achieved, maximums was during February 2006 (3±1.3) and February 2007 (2.5±1.5). Adult Male:female proportion was 1:1.14. Males' size was from 30 to 60cm of disk width (DW) and the females were from 60 to 120cm DW. The size at maturity of males and females, estimated with maturity ogive, was 52 and 84cm DW respectively. Gravid females were scarce (7% of total). Sex proportion of embryos was 1:1, average size for males and females were 12±9 and 16±12cm DW respectively. No correlation was achieved among embryos size and ovocite diameter this can indicate an asynchrony reproductive cycle. The high relative abundance and frequency of *D. americana* in the captures of artisanal fisheries in Western Campeche Bank indicates an important distribution area of this species, due to this more research about fisheries biology and ecology is necessary.

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332 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Tricia Meredith, Stephen Kajiura

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Olfactory Thresholds of Elasmobranchs

The olfactory capabilities of elasmobranchs are legendary. Although elasmobranchs are reputed to demonstrate remarkable olfactory sensitivities, this is based on surprisingly little empirical evidence. Olfaction in elasmobranchs is thought to mediate several life history functions, such as prey localization. Amino acids are known to be particularly effective odorants for aquatic organisms; however, olfactory thresholds to these compounds have been assessed for only three species of elasmobranch using a limited number of amino acids. Literature values for amino acid thresholds in these species are approximately 10^{-6} to 10^{-8} M with neutral amino acids being particularly stimulatory, similar to the findings for teleosts. The objective of this study is to determine the amino acid olfactory thresholds of five phylogenetically diverse elasmobranch species (*Dasyatis sabina*, *Urobatis jamaicensis*, *Raja eglanteria*, *Negaprion brevirostris*, and *Sphyrna tiburo*) in order to develop a more representative picture of the olfactory sensitivity of elasmobranchs. The electro-olfactogram (EOG) technique was used to assay the thresholds of these species to twenty amino acids. Both the relative stimulatory effectiveness of the tested amino acids and their estimated thresholds (~10^{-7} to 10^{-9} M) for all five species were similar. These results indicate that elasmobranch species do not demonstrate greater olfactory sensitivity than teleost fishes.

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563 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Brian Metts[1], William Hopkins[2], Kurt Buhlmann[1], Brian Crawford[1]

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Effects of Coal Combustion Wastes on Larval Amphibians

Coal combustion wastes (CCW), by-products of burning coal for electricity, are laden with heavy metals and metalloids. One of the current disposal options for CCW consists of sluicing CCW into large aquatic settling basins. However, these wetlands may serve as ecological traps because amphibians may use them as breeding sites but reproduction may not result in successful recruitment of offspring. We used experimental mesocosms to examine the effects of CCW on the survival and growth of larval southern toads (*Bufo terrestris*). Mesocosms were established with sediments from two CCW contaminated sites and a non-contaminated reference site, and filled with well water. Toads were collected from the three sites and allowed to breed in plastic containers with fresh water. Eggs were then distributed into the mesocosms resulting in a 3X3 experimental design with four replicates (n=36 mesocoms). Larval toads were reared to metamorphosis and measured, weighed and examined for malformations. Survival to metamorphosis in each mesocosm was calculated and statistical comparisons among treatments were conducted for the dependent variables. Our study supports mounting evidence that these disposal systems pose significant ecological risks by attracting wildlife from surrounding areas.

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522 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

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First Use of Mobile Peer-to-Peer Network (MP2P) Technology on a Marine Animal

Mobile peer-to-peer (MP2P) technologies offer new opportunities for characterizing interactions between animals and retrieving data about these events. The key attribute distinguishing the MP2P approach from traditional biotelemetry is the exchange of information between individuals (peers) rather than exclusively and directly from individuals to a base station such as a tracking receiver. We equipped 4 Galapagos sharks (Carcharhinus galapagensis) with prototype MP2P technology (Vemco™ 'Business Card Tags' - BCTs) which used ultrasonic encoding to exchange unique identification codes between host animals during spatial encounters. During the

experiment, the island of Oahu was surrounded by an array of 24 stationary receivers (Vemco VR2Ws) capable of detecting both BCTs and conventional coded transmitters. Before the BCTs were deployed, 32 sharks (Galapagos, sandbar and tiger) were captured at the study site and equipped with conventional coded acoustic transmitters (Vemco V16). Thus the experimental design allowed BCT-equipped sharks to: (1) detect one another, (2) detect other sharks equipped with conventional transmitters, and (3) be detected by fixed receivers stationed around the island of Oahu. Two BCTs were recovered after 20 and 132 days at liberty respectively. Recovered BCTs had recorded 4,506 and 4,875 detections of 28 and 30 transmitter-equipped sharks each, and had detected all 3 other BCT-equipped sharks on multiple occasions. Integration of both mobile (V16 and BCT-equipped sharks) and fixed peers (VR2 receivers) provided greater insight into shark behavior than would have been derived independently from either method. This study represents the first use of MP2P technology on a marine animal.

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446 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Debra Miller[2], Matthew Gray[1], Sreekumari Rajeev[2], William Thompson[1], Alan Mathew[1]

[1]University of Tennessee, Knoxville, TN, United States, [2]University of Georgia, Tifton, GA, United States

Ominous Tadpoles: American Bullfrogs are Suitable Hosts of *Escherichia coli* O157:H7

Escherichia coli O157:H7 is a zoonotic pathogen that can be transmitted to humans through contaminated beef and vegetables. Amphibian larvae may function as a spill-over reservoir for *E. coli* O157:H7 in aquatic environments used by livestock. We tested whether American bullfrog (*Lithobates catesbeianus*) tadpoles could become naturally infected with *E. coli* O157:H7 via exposure to this pathogen in outdoor aquatic mesocosms. Cattle feces inoculated with *E. coli* O157:H7 (10^6 CFU g^{-1}) were added daily at environmentally relevant levels to mesocosms that included bullfrog tadpoles, and tadpoles were euthanized and tested for infection. After 7, 14 and 28 days of exposure, 23, 35 and 51% of tadpoles tested positive for *E. coli* O157:H7. Maximum likelihood estimates revealed a 12% linear increase in the predicted odds of infection with each consecutive week of continuous pathogen exposure. Further, we determined that survivability of *E. coli* O157:H7 in mesocosm water was minimal beyond 3 days, suggesting that tadpoles can become infected quickly after exposure. We also found that 25% of the tadpoles that metamorphosed prior to the end of the experiment tested positive for *E. coli* O157:H7, providing preliminary evidence that infected metamorphs may transport the pathogen overland during dispersal. Together, our results suggest that American bullfrog tadpoles, and perhaps other amphibian larvae, could serve as a spill-over reservoir for *E. coli* O157:H7. Given that ruminants are the primary reservoir

for this foodborne pathogen, we recommend that livestock are fenced when possible from water sources where amphibian larvae are present.

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998 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Kimberly Miller

Victoria University of Wellington, Wellington, New Zealand

Maintaining Genetic Diversity in Reintroduced Populations of Skinks and Tuatara

Translocation provides one of the most powerful tools for species conservation, but reintroduced populations are often founded by a small number of individuals and generally have low success rates. The loss of genetic diversity in a small reintroduced population may reduce the probability of establishment and persistence. Maximising genetic diversity is therefore central to the success of reintroduced populations. Using population modelling and empirical data from reintroduced populations of skinks and tuatara, I examined factors that influence inbreeding dynamics and the long-term maintenance of genetic diversity in translocated populations. The translocation of gravid females aided in increasing the effective population size after reintroduction. Models showed that supplementation reduced the loss of heterozygosity over ten generations in species with low reproductive output, but not for species with higher output. Harvesting from a reintroduced population for a second-order translocation accelerated the loss of heterozygosity in species with low intrinsic rates of population growth. Male reproductive skew also accelerated the loss of genetic diversity over ten generations, but the effect was only significant at small population size. These results improve translocation planning by offering guidelines for maximising genetic diversity in founder groups and managing populations to improve the long-term maintenance of diversity. For example, founder groups should be larger than 30 for reintroductions of species with low reproductive output, high mortality rates after release, and highly polygynous mating systems.

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797 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Melissa Miller, William Lutterschmidt

Department of Biological Sciences, Sam Houston State University, Huntsville, TX, United States

Comparative Skin Permeability in Two Sympatric and Congeneric Pitvipers: Does Physiology Influence Habitat Partitioning?

Evaporative water loss (EWL) is a limiting factor in habitat selection for many ectotherms. Numerous studies on reptiles demonstrate negative correlations between EWL and habitat aridity. Cutaneous water loss (CWL) is the primary component contributing to total EWL in many squamates, with epidermal lipids governing skin permeability and resulting CWL. Heterospecific studies have documented EWL in regard to habitat selection for many snake taxa. However, fewer studies have examined congeneric comparisons of EWL in relation to differences in habitat preference. We examined skin permeability through measures of CWL and skin lipid content in two sympatric congeners, the western cottonmouth (*Agkistrodon piscivorus leucostoma*) and the southern copperhead (*A. contortrix contortrix*). Though closely related, and widely sympatric throughout much of their distribution, *A. piscivorus* and *A. contortrix* are not syntopic (i.e. they utilize different microhabitats). A. piscivorus occupies primarily an aquatic microhabitat while *A. contortrix* is more terrestrial. CWL and lipid content were determined from shed epidermis from each species for statistical comparisons. Samples of shed epidermis were also taken from multiple regions along the dorsal and ventral integument to examine potential variation in skin permeability and lipid content among different regions along the body. Potential species-specific differences in CWL and lipid content will be discussed with how these physiological differences may influence species partitioning of microhabitat use.

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117 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Michael Miller

Ocean Research Institute, The University of Tokyo, Nakano, Tokyo, Japan

Perspectives on the Population Connectivity of Tropical Diadromous Fishes

Catadromous, anadromous, and amphidromous fishes are present in the tropics, but catadromy appears to be the dominant form of diadromy. These diadromous fishes include anguillid eels, mullets, shads, gobies, and kuhliids, and population genetic or pelagic larval duration studies on a few species of catadromous eels and amphidromous gobies provide some information about the possible connectivity of these fish

populations. The majority of anguillid eel species are found in tropical areas, and some species of tropical anguillids show much shorter spawning migrations than temperate species, and have multiple spawning areas and different populations. *Anguilla celebesensis* appears to have two spawning areas within its species range in the northern Indonesia region, and the most widely distributed anguillid eel, *Anguilla marmorata*, appears to have five or more populations or metapopulations across its species range in the Indo-Pacific region. Amphidromous gobies of the subfamily Sicydiinae are also found in tropical areas, with most species being endemic or having limited distributions, except for *Sicyopterus lagocephalus*, which is widely distributed across the Indo-Pacific and appears to have regional population structure. Both amphidromous gobies and tropical anguillids have marine larval durations of > 90 days, but the presence of endemic species or regional populations of these fishes indicate that their long larval durations do not always result in large-scale dispersal. More studies on the life histories and population structures of tropical diadromous fishes are needed to better understand the connectivity of these poorly known fishes.

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548 Poster Session I, Exhibit Hall, Friday 24 July 2009

Michael Miller, Katsumi Tsukamoto

Ocean Research Institute, The University of Tokyo, Nakano, Tokyo, Japan

Ecology of Anguilliform Leptocephali in the Western North Pacific Subtropical Gyre

Surveys for leptocephali have been conducted along the edge of the Kuroshio Current, which is the western boundary current of the western North Pacific subtropical gyre, in the Kuroshio Extension along the northern margin of the gyre, and within the gyre, that provide new information about the possible spawning areas and larval dispersal patterns of marine eels in the region. Many species of marine eels of the Congridae, Muraenidae, and Ophichthidae, and a few species of the Nettastomatidae and Synaphobranchidae were found to spawn near the edge of the outer shelf of the East China Sea near the western edge of the Kuroshio, and some of these leptocephali appear to be transported offshore into the Kuroshio Extension. Other congrids such as *Bathycongrus retrotinctus*, and *Ariosoma major*, appear to migrate to the east of the Kuroshio to spawn so their leptocephali can use the Kuroshio Extension recirculation gyre for a larval development area. The leptocephali of *Ariosoma major* reach large sizes > 200 mm and seem to also use the larger subtropical gyre for development, because their large-size leptocephali are consistently collected in the westward flowing North Equatorial Current where the Japanese eel, *Anguilla japonica*, and giant mottled eel, *Anguilla marmorata*, spawn. Countercurrents at higher latitudes within the gyre may also transport leptocephali offshore from the west. Future studies are needed to determine the extent to which some marine eels have evolved specific spawning locations and larval recruitment strategies based on the surface currents in the western North Pacific subtropical gyre.

855 Fish Behavior, Parlor ABC, Monday 27 July 2009

Carlos Mireles, Christopher Lowe

California State University Long Beach, Long Beach, CA, United States

Petroleum Platforms as Fisheries Habitat: Using Acoustic Telemetry to Investigate How Shallow Occurring Nearshore Reef Species Utilize Deep Offshore Petroleum Platforms in Southern California

In California, populations of nearshore reef fish inhabit shallow areas of deep offshore petroleum platforms. With platforms offering unique habitat that extends from the benthos to the surface, it is not known to what extent these relatively shallow occurring species utilize the continuous vertical habitat available to them. We used acoustic telemetry to monitor the depth utilization of four economically important fish species inhabiting one shallow (50 m) and one deep (225 m) platform located 12 km off the coast of Long Beach. Adult Cabezon (*Scorpaenichthys marmoratus*), California Sheephead (*Semicossyphus pulcher*), Grass Rockfish (*Sebastes rastrelliger*), and Kelp Rockfish (*Sebastes atrovirens*) were monitored for 1.5 years. Trends in depth distribution were similar on both platforms, with grass rockfish, and kelp rockfish preferring shallow depths (10-20 m) and cabezon preferring deeper regions (30-55 m). Sheephead displayed three distinct behavior patterns associated with movement from shallow (15-20 m) to deeper (30-55 m) areas. Cabezon and sheephead displayed seasonal shifts in depth preference between warm and cold periods. Cabezon primarily reside deep (40-188 m) and sheephead shallow (15-20 m) during summer periods, while displaying an overlapping depth distribution (30 m) during winter. Individuals tagged on the deeper platform did utilize depths greater than those available on the shallow platform; however, cabezon was the only species to utilize depths greater than 100 m. Based on these findings, patterns of depth distribution are species specific with species utilizing deeper habitat when it is available.

791 Snake Conservation, Pavilion West, Monday 27 July 2009

Milan Mitrovich[1], Jay Diffendorfer[2], Robert Fisher[1]

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Using Site Occupancy Models to Infer the Response of the Coachwhip (*Masticophis flagellum*) and Striped Racer (*M. lateralis*) to Land Use Change in Coastal Southern California

We used detection data from a regional, on-going reptile-monitoring program conducted by the U.S. Geological Survey to measure the effect of landscape connectivity, urbanization, and habitat composition on the probability of site occupancy and local extinction for the Coachwhip (*Masticophis flagellum*) and Striped Racer (*M. lateralis*) in coastal southern California. Likelihood-based occupancy models implemented in program PRESENCE indicated a differential response by the Coachwhip and Striped Racer to land use change, with Coachwhip populations showing a much greater sensitivity to the isolation and urbanization of sites. Striped Racer occupancy responded more strongly to habitat composition, favoring scrub dominated sites over more open habitats. Large differences in the recovered annual rates of local extinction and detectability between the two species likely explain much of the observed difference in sensitivity to the isolation of sites. Movement data on the Coachwhip and Striped Racer supports interpretation of the results, with the Coachwhip described as a wider-ranging species. Observed differences in habitat use and specificity are also supported by telemetry studies and corroborate existing knowledge of historical patterns of occurrence. Collectively, the results suggest widespread loss of the Coachwhip from the region. Preliminary genetic analyses show significant phylogenetic structure among local Coachwhip populations suggesting the regional decline of the species has important conservation implications.

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145 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Masaki Miya[1], Tetsuya Sado[1], Kenji Saitoh[2], Michael Doosey[7], Henry Bart, Jr.[7], Ignacio Doadrio[8], Yazdan Keivany[4], Jiwan Shrestha[5], Vachira Lheknim[9], Rafael Zardoya[8], Mutsumi Nishida[6], Richard Mayden[3]

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Cypriniformes Tree of Life: A Mitochondrial Phylogenomic Approach Based on 363 Sequences

Fishes of the order Cypriniformes are almost completely restricted to freshwaters and comprise over 3400 species placed in six families, each with poorly-defined subfamilies and/or tribes. After publication of the mitochondrial phylogenomic study by Saitoh et al. (2006) based on 53 sequences, we newly determined over 300 whole mitogenome sequences for cypriniforms and this study represents the second step towards resolution of the higher-level relationships of the clade based on more extensive taxon sampling from 355 cypriniforms (including phylogenetically enigmatic *Psilorhynchus*, *Ellopostoma* and *Paedocypris*). Unambiguously aligned, concatenated mitogenome sequences from 13 protein coding (11,286 bp), two rRNA (2198 bp) and 22 tRNA (1463 bp) genes were divided into five partitions (1st, 2nd, and 3rd codon positions, rRNA and tRNA), with the entire 3rd codon positions converted into R (purine) and Y (pyrimidine) to take into account only transversional changes. Phylogenetic analyses based on partitioned maximum likelihood method using RAxML 7.04 were conducted and the resultant phylogenies were largely congruent with previous findings in Saitoh et al. (2006), although the addition of 302 new sequences provided a much more detailed picture of cypriniform relationships even at the generic level. As for the most unusual taxa, *Psilorhynchus* is the sister group of the subfamily Cyprininae (sensu lato); *Ellopostoma* is closely related to the subfamily Balitorinae (not Nemacheilinae as previously thought); and *Paedocypris* occupied a position sister to all the remaining members of the family Cyprinidae (not a rasborin as previously demonstrated). Also *Sundadanio* represented a unique lineage, independent of other rasborin taxa.

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831 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Koji Mochida

Kyoto University, Kyoto, Japan

Phenotypic Mismatches Between Functionally Interrelated Aposematic Traits

Aposematism has been a focus of attention for biologists since the 1800's (Darwin 1887; Wallace 1889), but theories regarding its origin and maintenance remain controversial. Animals advertise their unprofitability to potential predators with conspicuous coloration, occasionally in combination with other aposematic traits. Theory posits that selection on such "functionally interrelated aposematic traits" promotes unidirectional evolution of them, resulting in an increase or decrease in the effectiveness of the signal, and it has been examined on macro- and microevolutionary scales. However, this prediction does not always fit what is observed in nature. In this study, I investigated aposematic coloration and behavior of the newt, *Cynops pyrrhogaster*, sampled from 44 sites ranging over 800 km of latitude. I demonstrated that newts on islands displayed more conspicuous aposematic signals, both morphologically and behaviorally, than those on the mainland. Also I found a mismatch of geographic variation between aposematic traits, namely, there was a latitudinal gradient only in coloration, but not in aposematic behavior. Aposematic coloration of newts at low latitude exhibited more conspicuous and distinctive differences between islands and the mainland than that at high latitude. Based on the analyses examining the effects of biotic and abiotic variables on variation in aposematic traits, I discuss the possibility that latitude-dependent abiotic variables might constrain the color expression but not behavioral trait, and that these variables might also influence the evolutionary response to predation pressure on coloration that increases the effectiveness of aposematic signals.

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830 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Shabnam Mohammadi, Krista McCoy, Alan Savitzky

Old Dominion University, Norfolk, VA, United States

A Comparison of Adrenal Glands in Toad-eating and Nontoad-eating Snakes

Toads are chemically defended by bufadienolides, cardiotonic steroids synthesized in their parotoid glands. When ingested by a predator, bufodienolides bind to Na+,K+-ATPase (NKA), disabling the sodium pump. Bufadienolides are lethal to most predators, including many snakes. However, several snake species are resistant to bufadienolides and readily consume toads. We hypothesize that toad-eating snakes possess modified adrenal glands that play a role in the snakes' resistance to bufadienolides. Adrenal glands produce steroids and catecholamines that play various roles in the control of NKA production and activity and thus are important for the

maintenance of heart rate and blood pressure. We therefore expect adrenal glands to play an important role in countering the negative effects of toads on toad-eating snakes. Indeed, the toad-eating specialist *Heterodon platirhinos* is known to possess enlarged adrenal glands. In this study, we used phylogenetically independent samples to investigate various aspects of adrenal morphology in snakes that primarily eat toads (bufophagus), facultatively consume toads, or do not eat toads (nonbufophagus). We compared adrenal size and histology of steroidogenic and catecholaminergic tissues among some of these species. Preliminary results suggest that bufophagous snakes possess enlarged adrenal glands relative to facultative toad-eaters and nonbufophagus snakes.

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631 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Brad Moon, Paul Hampton

University of Louisiana at Lafayette, Lafayette, LA, United States

Using Rattlesnake Shaker Muscles to Test How Long Tendons Affect the Energetic Cost of Contraction

In this project we are using the shaker muscles in the tails of western diamond-backed rattlesnakes (*Crotalus atrox*) to test the hypothesis that muscles with long have a lower energetic cost of contraction than muscles with short or no tendons. Muscles that have long tendons often shorten less than muscles with short tendons, which suggests that they have a lower cost of contraction. However, in most muscles it is difficult to separate the effects of fiber type and tendon length on contractile cost. Rattlesnake shaker muscles are good models for this study because they vary in tendon length along the tail but have a uniform fiber type, which provides a natural control that is lacking in typical muscles, and because the segments with long tendons shorten significantly less than segments lacking tendons, which suggests different contractile costs. By selectively denervating shaker muscles while measuring oxygen consumption, we can partition the cost of contraction between muscles that have long tendons and no tendons. Our early results indicate that (1) shaker muscles have metabolic rates that are high enough to allow selective paralysis without loss of metabolic signal strength, (2) denervation of the distal-most muscles segments does not alter the activation or contractile strains of more proximal, intact segments, and (3) the cost of contraction in segments with long tendons is lower than in segments without tendons. These results are probably representative of other fast muscles, which occur in diverse lineages of animals, as well as typical skeletal muscles.

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70 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Jennifer Moore[2], Charles Daugherty[1], Stephanie Godfrey[3], Nicola Nelson[1]

[1]Victoria University of Wellington, Wellington, New Zealand, [2]University of Alaska Southeast, Juneau, AK, United States, [3]Flinders University, Adelaide, Australia

Love on the Rocks: Seasonal Monogamy, Multiple Paternity, and Large-Male Advantage in Tuatara

Investigating the mating system of a population provides insight into the evolution of reproductive patterns, and can inform conservation management of threatened or endangered species. Combining behavioral and genetic data is necessary to fully understand the mating system and factors affecting male reproductive success, yet behavioral data are often difficult to collect for threatened species. We use behavioral data and paternity analyses to characterize the mating system of a high density population of a long-lived, ancient reptile (tuatara, *Sphenodon punctatus*) on Stephens Island, New Zealand. We further investigate the phenotypic traits (including body size, body condition, tail length, and ectoparasite load) that affect male reproductive success. Our behavioral data reflect a seasonally monogamous system with low levels of polyandry and polygyny that are consistent with male mate guarding. Male reproduction is highly skewed (only 25-30% of males are successful), and body size is the primary predictor of male reproductive success. Based on the genetic data, multiple paternity was found in only 8% of clutches, and paternity results showed monandrous clutches from socially polyandrous females. Our behavioral and genetic results revealed complexities in female mating patterns that support the potential for cryptic female choice or sperm competition. This warrants further experimental investigation into the mechanisms underlying reptile fertilization and the disparities between social and genetic polyandry in wild populations.

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977 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Johnny Moore[1], Dewayne Fox[1], Bradley Wetherbee[3], Camilla McCandless[4]

[1]Delaware State University, Dover, DE, United States, [3]University of Rhode Island, Kingston, RI, United States, [4]NOAA/National Marine Fisheries Service, Narragansett, RI, United States

Critical Habitat for Sand Tiger Sharks During their Summer Residency in Delaware Bay

The population of sand tiger sharks (*Carcharias taurus*) along the US East coast has declined over the past several decades and recovery of stocks is limited by low reproductive rates coupled with continued take as bycatch in various fisheries.

Identification of essential habitat is critical for enhanced recovery of sand tiger stocks. Delaware Bay is one of the most important areas used by this species on the US East coast. We have been using acoustic transmitters and an array of receivers in Delaware Bay to identify critical habitat of sand tigers during their Delaware Bay summer residency. We monitored the movements and habitat use of 69 sand tigers in the summers of 2006 - 2008. Males and females were segregated, with males more commonly found in the lower salinity middle portion of the bay and in shallower waters, whereas females were more common in deeper, higher salinity waters near the mouth of the bay. Habitat use varied between years with significantly shallower depths used in 2007 than in 2008. The importance of Delaware Bay as summer habitat for sand tigers is demonstrated by relatively high interannual site fidelity with 50% of sharks tagged in 2006 returning in 2007, and 60% tagged in 2007 detected in the bay the following summer of 2008. This study has been very successful in identifying habitat of high use within Delaware Bay and providing information for protection of discrete portions of the bay that are vital to the recovery of this imperiled species.

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707 Herp Conservation III, Grand Ballroom II, Monday 27 July 2009

Stanton Moore

U.S. Department of the Interior, Bureau of Reclamation, Denver, CO, United States

Movement Patterns, Home Range and Habitat Use of Western Spiny Softshells (*Apalone spinifera hartwegi*) in the Upper Missouri River, Montana

The disjunct population of Western Spiny Softshells (*Apalone spinifera hartwegi*) in the Upper Missouri River of Montana is separated from the nearest downstream populations by hundreds of miles. It is the most upstream population in the Missouri River and is listed as a Species of Concern in Montana due to its restricted range. For these reasons, movement patterns, home range, and habitat use were investigated between 2007 and 2009. Fourteen females and eight males were fitted with radio-transmitters and tracked from between one week and 20 months. Mean home range size for females did not differ from males and both varied widely in size. Turtles had significantly larger home ranges during the high water year (2008) than during the low water year (2007). Nesting was not documented for any tagged females. However, two female concentrations during the nesting season were documented in reaches characterized by a highly braided channel with slower moving/stillwater side channels and sandy/gravelly banks. Similarly, three hibernacula sites were used by ten of the 18 turtles located during the winter. These sites consisted of main-channel margins with slow to moderate flows and silt, sand, and/or gravel substrates. Suitable nesting and hibernacula sites are juxtaposed in our study area and it is unclear why several individuals made movements greater than 20 km during the study. Conservation of this relatively natural portion of the Missouri River is essential to the maintenance of this isolated population.

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123 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Alexia Morgan[1], Mike Allen[1], Enric Cortes[2], Colin Simpfendorfer[3], George Burgess[1], Jack Musick[4]

[1]University of Florida, Gainesville, FL, United States, [2]NOAA/NMFS, Panama City, FL, United States, [3]James Cook University, Townsville, Queensland, Australia, [4]Virginia Institute of Marine Science, Gloucester Point, VA, United States

Population Assessment of the Dusky Shark in the Northwestern Atlantic Ocean Using an Age Structured Model

The objectives of this study were to build an age-structured model to assess the effects of fishing on population trends for dusky shark. This model included sensitivity analyses to assess the effects of time/area closures, reduced mortality as a result of reduced soak times for the bottom longline fishery, full selectivity of age-zero animals, combined CPUE series for all catch rates and changes to other model parameters on overall population sizes. Results showed that the impacts of fishing already imposed on the dusky shark will be difficult to overcome even with the implementation of time/area closures, gear modifications and/or catch and discards being reduced for another 20 years. Results of the base case, all scenarios and sensitivity analyses indicated that the population of dusky sharks in the northwestern Atlantic Ocean is at 9 to 50% of virgin biomass. Recent publications have shown that the Maximum Sustainable Yield (MSY) for dusky sharks may be well above 50% of the carrying capacity. Fisheries managers must determine whether the high depletion rates reported in these models suggest this species is overfished, and would therefore require long-term targets for population recovery to sustainable levels.

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155 Fish Conservation I, Parlor ABC, Sunday 26 July 2009

Ray Morgan

UMCES_AL, Frostburg, MD, United States

Effects of Road Salt on Fish Assemblages in Maryland

Road salt usage ensures safe winter driving conditions on high traffic volume highways and secondary roads. However, there are often excessive and repetitive applications of road salt, depending on storm severity and frequency. I used the Maryland Biological Stream Survey (MBSS) data base to examine water quality collected during the MBSS Spring Index period and fish assemblage data from the MBSS Summer Index period for Maryland. Statistical analyses indicated that there are significant changes in fish

assemblages in first, second and third order streams, with simpler assemblages (2-3 tolerant fish species) present in streams with high chloride levels. The number of intolerant fish species declines significantly at chloride levels greater than 100 mg/L, along with decreases in fish assemblage diversity and the Maryland Fish Index of Biotic Integrity. Road salt is an important stressor to fish assemblages, and needs to be considered in conservation of intolerant Maryland fish species and stream biodiversity.

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893 Poster Session II, Exhibit Hall, Saturday 25 July 2009

James Morley[1], Jeffrey Buckel[1], Thomas Lankford[2]

[1]North Carolina State University, Raleigh, NC, United States, [2]University of North Carolina at Wilmington, Wilmington, NC, United States

Development and Tests of Predictive Models to Estimate Muscle and Liver Energy Content of Bluefish

The positive correlation between percent dry weight and energy density has been documented for many fish species, including bluefish (*Pomatomus saltatrix*). When processing larger fish, considerable effort can be saved if the energy content of the whole fish can be estimated from tissue samples. Both muscle and liver tissue are known to be important energy storage depots in bluefish. In this study we developed predictive models for bluefish between energy density in muscle tissue and percent dry weight ($\%M_D$), and total liver energy content and dry weight of whole livers (L_D). Soxhlet extraction was used to determine energy content of tissues dissected from 870 juvenile bluefish from three year-classes. Each year-class was sampled from the fall through the spring during its first winter. Six candidate models were fit to each year-class and tissue type. For muscle, a piecewise linear model provided the best fit for each year-class, with a mean breakpoint of $22.8\%M_D$. This piecewise relationship results from a shift in lipid:protein storage ratios at the breakpoint, indicated by a doubling of the slope value. For liver, an exponential model best described the relationship between energy content and L_D for each year-class. For both muscle and liver energy estimation, models without a year effect (pooled years) had more support than models with a year effect. Thus, these relationships are temporally consistent and can be used to predict energy content of bluefish from estimates of dry weight.

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896 Fish Ecology III, Pavilion West, Monday 27 July 2009

James Morley[1], Jeffrey Buckel[1], Thomas Lankford[2]

[1]North Carolina State University, Raleigh, NC, United States, [2]University of North Carolina at Wilmington, Wilmington, NC, United States

Seasonal Changes in Prey Abundance and Temperature Dependent Capture Success Affect Winter Feeding in Bluefish

Our previous work has shown that bluefish (*Pomatomus saltatrix*), under experimental conditions, exhibit a reduction in temperature specific consumption and growth rates during winter months. This suggests a physiological adaptation to poor feeding and growth conditions during winter. Here we examine if this seasonal adaptation is a result of decreased prey abundance and a reduction in capture success at low temperature. First, we examined spatial overlap between juvenile bluefish and their prey using trawl survey data off North Carolina from November – June. Moderate declines in prey abundance and increasing spatial variability of prey density were observed during winter. However, trawl specific gut fullness levels of bluefish showed only weak correlation with prey catch, suggesting bluefish are not prey limited. Second, we experimentally examined the effect of temperature on capture success of bluefish preying on bay anchovy. Twenty-minute feeding trials were conducted at five temperature treatments. Feeding trials were recorded using a two-camcorder set up that allowed us to quantify movement and location in three dimensions. The number of attacks by individual bluefish decreased at low temperature. Also, capture success of bluefish was reduced at low temperatures due to bluefish experiencing a greater decline in burst swimming speed. A reduction in the ability to find prey during winter, coupled with decreases in a predators ability to capture prey, both likely contribute to the seasonal adaptations in metabolic rate seen in fishes. This reduction in metabolic rate during winter leads to a reduction in consumption and feeding motivation.

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414 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Elvira Morote[1], M. Pilar Olivar[1], Leonardo Castro[2], Fernando Villate[3], Ibon Uriarte[3]

[1]Institut de Ciències del Mar (CSIC), Barcelona, Spain, [2]Universidad de Concepción, Concepción, Chile, [3]Universidad del País Vasco, Bilbao, Spain

Feeding ecology of Two Hake Larvae: *Merluccius merluccius* from NW Mediterranean and *Merluccius gayi* from Central Chile. Ontogeny versus Environmental Conditions

Trophic relationships and food habits of larvae of two species of Merluccidae were examined, *Merluccius merluccius* from the NW Mediterranean and *Merluccius gayi* from Central Chile, in two different environmental conditions: vertical stratification versus mixed period (NW Mediterranean) and upwelling versus reversal upwelling period (Central Chile). Examined larvae ranged from 2.5 to 8 mm Standard Length (SL). Both species have similar morphology characterized by big mouths and large looped-guts Mouth growth showed a positive allometry in relation to SL. Feeding incidence was very high in both species (>90%). The prey number was high, with a significant increase along growth and with differences between the periods in both ecosystems. Prey size increased also significantly along development, without differences between species periods. Both species start to feed on big preys (width size>150 μm) from first feeding, with the Mediterranean larvae predating on bigger preys than the Chilean ones. The dominant prey in Mediterranean hake larvae was adult female of *Clausocalanus* sp. (>75% of the copepods) followed by p-calanus and *Ctenocalanus* sp. in June and by *Paracalanus* sp.>*Centropages* sp.>Aetideidae> *Oncaea* sp.> p-calanus in November. On the other hand, the most important prey for the Chilean hake larvae was *Paracalanus* sp., although there were differences between the two periods, with a higher dominance of this prey in the diet of the larvae collected in March (80% of the copepods) whereas in November diet was more diversified (36% *Paracalanus* sp.>Calanidae>*Oithona* sp.>*Euterpina* sp.). Chesson index for prey selection was also analysed in each species.

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316 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Philip Motta[1], Michael Maslanka[2], Robert Hueter[3], Ray Davis[4], Rafael de la Parra[5], Samantha Mulvany[5], Maria Laura Habegger[5], James Strother[5], Kyle Mara[5], Jayne Gardiner[5], John Tyminski[5], Leslie Zeigler[5]

[1]University of South Florida, Tampa, FL, United States, [2]Georgia Aquarium, Atlanta, GA, United States, [3]Mote Marine Laboratory, Sarasota, FL, United States, [4]Comision Nacional de Areas Naturales Protegidas, Cancún, Quintana Roo, Mexico, [5]University of California, Irvine, CA, United States

Filter Feeding in the World's Largest Fish: Form, Function and Diet

Filter feeding is employed by the largest elasmobranchs. Among these the whale shark *Rhincodon typus*, utilizes ram and suction filter feeding. Archived satellite tag data and aerial observations indicate sharks ram filter feed near the surface approximately 7.5 hours per day in dense aggregations (4.5 g/m^3) of plankton off Quintana Roo, Mexico from May through September. With swimming speeds averaging 1.1 m/s, computational fluid dynamics indicates the effective flow rate into the partially submerged mouth is 0.99 m/s. Calculated filter rates, based on mouth morphometrics and swimming speeds, combined with plankton tows and energetic analysis of the plankton, estimate consumed biomass of 11 kg/day for a 476 cm TL shark, and 20 kg/day for a 631 cm shark, equating to an approximate intake of 3,565 and 6,464 kcal/day, respectively. These estimates are compared to dietary intake of captive whale sharks and the filter-feeding basking shark. The novel filtering apparatus of the whale shark consists of a series of twenty filtering pads that lie dorsally and ventrally on either side of the pharynx. These pads, which overlay and completely occlude the branchial arches, have a mesh with holes averaging 1.2 mm in diameter, considerably smaller than the majority of their prey. A mechanism of crossflow filtration whereby particles are entrained and passively transported posterior to the pads is proposed. After passing through the pads an elaborate system of channels directs water through what appear to be collimator vents, and over the gill lamellae before exiting the pharyngeal slits.

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851 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Krista Mougey[1], Gad Perry[1], Matthew Gifford[2], Clint Boal[3]

[1]Texas Tech University, Lubbock, TX, United States, [2]Univeristy of Minnesota, St. Paul, MN, United States, [3]USGS Texas Cooperative Fish and Wildlife Research Unit, Lubbock, TX, United States

Radio Transmitter Weight: Impacts on Home Range, Vertical Habitat Use, Body Condition, and Jumping Ability in Male Crested Anoles

Radio telemetry technology is used extensively in wildlife research, and it has traditionally been accepted that transmitters weighing up to 10% of an individual's weight can be used without appreciable negative impacts. However, this has rarely been tested. We conducted a study of male crested anoles to determine how additional weight from a faux transmitter impacted the anole's home range size, vertical habitat use, body condition, and jumping ability. Information on the location and vertical position of 33 males was recorded each time an individual was seen. In mid-study, individuals that had at least 10 resightings were caught, re-processed, and assigned to a weight treatment group that ranged from 0 to 20% of that individual's body weight. A second round of visual recaptures was then recorded. At the end of the study, lizards were caught and measured again, then each underwent five consecutive jump-distance tests from a standard height post. We did not find a difference in home range size or vertical habitat use. However, there was a significant decrease in body weight over the season for individuals carrying as little as an additional 5% of their body weight. Jump distance was also significantly decreased in weighted individuals. It has traditionally been accepted that transmitters weighing up to 10% of an individual reptile's body weight could be used without appreciable negative impacts to the normal behavior, physiology, reproduction, or locomotion of that organism. Our data suggest that the 10% standard rule may be inappropriate for some reptilian species.

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862 Poster Session I, Exhibit Hall, Friday 24 July 2009

Hendrik Mueller[1]

[1]Jena University, Department of Comparative Zoology and Evolutionary Biology, Jena, Germany, [2]Harvard University, Museum of Comparative Zoology, Cambridge, MA, United States

Egg Deposition and Embryonic Development in Plethodontid Salamanders

Plethodontid or lungless salamanders are the largest group of the Urodela and are unmatched not only in terms of species number but also for the diversity of

reproductive modes across the group. These range from paedomorphic species and species with a biphasic life history with long larval periods, to species with a very abbreviated larval stage, to direct developing species without a larval form. Recent research has further suggested that some species of *Desmognathus* have regained an aquatic larva from a direct developing ancestor. To gain a better understanding of the evolution of the different life history modes, the available information on egg deposition site was reviewed. Field collected embryonic material of various species representing several lineages, together with published information, further enabled an assessment of the state of development at hatching. While there is a strong correlation between developmental mode and degree of development at hatching in most plethodontids, *Desmognathus* deviates from this pattern in having externally well developed hatchlings in both direct developing species and species with larval development. Data on egg deposition site show a variable pattern when compared to life history mode in plethodontids. These findings are discussed in light of a potential regain of an aquatic larva in some species of *Desmognathus*.

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188 Poster Session I, Exhibit Hall, Friday 24 July 2009

Sarah Muffelman[1], Renee Collini[1], Frank Hernandez, Jr.[1], Keith Bayha[2], Sean Powers[3], William Graham[1]

[1]Dauphin Island Sea Lab, Dauphin Island, AL, United States, [2]University of California-Merced, Merced, CA, United States, [3]University of South Alabama, Mobile, AL, United States

Spatial and Temporal Distributions of Vermilion Snapper (*Rhomboplites aurorubens*) and Red Snapper (*Lutjanus campechanus*) Eggs and Larvae in the Northern Gulf of Mexico

Ichthyoplankton surveys can be used to infer the location and timing of adult fish spawning events. This information can be used by fisheries resource managers to assess the relative value of different spawning habitats and as fisheries-independent data for stock assessment models. Unfortunately, the identification of fish eggs and larvae of many species from the Gulf of Mexico remains problematic. Here we present preliminary results from a study utilizing frequent ichthyoplankton surveys combined with molecular techniques developed by us to identify the cross-shelf and vertical distribution patterns of red snapper (*Lutjanus campechanus*) and vermilion snapper (*Rhomboplites aurorubens*) eggs and larvae off the coast of Alabama (USA). Depth-discrete ichthyoplankton samples were collected during multiple cruises (n=13) in 2007 and 2008 (May-September) at three stations across the continental shelf representing a range of water depth and artificial habitat complexity. In addition, vertical net hauls were collected during cruises (n=10) in 2008 (May-September) at eighteen stations along the same transect line. Using a TaqMan multiplex Real-Time PCR assay, we were able to successfully identify red snapper and vermilion snapper eggs and early larval stages.

The relative abundance of red snapper and vermilion snapper eggs and larvae were compared with respect to their spatial (across the shelf) and temporal (date of collection) distributions. In addition, depth-discrete samples were analyzed to determine differences in larval fish and egg vertical distributions (e.g., center of mass) between the two species. The results from this study provide the first description of distributions for these previously unidentifiable stages.

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943 Herp Systematics, Pavilion West, Thursday 23 July 2009

Daniel Mulcahy[1], Brice Noonan[2], Travis Moss[1], Ted Townsend[3], Tod Reeder[3], Sarah Smith[4], Caitlin Kuczynski[4], John Wiens[4], Jack Sites, Jr.[1]

[1]Brigham Young University, Provo, UT, United States, [2]University of Mississippi, University, MS, United States, [3]San Diego State University, San Diego, CA, United States, [4]Stony Brook University, Stony Brook, NY, United States

Basal Relationships Among Squamate Reptiles Based on 25 Protein-coding Nuclear Loci

The 'Deep-Scaly' project is part of the NSF-funded Assembling the Tree of Life (AToL) program, intended to address higher-level phylogenetic relationships among squamate reptiles. Squamates include snakes, "lizards," and amphisbaenians, which are characterized by possessing hemipenes (paired copulatory organs), among many other synapomorphies. Traditional morphology-based hypotheses of squamates illustrate a progression of tongue evolution that place the Iguania, with a relatively fleshy tongue used for food gathering, as the sister taxon to all remaining squamates. This transition depicts the gekkotans evolved next, with partly chemoreceptive tongues, and finally the autarchoglossans, which include the scincomorphs and anguimorphs evolved snake-like tongues used primarily for chemoreception. Recent molecular analyses using mitochondrial and nuclear DNA sequence data place the Iguania in a more nested position, closer to snakes and anguimorphs. However, these analyses were based on few gene regions and small numbers of nucleotide characters. Here we present results of the Deep-Scaly project from 25 nuclear protein-coding loci, approximately 19kb in total, from 64 taxa representing the major clades of Squamata. Parsimony, likelihood, and Bayesian analyses largely agree the molecular studies. We also estimate dates of divergence for major clades of squamates with fossil-based calibrations using two commonly used methods (r8s and BEAST) based on our entire dataset. We then evaluate differences in these methods by comparing smaller iterations of our data (e.g., 5, 10, 15, and 20 loci) to the overall estimated dates of divergence.

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780 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Daniel Mulcahy[1], Tyler Williams[1], Joseph Mendelson III[2], Jack Sites[1]

[1]Brigham Young University, Provo, UT, United States, [2]Zoo Atlanta, Atlanta, GA, United States

Phylogenetic Relationships Among Mesoamerican Bufonids

Phylogenetic hypotheses among species can be important in helping to direct conservation efforts focused on protecting biodiversity. For instance, upland forests in Mesoamerica are becoming threatened because of increased human populations. Many species occur in these upland areas and are isolated from their closest relatives by lowland habitats. Toads offer a unique opportunity to study natural history, morphological variation, and biodiversity because they offer an array of chemical compounds which are used for defense and have a wide variety of reproductive and life history strategies. Amphibians are experiencing global declines in populations and species numbers, which are largely caused by the recent spread of a unique form of chytrid fungus. Therefore, understanding the evolutionary relationships of toads before they experience more declines should be a top conservation priority. In this study, we combine mitochondrial and nuclear sequence data with morphological data (39 characters) to conduct phylogenetic analyses for most species of Mesoamerican bufonids. We examine sequences from 46 individuals representing 34 species, including four South American species and one North American species as outgroups. We collected 3,757 bp of sequence data: 568 bp 16S, 933 bp 12S, and 675 bp cyt b (total 2,176 mtDNA characters). The nuclear data consists of 717 bp from the CXCR4 gene and 864 bp from the RAG1 gene (1,581 bp total nuclear). Our study will help us to answer evolutionary questions such as monophyly of the *valliceps* and *coccifer* groups, genetic diversity of the upland species, and an evolutionary framework for the entire group.

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971 Poster Session I, Exhibit Hall, Friday 24 July 2009

Cristopher Mull[1], Christopher Lowe[1], John O'Sullivan[2]

[1]California State University, Long Beach, CA, United States, [2]Monterey Bay Aquarium, Monterey Bay, CA, United States

Heavy Metals and Trace Elements in Juvenile White Sharks (*Carcharodon carcharias*) from the Southern California Bight

Evidence suggests that the white shark (*Carcharodon carcharias*) in the eastern north Pacific utilize the southern California bight (SCB) as a nursery ground. Due to the proximity of highly urbanized locations a large amount of anthropogenic contaminants are introduced to the system, and juvenile white sharks are potentially exposed to

relatively high levels of trace elements. To assess potential exposure levels, concentrations of 17 elements, including arsenic, selenium, cadmium and mercury were measured from the muscle and liver tissue of juvenile white sharks using inductively coupled plasma mass spectrometry (ICP-MS). Samples were collected from incidental mortalities of juvenile white sharks in the southern California gill net fishery. There was no significant difference in concentration of arsenic, selenium or cadmium between muscle and liver. Average mercury concentrations were significantly higher in muscle (2.74 ± 0.61 μg/g dry weight) than liver (0.42 ± 0.07 μg/g dry weight) ($p<0.05$). Dry weight concentrations of mercury and selenium are comparable to levels in adults of other shark species for which trace elements have been analyzed (Galeocerdo cuvier; Prionace glauca) and due to the young age of the sharks suggest a high level of dietary exposure or the potential for maternal offloading during reproduction.

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289 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Philip Munday

ARC Centre of Excellence for Coral Reef Studies, and School of Marine and Tropical Biology, James Cook University, Townsville, Australia

Ocean Temperature, Global Warming And Population Connectivity Of Tropical Marine Fishes

Tropical species are predicted to have narrower thermal tolerance limits and live closer to their thermal optimums than temperate species because they have evolved in a more thermally stable environment. Water temperature can affect a wide range of biological factors important to population connectivity, including: duration of the spawning season, reproductive effort, pelagic larval duration, larval growth rate, larval survival and behaviour. Therefore, we might expect that there will be differences in connectivity patterns between cold and warm water species. Narrower tolerance limits might also make tropical species more susceptible to increased sea surface temperatures from global warming. Here I update existing analyses of the relationships between temperature and life history traits of marine larvae to show that, in general, tropical species tend to have longer spawning seasons, faster larval growth and shorter pelagic durations than temperate species. Shorter larval duration should reduce the proportional mortality of cohorts of tropical larvae compared to temperate larvae, but higher energetic demands are expected to increase the risk of starvation. Therefore, the nett effects on larval survival are difficult to determine. I then present new experimental evidence that the reproductive and larval stages of some coral reef fishes are sensitive to small increases in water temperature and consequently that the connectivity of reef fish populations could be significantly affected by global warming.

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150 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009

Philip Munday, Jennifer Donelson, Danielle Dixson

ARC Centre of Excellence for Coral Reef Studies, and School of Marine and Tropical Biology, James Cook University, Townsville, Australia

Ocean Acidification Affects Larval Growth and Olfactory Discrimination of a Marine Fish

Almost nothing is known about how fishes will respond to the increased levels of dissolved CO_2 and reduced seawater pH that are predicted to occur over the coming century. We reared larvae of the orange clownfish, *Amphiprion percula*, in seawater simulating ocean acidification scenarios for the next 100-150 years. Elevated CO_2 and reduced pH had no detectable effect on embryonic duration, but did influenced the growth of larvae. By the time of settlement, larvae in reduced pH treatments were larger than larvae reared in control water, although the differences in size between treatments were smaller than variation among clutches. Larval clownfish reared in control seawater discriminated between a range of cues that could help them locate reef habitat and suitable settlement sites. This discriminatory ability was impaired in larvae reared in conditions simulating ocean acidification. Larvae became strongly attracted to olfactory stimuli they normally avoided when reared at pH7.8/1000ppm CO_2 and they no longer responded to any olfactory cues when reared at pH7.6/1600ppm CO_2. These results indicate that larval growth and development might not be adversely affected by ocean acidification, but that the disruption of larval sensory abilities could have profound effects on population replenishment and connectivity patterns of many marine species.

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76 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Bruce C. Mundy[1], Kathleen S. Cole[2], E. H. Chave[3], Robert B. Moffitt[1]

[1]*NOAA Pacific Islands Fisheries Science Center, Honolulu, HI, United States,*
[2]*University of Hawai`i at Manoa, Department of Zoology, Honolulu, HI,, United States,*
[3]*University of Hawai`i at Manoa, Hawai`i Undersea Research Laboratory, Honolulu, HI, United States*

Records of Deep-sea Spiny Eels from the Hawaiian Archipelago and Emperor Seamounts, Including a First Report of *Lipogenys gillii* (Notacanthidae: Albuliformes)

Deep-sea spiny eels (Notacanthidae) were previously reported from the Hawaiian Islands only in species lists, from collected specimens and submersible observations, but without detailed information to confirm their identity. We now provide the collection and observation data for those records. We report the first central Pacific specimen of

Lipogenys gillii, traditionally placed in the monotypic family Lipogenyidae, but more recently included in the Notacanthidae. The report of *Notacanthus abbotti* from the Hancock Seamounts north of Kure Atoll is confirmed. We reevaluate reports of *Notacanthus chemnitzi* and find those from submersible observations to be based on sightings of *L. gillii*. The identification of specimens of *N. chemnitzi* from Maui is discussed. The Hawaiian records of notacanthids are the only reports of the family from the Pacific tectonic plate. However, deep-sea fishes are poorly sampled elsewhere in the central Pacific, thus making it premature to speculate about the distribution of the family in this ocean.

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679 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Edward Murdy[1], Koichi Shibukawa[2]

[1]National Science Foundation, Arlington, VA, United States, [2]Nagao Natural Environment Foundation, Tokyo, Japan

A Review of the Genus *Taenioides* (Gobiidae: Amblyopinae)

The genus *Taenioides* is in need of revision. *Taenioides* is diagnosed amongst Gobiidae by the proximal radial of anterior second anal-fin pterygiophore being spatulate, which is equivalent to the Y-shaped, second anal-fin pterygiophore observed and reported from radiographs. *Taenioides* spp. have raised dermal ridges bearing sensory papillae on the head and body as well as barbels on the underside of the head arranged in several different patterns. Based primarily on barbel patterns and meristics, we recognize four species, two of which are wide ranging. *Taenioides anguillaris* and *T. gracilis* have overlapping distributions and are found from the east coast of Africa, throughout southeast Asia, to China and Japan. *Taenioides kentalleni* is known only from a single specimen collected from the east coast of Saudi Arabia whereas *T. purpurascens* is known from many localities in Australia and, possibly, the Philippines. The status of nominal species such as *T. buchanani, T. jacksoni, T. limicola, T. nigrimarginatus* and *T. sumatranus* will also be discussed.

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583 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Janice Muriel-Cunha

Museu de Zoologia da Universidade de São Paulo, São Paulo, SP, Brazil

Tales from the Underground Amazon: Diversity and Evolution of *Phreatobius* (Siluriformes, Ostariophysi)

Phreatobius is a peculiar genus of subterranean catfishes inhabiting hyporheic and phreatic ecosystems in the Amazon. A taxonomic revision of *Phreatobius* shows that at least seven species exist: *Phreatobius cisternarum*, *Phreatobius dracunculus*, *Phreatobius sanguijuela*, *Phreatobius* sp. "Anapixi", *Phreatobius* sp. "Jaú", *Phreatobius* sp. "Tarumanzinho", *Phreatobius* sp. "Viruá". An identification key based on morphological plus diagnostic molecular characters is provided. RAG-2 gene sequence were obtained from different species of *Phreatobius* and were combined with equivalent sequence from representatives of Heptapteridae, Pimelodidae and Pseudopimelodidae, plus several other siluriform families from the genebank. The total data set was analyzed by MP and resulted in 172 trees, with 5213 steps. The results strongly indicate that *Phreatobius* forms a monophyletic group (supported by 33 molecular synapomorphies) with Pseudopimelodidae and Pimelodidae plus *Conorhynchos*+Heptapteridae. Previous hypotheses indicating *Phreatobius* exclusively with Heptapteridae or any other individual siluriform family were not supported. Results suggest that *Phreatobius* be allocated in its own family, Phreatobiidae (already available at subfamilial level). A hypothesis of relationships within *Phreatobius* shows that *P. cisternarum* is sister-group of a clade composed of (*P.* sp. "Viruá" (*P. dracunculus* + *P.* sp. "Tarumanzinho")). Phylogenetic mapping shows that phreatic environment was invaded twice. The new species are the first vertebrates reported to inhabit the hyporheic zone, defined as an interstitial habitat bounded above by surface water in the river channel and by the groundwater below. The hyporheic and sedimentary aquifers habitats worldwide have just recently begun to be investigate, and is yielding unexpected biodiversity, until now only of invertebrate taxa.

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275 Poster Session I, Exhibit Hall, Friday 24 July 2009

Christopher Murray

Southeastern Louisiana University, Hammond, LA, United States

Can Reproductive Allometry Assess Population Marginality in Crocodilians? A Comparative Analysis of Gulf Coast American Alligator (*Alligator mississippiensis*) Populations

This project will assess the use of reproductive allometry to infer crocodilian population marginality based on conformation to advantageous life-history strategies. Does reproductive allometry vary between intraspecific populations? Does this variation reflect population marginality based on size, temporal exploitation, habitat fragmentation, and presence of social hierarchy? Which morphometric comparisons are accurate predictors of population marginality? In the proposed study reproductive allometry will be used comparatively among three populations of Alligator mississippiensis in both southeastern Texas and coastal Louisiana. This study will test the hypothesis that allometric correlations are strongest in core populations. If the allometric correlations are stronger in more core populations, than this methodology may be an effective way to comparatively analyze crocodilian populations (within all 23 species).

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324 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

David Mushet[1], Craig Stockwell[2], Ned Euliss, Jr.[1]

[1]U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, ND, United States, [2]North Dakota State University, Environmental and Conservation Science Program, Fargo, ND, United States

Complex Spatial Dynamics Maintain High Genetic Diversity in the Face of Climate Variation

Understanding spatial and temporal dynamics of amphibian metapopulations is critical to evaluating how species respond to anthropogenic as well as natural disturbance. In most amphibian metapopulation studies, the breeding pond is considered as the basic spatial unit used to delineate subpopulations of larger metapopulations. However, this "ponds-as-patches" view of metapopulations presents an oversimplification of spatial dynamics that can lead to a loss of focus on other ecosystem components critical to amphibian conservation and metapopulation dynamics. In an effort to better understand pitfalls associated with applying a "pond-as-patches" approach to amphibian metapopulations, we explored the genetic structure of the northern leopard frog (*Rana pipiens*) in an area of its range subjected to significant climate variation, the Prairie

Pothole Region (PPR) of the northern Great Plains. Under a classic "pond-as-patches" metapopulations approach, we expected to find low genetic diversity due to frequent extinction events associated with the periodic drying of wetlands during reoccurring droughts. Thus, we hypothesized that heterozygosity (H_E) for northern leopard frogs in the PPR would be low compared to regions with less dynamic climates. To test our hypothesis we collected genetic material from 40 leopard frogs at each of 12 wetlands in North Dakota. We used microsatellite markers to explore genetic structure within our study area. Contrary to the original hypothesis, we found high H_E in all breeding wetlands sampled compared to other regions of the species. We believe this resulted from a complex system of migration and gene dispersal inadequately represented using a "pond-as-patches" view of amphibian metapopulations.

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566 Plenary Session, Grand Ballrooms, Thursday 23 July 2009,

Henry Mushinsky, Earl McCoy

University of South Florida, Tampa., FL, United States

Science, Advocacy, and a Race to Extinction: The Tortoise and the Skink

Scientists who accept public funds to support their research have an obligation to share their findings with the public and to advocate the proper application of their findings to help solve problems. For example, Florida recently has placed significant restrictions on the harvesting and exportation of turtles largely in response to the efforts of a group of turtle biologists, who were able to convince regulators that the characteristic life history of turtles is not conducive to extensive harvesting. More personally, we have drawn upon our research experience with the Gopher Tortoise to aid the Florida Fish and Wildlife Conservation Commission in its efforts to uplist the species to threatened in Florida, and have leant our expertise with the Florida Sand Skink to design research specifically to help this threatened species recover. We use research on the Gopher Tortoise and Florida Sand Skink to illustrate how targeted research with the aim of helping species move away from the edge of the extinction vortex, and subsequent advocacy for the proper use of the results by regulatory agencies, need not compromise good science. We also use the case of URTD in the Gopher Tortoise to show how raw advocacy based on incomplete science can lead to unwanted results; in this case, to the deaths of thousands of individuals.

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121 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Erin Muths[1], David Pilliod[2], Rick Scherer[3], Paul Bartelt[4], P.S. Corn[5], Blake Hossack[5], Brad Lambert[6], Rebecca McCaffery[7], Christopher Gaughan[6]

[1]USGS - FORT, Fort Collins, CO, United States, [2]USGS - FRESC, Snake River Field Station, Boise, ID, United States, [3]Colorado State University, Fort Collins, CO, United States, [4]Waldorf College, Forest City, IA, United States, [5]USGS - NOROCK, Missoula, MT, United States, [6]Colorado Natural Heritage Program, Fort Collins, CO, United States, [7]University of Montana, Missoula, MT, United States

Survival with Disease: Toad Populations in the Rocky Mountains

Chytridiomycosis has played a role in the decline of many species of amphibians worldwide, but the degree to which it impacts demographic parameters has not been investigated thoroughly. We used capture-recapture data from three populations of boreal toads (*Bufo boreas*) in the Rocky Mountains, U.S.A. to examine a priori hypotheses about the effect of the amphibian chytrid fungus (*Batrachochytrium dendrobatidis*, *Bd*) on apparent survival probability (ϕ_i) and population growth (l_t). Probability of survival was lower (ϕ = 0.53 - 0.64) at the two sites where *Bd* was present relative to the site where the disease was not detected (ϕ = 0.77). We found that estimates of survival probability for individuals that tested positive for *Bd* were >20% lower than for individuals that tested negative but that *Bd* was not lethal to all toads. Although the average prevalence of *Bd* in diseased populations was 57%, these populations were declining by only about 5% per year over the 6 years of the study. These data provide evidence that *Bd* does not always cause rapid population declines, although they also suggest that *Bd* may act as an additional mortality factor in populations coexisting with the disease.

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413 ELHS/LFC Connectivity Symposium II, Galleria South, Friday 24 July 2009

Ivan Nagelkerken

Radboud University Nijmegen, Nijmegen, Netherlands

Intermediate Habitat Use by Post-Settlement Tropical Coastal Fishes

Some species of tropical coastal fishes use intermediate habitats located in estuaries and lagoons during their early juvenile life phase. Movement of larval and adult fish thus results in connectivity between near-shore nurseries and offshore adult habitats. The use of estuarine and lagoonal habitats by early juveniles purportedly lowers mortality and increases growth rates. Although the number of species adopting this strategy is relatively low compared to the complete species array of tropical coastal fishes, it often concerns species that occur in high densities. The exact degree to which intermediate habitats are used by tropical coastal fishes is difficult to quantify, as a result of factors

such as (i) few quantitative studies focusing on the life phase directly following settlement, (ii) variation in definition of habitats, (iii) a predominant focus on Caribbean fish species, (iv) confounding effects of shelf size, variation in (a)biotic variables, seascape configuration, and island vs. mainland setting, (v) the possibly independent effect of estuarine dependence, and (vi) differences in methodologies, approaches and research questions among studies. This has led to different results and perspectives regarding habitat connectivity. These issues make a comparison with other temperature-defined zones more challenging. Intermediate habitat use by tropical fishes will be evaluated in the light of these problems. Aspects of temperature-related effects on habitat use by fish in the wider tropical zone are discussed.

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334 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Shin Nakayama, Alfredo Ojanguren, Lee Fuiman

The University of Texas at Austin, Port Aransas, TX, United States

Habitat Competition Among Young Red Drum

The extended reproductive season of red drum creates a varying size structure of conspecific larvae in nursery habitats during the spawning season. Size variability in nursery habitats is small when the first cohort settles, but it increases as successive cohorts arrive. We hypothesized that: (1) new settlers may not be able to occupy preferred habitats because earlier arriving and larger conspecifics (occupants) out-compete them; (2) the magnitude aggressive interactions explains the resulting habitat choice, and (3) the presence of food in the preferred habitat alters habitat utilization of new settlers as a result of a trade-off between food and aggressive interactions with occupants. We tested these hypotheses in experiments, using the preference of red drum larvae for a well-lit habitat. We placed a small fish (about 8 mm SL) into a wide tank with a horizontal light gradient alone or with either a small or a big (about 17 mm) fish, and recorded the position of the focal fish, behavioral interactions between the two fish, and the distance of any escapes resulting from aggression. After adding a small amount of food to the light area of the tank, we made the same observations. We tested whether the size of conspecifics explains the number of aggressive interactions and the escape distance, which would explain why small fish change their habitats in the presence of big fish.

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331 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Shin Nakayama[1], Kenneth Rose[2], Lee Fuiman[1]

[1]The University of Texas at Austin, Port Aransas, TX, United States, [2]Louisiana State University, Baton Rouge, LA, United States

Intraspecific Competition among Early Life Stages and the Optimal Spawning Strategy of Red Drum

Competition has received little attention in studies of early life stages, yet recent laboratory experiments demonstrate significant potential for interference competition among larvae. When competition among early life stages affects their survival, parental reproductive traits that reduce temporal and spatial overlap among early life stages should be favored. We used an individual-based based model to investigate the optimal spawning interval and batch fecundity for a fractional spawning fish (red drum, *Sciaenops ocellatus*) at different magnitudes of interference competition among early life stages. The model simulated the spawning of individual females and the subsequent hourly growth, mortality, and movement of their offspring on a 100 x 100 spatial grid of habitat cells that differed in prey abundance and predation pressure. Each female was assigned a spawning interval and number of batches, and super-individuals were used to represent each batch of eggs. Pelagic larvae developed based on temperature, and post-settlement fish were followed hourly through feeding, growth, mortality, and movement. Feeding was based on individuals selecting between copepods and mysids. Laboratory experiments quantified the size-specific effects of competition on search volume. Competition was modeled as a function of the density and sizes of fish in the same cell and resulted in reduced search volume, and thus reduced feeding and growth rate. Individuals then moved to the cell within a neighborhood of cells that offered the highest growth to mortality ratio. We simulated the survival of individuals to 25 mm under different combinations of spawning traits and degrees of interference competition.

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232 Storm Symposium, Pavilion West, Friday 24 July 2009

Richard Nauman

National Center for Conservation Science and Policy, Ashland, OR, United States

Conservation of the *Plethodon stormi* complex: Management in a Changing Climate

Plethodon stormi and *P. asupak* are two endemic species found in small portions of the Rogue and Klamath River watersheds in Northern California and Southern Oregon.

These species, particularly *P. asupak*, exist under relatively dry conditions and appear vulnerable to the effects of timber harvest and climate change. Management of these species has been controversial. A petition for listing both species under the Endangered Species Act was considered not warranted by the US Fish and Wildlife Service. Both species are considered Threatened by the State of California although attempts to remove protection under the California Endangered Species Act have been initiated by the California Department of Fish and Game. Federal agencies have created a Conservation Strategy for the northern portion of the range of *P. stormi* that identifies high priority sites for conservation and prescribes management for these sites. Currently, *P. asupak* may be at risk due to proposed timber harvest on private lands. We are using data developed by the Intergovernmental Panel on Climate Change to asses the impacts of a changing climate of the persistence of these unique species. We plan on integrating these data with geographically explicit models of species distribution and habitat to guide management in a changing climate.

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356 Herp Conservation II, Grand Ballroom II, Monday 27 July 2009

Nicola Nelson, Susan Keall, Charles Daugherty

Victoria University of Wellington, Wellington, New Zealand

Threatened Long-lived Species with TSD will rely on Management to Cope with Global Warming

Global warming may result in biased hatchling sex ratios for reptiles with temperature-dependent sex determination (TSD), with consequences for long-term population viability. However, negative impacts of global warming are not assured. Species with wide geographic ranges may exhibit local adaptations e.g. genetic variability in pivotal temperatures, different temperature ranges across which eggs hatch successfully, and/or exhibit behavioural responses to environmental signals e.g. nesting in open or shaded locations, allowing responsiveness to changing circumstances. In addition, reptiles thrived and diversified during warmer climates in the past. We investigated the effect of temperature on sex ratios of tuatara (*Sphenodon*), a lineage which emerged about 230 million years ago. Once widespread, tuatara are now limited to 38 offshore islands of New Zealand, with 9 of these populations resulting from repatriation efforts. Tuatara exhibit a rare form of TSD, where males result from incubation temperatures above 21.7°C, with 1°C separating production of 100% females from 100% males. The pivotal temperature does not appear to vary with latitude. Sex determination in tuatara takes place within the first third of embryonic development, when environmental temperatures are hottest. Warm years produce a male-bias in hatchlings, but hatchling sex ratios vary among rookeries. Long-term viability of tuatara is likely to be limited by habitat constraints within their current distribution and their k-selected life history characteristics with respect to the speed of global warming. Management techniques, for example, translocations, will be needed to increase the opportunities for threatened long-lived reptiles with TSD.

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116 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009; ELHS SALLY RICHARDSON AWARD

Philipp Neubauer[1], Jeffrey Shima[1], Steven Swearer[2]

[1]Victoria University of Wellington, Wellington, New Zealand, [2]University of Melbourne, Melbourne, Australia

Sources and Patterns of Variation in Natal Otolith Trace Element Signatures: Experimental Insights and Statistical Considerations

Trace element signatures recorded within the cores of otoliths that form during egg and larval development may characterize natal populations of reef fish, enabling researchers to trace larvae, settlers and adults back to their natal habitat. While this approach holds great promise, environmentally influenced signatures need to vary over appropriate spatial scales and remain relatively consistent through time if they are to be robust indicators of natal populations over useful time- and spatial scales. Furthermore, maternal effects on trace element composition may overlap with environmental signatures of natal locations, complicating inference on putative larval source populations. Here I report on spatial and temporal variability in otolith signatures of the common Triplefin (*Forsterygion lapillum*) in the Cook Strait Region of New Zealand. Statistical issues are examined and a few remedies such as optimal scaling and improved linear discriminant analysis are discussed. I further present experiments evaluating the relative importance of environmental vs. maternal influences on natal otolith chemistry. A better understanding of the mechanisms that underlie trace element signatures may enable us to track dispersal in a marine fish metapopulation, and evaluate patterns of connectivity among local populations including those within several no-take marine reserves in the Cook Strait region.

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322 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD I, Galleria North, Sunday 26 July 2009

Lorin Neuman-Lee[1], Fredric Janzen[2]

[1]Eastern Illinois University, Charleston, IL, United States, [2]Iowa State University, Ames, IA, United States

Examining the Effects of Atrazine on Embryos of Turtles from Two Deeply Divergent Cryptodiran Families (Emydidae and Trionychidae)

The effects of atrazine and similar endocrine disrupting chemicals are being examined extensively in several taxa, but the impact on reptiles is still poorly understood. How

this common herbicide affects organisms with a common ancestry but different adaptive strategies is still an enigma. To elucidate this relationship, we chose representative turtle species from the Family Emydidae (*Graptemys pseudogeographica*) and the Family Trionychidae (*Apalone mutica*) that occur sympatrically and utilize the same riverine habitat, nesting beaches, and food sources. Despite their similarities, these two taxa have developed highly divergent physiologies and morphologies. For example, *Apalone mutica* have a semi-permeable cartilaginous carapace and the eggs are rigid-shelled. *Graptemys pseudogeographica*, in contrast, have a bony carapace and produce highly-permeable eggs. These factors may influence how chemicals, such as atrazine, impact the development of embryos. We harvested eggs from both species and randomly placed them into one of four treatment groups (control, 0.1ppb, 10.0ppb, 100.0ppb). The eggs were treated with atrazine once within the first 7 days after oviposition and allowed to develop and hatch. Incubation length, morphometric measurements of body size, and gonadal sex were determined for each individual to assess the impact that atrazine has on these two distinct turtle families.

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359 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Lorin Neuman-Lee[1], Jeramie Strickland[2], Shannon Thol[2], Fredric Janzen[2]

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Planting a TREE: Exposing High School Students to Ecological Research with Reptiles

There is a serious dearth of female and minority representation in the sciences. To help remedy this problem, we carefully developed a program called TREE (Turtle Camp Research and Education in Ecology). We seeded the program with high school (HS) students from rural Iowa and Illinois, as well as Des Moines and Chicago, along with undergraduate and graduate student mentors from four different institutions, comprising an economically and racially diverse group. Participants converged at a field site known as "Turtle Camp" in June of 2007, 2008, and 2009 (totaling 17 HS students, 8 undergraduate students, 6 graduate students, and 2 post doctorates over the three years). At Turtle Camp, all students worked toward four main goals: research experience, education, local outreach, and mentoring. The program utilized the extensive local diversity in reptiles (8 species of turtles, 7 species of snakes, 1 species of lizard) to allow students to receive hands-on experience with research. Reptiles present variety of model organisms for achieving these four goals given their abundance, ease of capture and handling, human familiarity with them, and generally passive dispositions. Students gained a meaningful experience in all four of our target areas by working with these organisms. Overall, TREE provides an excellent environment for advancing interest in, and knowledge of, science and for positively influencing career plans of the participants.

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239 Poster Session I, Exhibit Hall, Friday 24 July 2009

Kirsten Nicholson

Central Michigan University, Mt. Pleasant, MI, United States

Endemic and Esoteric Pacific Island Anole, *Anolis medemi*

Gorgona Island is home to five species of anoles, one of which is the endemic *Anolis medemi*, about which nearly nothing is known. The island is approximately 54 km off the coast of Colombia, comprises an area of 26 km^2 with a maximum elevation of 338 m near its center. It is nearly uninhabited except for a very small field station and crew present year round, and is well-protected by the government. *Anolis medemi* is very common on the island and occupies microhabitats low to the ground and is often found in the typical head-down perching posture on tree trunks. The relationship of this species to other anoles is unknown, although the original species description placed it within the *Norops* clade. Here we report on the phylogenetic placement of the species and discuss the implications of our results to its biogeography. It appears that *A. medemi* is a close relative of *A. fuscoauratus*, a wide-spread South American species, and common in Colombia. In addition, *A. fuscoauratus* and *A. medemi* seem to occupy similar microhabitats. The island is believed to have shared an arial connection with the mainland so it is highly likely ancestral *A. fuscoauratus* individuals dispersed to the island before the land connection was lost and subsequently speciated.

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711 Herp Development & Morphology, Galleria North, Sunday 26 July 2009

Philip Nicodemo, Harvey Lillywhite

University of Florida, Gainesville, FL, United States

Ontogenetic Shifts of Heart Position in Snakes

Heart position relative to body length varies among snakes, with anterior hearts in arboreal species and relatively more mid-body hearts in aquatic or strictly ground-dwelling species. Thus, heart position correlates with gravity stress on blood circulation, which increases with the absolute length of a vertical blood column above the heart. Anterior hearts decrease the cardiac work associated with cranial blood flow during head-up climbing. Here we investigate the question of whether heart position shifts during ontogenic increases in body length. Insular cottonmouth snakes, *Agkistrodon piscivorus*, are entirely ground-dwelling, with adults ≥ 75 cm total length having a mean heart position that is 32.1 (± 0.13 SE) % of total body length from the head. In contrast, arboreal rat snakes, *Pantherophis obsoleta*, of similar lengths have a mean heart position that is 17.3 (± 0.12 SE) % of total body length from the head. In both

species, heart position shifts cranially during ontogeny, but relatively moreso in *Elaphe* than in *Agkistrodon*. Using a large data set of morphometric measurements available for *Agkistrodon* (N = 188 individuals, 23-155 cm total length), we demonstrate there is an anterior ontogenetic shift of the heart (= 4.56% trunk length) when elongation is corrected for both head and tail allometry. Tail length exhibits near-isometry whereas head length exhibits negative allometry. These data suggest that ontogenetic changes of heart position are likely attributable to normal growth processes of the body cavity and organs, but with presumptive selection for greater displacement in the arboreal species.

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541 Herp Biogeography, Galleria North, Saturday 25 July 2009

Stuart Nielsen[1], Aaron Bauer[2], Todd Jackman[2], Brice Noonan[1]

[1]University of Mississippi, University, MS, United States, [2]Villanova University, Villanova, PA, United States

Something Old in New Zealand: Dating Suggests Possible Gondwanan Connections for New Zealand's Endemic Geckos

The long-standing debate concerning the origin and age of diversification of New Zealand's reptiles has recently experienced a renaissance with the advent of sophisticated dating algorithms. Geological evidence suggests that the largely submerged subcontinent Zealandia, which includes New Zealand (NZ), separated from Gondwana approximately 80 MYA. Although some of NZ's biota represents remnants of a pan-Gondwanan fauna, most lineages appear to be the result of recent dispersal/colonization. Among NZ's three reptile clades – sphenodontids, scincids and diplodactylid geckos, dating analyses of only the two former taxa have been addressed in any detail. Sphenodontids have an extensive fossil record outside of NZ, suggesting diversification during the Cretaceous. Numerous recent analyses of NZ's skink fauna suggest colonization from New Caledonia (NC) during the early Miocene, with diversification of the modern lineages between the late Miocene to early Pliocene. Using a combination of nuclear (RAG1 and Phosducin) and mitochondrial (ND2 and 16S) markers, we performed phylogenetic analyses to estimate relationships among diplodactylid geckos of NZ, NC and Australia. Using the well-resolved phylogeny, we performed multiple BEAST runs, based on three independent calibrations (two fossil and one geological event), and found that divergences both between and within clades range widely in their relative ages. The earliest cladogenesis within NZ geckos appears to be mid-Tertiary in age and may post-date the Oligocene marine transgression, but relationships of the NZ clade as a whole to its closest relatives in Australia and NC may reflect Gondwanan connections.

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671 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Matthew L. Niemiller[1], Michael S. Osbourn[5], John R. Holsinger[4], Thomas K. Pauley[3], Dante B. Fenolio[6], Brian T. Miller[2]

[1]University of Tennessee, Knoxville, TN, United States, [2]Middle Tennessee State University, Murfreesboro, TN, United States, [3]Marshall University, Huntington, WV, United States, [4]Old Dominion University, Norfolk, VA, United States, [5]University of Missouri, Columbia, MO, United States, [6]Atlanta Botanical Garden, Atlanta, GA, United States

Status and Relative Abundance of the West Virginia Spring Salamander (*Gyrinophilus subterraneus*) from General Davis Cave, Greenbrier Co., West Virginia

The West Virginia Spring Salamander (*Gyrinophilus subterraneus*) is one of four obligate, cave-dwelling species of plethodontid salamanders found east of the Mississippi River in the United States. Unlike the other three species, *G. subterraneus* is not neotenic and readily undergoes metamorphosis, albeit at an exceptionally large size (up to 95 mm SVL). Additionally, it is endemic to a single cave system, General Davis Cave, in the Appalachian Valley and Ridge karst region in Greenbrier Co., West Virginia, where it is syntopic with the closely-related Spring Salamander (*G. porphyriticus*). Although not in immediate danger of extinction, the West Virginia Spring Salamander is of critical conservation concern because of its restricted distribution and threats to the cave system it resides in. Accordingly, *G. subterraneus* is listed as "Critically Imperiled" by NatureServe and "Endangered" by IUCN. Because of its conservation status and lack of data regarding the ecology and life history, particularly about population size trends, we present data on relative abundance, habitat use, and diet over a 33-year period for *G. subterraneus* from 1975–2008. Specifically we address (1) stability of the population over the last 33 years, (2) variation in habitat use by life stage (larva and adult) and between species (*G. subterraneus* and *G. porphyriticus*), (3) plausibility of neoteny in *G. subterraneus*, and (4) characterization of diet.

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754 Poster Session I, Exhibit Hall, Friday 24 July 2009

Anthony Nowacki[1], Tiffany Doan[1], Natalie Weir[2], Darlene Rodriguez[1], Olutayo Sogunro[3]

[1]Central Connecticut State University, New Britain, CT, United States, [2]Carnegie Mellon University, Pittsburgh, PA, United States, [3]Edward Via Virginia College of Osteopathic Medicine, Blacksburg, VA, United States

An Analysis of Anuran Abundance in Relation to Water Proximity at Lago Sachavacayoc, Peru

Because anurans are highly dependent on water for respiration and reproduction, they may use microhabitats in proximity to standing water preferentially to other microhabitats. We examined the anuran assemblage of Sachavacayoc, Peru to test whether lake proximity, distance to trees, temperature, and humidity influenced anuran abundance and diversity in a rainforest habitat. We conducted quadrat searches of paired-plots at the shore of a lake and 25 m distant from the lake's shore. Abundance of anurans and of *Leptodactylus andreae* were significantly higher in the lake shore quadrats. Temperatures at capture sites in the water quadrats were significantly higher; frogs were significantly closer to trees in the away from water quadrats. Humidities at points of capture did not differ significantly with quadrat position. Most of the anuran species found in the water quadrats depend on standing water for reproduction. However, *Leptodactylus andreae* is a terrestrial nester and had not previously been recorded as using a lakeshore microhabitat. We hypothesize that the extreme lack of rain experienced during the time period preceding and during the study caused *L. andreae* to shift its microhabitat to a more humid area to prevent dehydration. Additional studies that examine the fine scale spacing in relation to large water bodies will shed more light on this phenomenon.

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843 Storm Symposium, Pavilion West, Friday 24 July 2009

Ronald Nussbaum

University of Michigan, Ann Arbor, United States

Post-hatching Maternal Care in Caecilians: Maternal Dermatophagy in *Boulengerula taitanus* of Eastern Equatorial Africa

Although the growth and development of most multicellular animals depends on the provision of yolk, there are many varied contrivances by which animals provide additional or alternative investment in their offspring. Providing offspring with additional nutrition should be favoured by Natural Selection when the consequent increased fitness of the young offsets any compensatory reduction in fecundity.

Alternative forms of nutrition may allow parents to delay and potentially redirect their investment. Here I summarize the results of studies of a remarkable form of parental care in a caecilian amphibian. *Boulengerula taitanus* from eastern Equatorial Africa is a direct developing, oviparous caecilian, the skin of which is transformed in brooding females to provide a rich supply of nutrients for the developing offspring. Young animals are equipped with a specialised dentition, which they use to peel and eat the outer layer of their mother's modified skin. This novel form of parental care provides a plausible intermediate stage in the evolution of viviparity in caecilians. The specialised dentition of skin-feeding (dermatophagous) caecilians constitutes a preadaptation to the foetal feeding on the oviduct lining of viviparous caecilians.

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745 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Jamie Oaks

University of Kansas, Lawrence, KS, United States

Objective Partition Choice and the Phylogenetic Systematics and Biogeography of the True Crocodiles

Crocodylian systematics has been dominated by investigations of higher-level relationships aimed at resolving the disparity between morphological and molecular data, especially regarding the phylogenetic placement of the true gharial (*Gavialis*). Consequently, no studies to date have provided adequate resolution of the interspecific relationships within the most broadly distributed and species-rich crocodylian genus, *Crocodylus*. The true crocodiles (*Crocodylus*) have traditionally been viewed as an ancient group of species derived from Africa whose circumtropical distribution was the result of vicariance during continental breakup, although newer data have suggested a more recent, dispersal-mediated history. In this study, partitioned phylogenetic analyses were performed on a DNA alignment of 10 loci (7,282 bases) from 79 individuals representing all 23 crocodylian species. The dataset was analyzed under a suite of objective and subjective partitioning strategies to investigate the modeling effects of a priori partition choice in phylogenetics. A robust phylogeny of all extant crocodylians was reconstructed and used to estimate ancestral distributions and divergence times, testing the hypotheses that the most recent common ancestor (MRCA) of *Crocodylus* predated continental breakup and was from Africa. The results reject both hypotheses and demonstrate that the true crocodiles originated from a MRCA in the tropics of the Serravallian Indo-Pacific and rapidly radiated and dispersed around the globe during a period marked by mass extinctions of fellow crocodylians. The results also reveal more diversity within the genus than recognized by current taxonomy, and demonstrate that a priori partitioned models perform poorly in comparison with partitions estimated from the data.

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19 Poster Session III, Exhibit Hall, Sunday 26 July 2009

María Ocasio-Torres, Raisa Hernández, Tagrid Ruiz, Edwin Hernández-Delgado

University of Puerto Rico, Río Piedras, Puerto Rico

Ecological Impacts of the 2006 Post-bleaching Mass Mortality Event and of Overfishing on Star Corals *Montastraea annularis* and *M. faveolata* in Culebra Island, Puerto Rico

A catastrophic warming event occurred during 2005 throughout the Caribbean Sea that caused an unprecedented mass coral bleaching event in Puerto Rico that was followed by mass mortality of star coral species complex (*Montastraea annularis* and *M. faveolata*) and associated fauna. It resulted in a severe physiological fragmentation of large coral colonies. Permanent photo-stations were established in 4-6 m deep reef terraces dominated by *Montastraea* spp. at four sites in Culebra, Puerto Rico. Digital photography was used to document changes in benthic community structure before (2005) and after (2007, 2008) this event. Because overfishing has been implicated in the decline of herbivorous reef fishes, another objective of our research was to learn if the living tissue-cover of *Montastraea* spp. on reefs located in areas where fishing is not prohibited has different percent tissue cover and fragment survival compared to corals located in a No-take Natural Reserve. We conducted visual censuses of herbivorous reef fishes. Mass coral mortality caused a 66 to 98% decline in the percentage of living tissue cover in *Montastraea* spp. No significant difference in % living tissue cover loss or in mean fragment size was documented among sites. Fragment density was higher ($p<0.0001$) at Carlos Rosario Beach (130/m^2) in comparison to the other sites (25-40/m^2). We found no significant difference ($p=0.157$) in the density of the herbivorous reef fishes among sites. The control site, outside the Natural Reserve, reflected lower scraper and higher non-denuder abundance. More fish censuses and long-term ecological monitoring are needed to address questions regarding future reef resilience.

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284 AES Conservation & Management II, Parlor ABC, Saturday 25 July 2009

Craig O'Connell[1], Daniel Abel[1], Eric Stroud[1], Patrick Rice[1]

[1]Coastal Carolina University, Myrtle Beach, SC, United States, [2]SharkDefense Technologies, LLC, Oak Ridge, NJ, United States, [3]Florida Keys Community College, Key West, FL, United States

A Quantitative Analysis Examining the Effects of Permanent Magnets on Elasmobranchs in Recreational and Longlining Fisheries

Elasmobranch fishes (sharks and rays) detect magnetic fields through the process of indirect-based magnetoreception via electromagnetic induction using their ampullae of

Lorenzini. We evaluated the feeding responses of elasmobranchs in the presence of permanent magnets in hook-and-line and longline fishing experiments. In the hook-and-line study, we used control, sham magnet, and neodymium magnet hook treatments. Longlines, 150 m in length and containing 24 hooks, were deployed with an alternating sham magnet hook - magnetic hook design. Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) were significantly repelled from the magnetic hook-and-line treatments (X^2=11.967, d.f.=1, p=0.0005), while spiny dogfish (*Squalus acanthias*) were not (X^2=0.532, d.f.=1, p=0.4658). On longlines, ceramic magnets significantly altered shark capture (X^2=4.455, d.f.=1, p=0.035). Blacktip sharks (*Carcharhinus limbatus*; X^2=4.455, d.f.=1, p=0.035) and southern stingrays (*Dasyatis americana*; X^2=4.455, d.f.=1, p=0.035) significantly fed from the sham magnet hooks more than magnetic hooks, while sandbar sharks (*Carcharhinus plumbeus*; X^2=1.286, d.f.=1, p=0.257) did not demonstrate a preference for hook type. Results suggest that magnetic-induced repellent behaviors may be a species-specific phenomenon. The effectiveness of these magnets may have large implications in elasmobranch population recovery in two areas where anthropogenic mortality is the leading contributor to elasmobranch declines, e.g. on commercial longlines.

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94 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Alfredo F. Ojanguren, Lee A. Fuiman

University of Texas at Austin, Port Aransas, TX, United States

Developmental Plasticity of Antipredator Responses of Red Drum Larvae

Environmental conditions have well known immediate effects and less-studied long term phenotypic consequences for fish larvae. For instance, water temperature affects metabolism, developmental rate, growth and performance of general functions, but the permanent effects of environmental conditions on fish phenotype are less well known. Red drum (*Sciaenops ocellatus*) is an interesting model organism to test these ideas because females spawn during a period of sharp decline in water temperatures, between September and November (from 30 ^{o}C to 20 ^{o}C). Previous research on this species has shown a seasonal decrease in performance of wild larvae but no strong effects of recent thermal experience in laboratory produced individuals. The aim of this study was to investigate the effects of incubation temperature on behavioral performance of settlement-size larvae. Fertilized eggs were collected immediately after spawning and incubated at five constant temperatures (23, 25, 27, 29 and 31 ^{o}C). Ten days after hatching, all larvae were transferred to a common temperature (27 ^{o}C) until 20 days posthatching. Then, 24 fish from each incubation temperature were tested in two different assays: routine swimming and escape responses to a visual stimulus. The experiment was replicated to account for possible differences between egg batches. Our results contribute to a better understanding of the effects of early thermal experience on behavioral traits with potential consequences for recruitment of marine fish.

890 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Ronald Oldfield[1], Hans Hofmann[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]The University of Texas at Austin, Austin, TX, United States

V1a Receptor Regulation of Pairbond Formation in a Monogamous Cichlid Fish

Arginine vasotocin/vasopressin (AVT/AVP) regulates social behavior, including aggression and reproduction, across vertebrates. In monogamous prairie vole males, the vasopressin V1a receptor is crucially important for pair-bond formation, specifically by influencing affiliative behavior toward the mate and aggression toward non-mates. Monogamous social systems are found in numerous taxa, including teleost fishes. Cichlid fishes, in particular exhibit an astonishing diversity of mating systems. We hypothesized that the AVT/AVP-V1a pathway is associated with the evolution of monogamy across diverse taxa. We used the monogamous convict cichlid, *Amatitlania nigrofasciata* to test this idea. In the first experiment, we administered on three consecutive days a selective V1a receptor antagonist to males that were in an established pairbond. Control males were treated with vehicle. In established pairs, male affiliation towards the mate and aggressive behavior towards territorial neighbors were not affected by the antagonist. However, there was a significant interaction between inhibiting AVT/V1a, treatment day, and presence of offspring affecting aggression toward neighbors. In the second experiment, we treated males with the V1a antagonist during pairbond formation. We observed a significant reduction in both affiliative behavior toward the (potential) mate and aggression toward neighbors. However, the antagonist did not prevent the pairbond from forming and the behavioral effects disappeared on subsequent treatment days. Our results suggest that the role of the AVT/AVP-V1a pathway in regulating social affiliation may be evolutionarily conserved across vertebrates despite the fact that monogamous mating systems have evolved independently many times.

415 Poster Session I, Exhibit Hall, Friday 24 July 2009

M. Pilar Olivar[1], Mikhail Emelianov[1], Fernando Villate[2], Ibon Uriarte[2], Francesc Maynou[1], Elvira Morote[1], Ignacio Álvarez[1]

[1]Institut de Ciències del Mar (CSIC), Barcelona, Spain, [2]Universidad del País Vasco, Leioa, Spain

The Role of Water Dynamics and Plankton Availability in Larval Fish Assemblages off the Catalan Coast (NW Mediterranean)

In the northwestern Mediterranean most fish species reproduce in early summer, while the mixing autumn period is the spawning season for a lower number of species. This study analyses and compares larval fish assemblages (LFA) in both seasons, being the first attempt to characterize autumn LFA structure for the autumn period. We analyze horizontal and vertical distribution of fish larvae, and micro and mesozooplankton biomass and abundance of the main zooplankton groups. The oceanographic situation was analyzed through the study of data from CTD, Nu-Shuttle and ADCP. LFA were determined by similarity analyses based on larval abundance, and the relationships between larval assemblages and environmental variables were investigated through Canonical Correspondence Analysis. The importance of water masses, current fields (along-shelf and across-shelf transport) and abundance of zooplankton organisms are discussed as important factors shaping assemblages structure. In early summer LFA were mainly structured by a combination of bathymetry and trophic components, although sea surface temperature plays also a role in shaping the horizontal larval distributions. In autumn, trophic variables were the main factors influencing shelf-dwelling species assemblage. On the contrary, larvae of oceanic species were not related to them, but were more affected by current fields.

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278 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Paul Oliver[1], Mark Adams[1], Mark Hutchinson[1], Paul Doughty[1]

[1]University of Adelaide, Adelaide, Australia, [2]South Australian Museum, Adelaide, Australia, [3]WestAustralian Museum, Perth, Australia

Severe Underestimation of Specific and Phylogenetic Diversity in the Australian Gecko Fauna

Australia has an exceptionally diverse squamate fauna and the number of species recognised is still increasing. We report the results of molecular systematic studies of several genera of gecko in the family Diplodactylidae. In spite of a long history of taxonomic work, our results suggest that actual species diversity of the Australian

radiation of Diplodactylidae may be as high double the current total. Much of this unrecognised diversity is also phylogenetically divergent and is estimated to date back to at least the mid-Miocene. The high levels of cryptic diversity uncovered have important ramifications for biogeography, ecology and conservation management.

1049 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

John E. Olney[1], G. David Johnson[2]

[1]College of William and Mary, Gloucester Point, VA, United States, [2]Division of Fishes, USNM, Washington, DC, United States

Larvae of Zeiform Fishes

Larval stages of four of the 16 known genera of zeiform fishes have been described. Here we report the discovery of larvae in three additional genera and comment on the potential use of ontogenetic data in phylogenetic analysis of the order. The larva of the thorny tinselfish *Grammicolepis brachiusculus* is distinctive in the possession of narrow, vertically elongate scales characteristic of the family Grammicolepididae. Larvae of *Zenion* (Zeniotidae) possess the adult compliment of fin elements by 9 mm SL. A larva of *Allocyttus* (Oreosomatidae) bears a conspicuous cranial cone-shaped spine that persists in juveniles. Phylogenetically informative ontogenetic traits include elongate dorsal, anal and pelvic elements, pterotic spines, serrated orbital; ridge, cranial sculpturing, spiny scales and patterns of metamorphosis.

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62 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Deanna H. Olson[1], David M. Aanensen[2], Kathryn L. Ronnenberg[1], Matthew C. Fisher[2]

[1]US Forest Service, Pacific Northwest Research Station, Corvallis, OR, United States, [2]Imperial College, London, United Kingdom

Amphibian Chytrid Fungus: Global Patterns

The amphibian chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*), is recognized as both an infectious disease and invasive species with potentially profound effects on global amphibian biodiversity. Losses attributed to *Bd* are documented in single species, and in some areas assemblages of amphibian species apear to be affected. In 2008, *Bd* was listed as a notifiable disease by the World Organization of Animal Health (OIE) due to its biosecurity risk. Understanding the geographic and taxonomic scope of the disease is a first step in developing research directions and management guidance. Our Global *Bd*

Mapping Porject was initiated with this overarching goal in mind. Furthermore, our global *Bd* database has enabled distributional and taxonomic analyses of patterns, including habitat modeling at the world scale using available environmental metrics such as climate parameters. We have compiled over 2,000 sites worldwide where *Bd* has been sampled. We have found the occurrence of the disease is associated with locations known to have enigmatic amphibian declines, i.e., losses that have been previously unexplained. In our model of *Bd* global habitat associations, temperature metrics are the most significant predictors of *Bd* detetection. This suggests that the distribution of *Bd* will respond to scenarios of climate change. The distribution of *Bd* is a moving target due to both its invasive tendencies and the hypothesized altered prevalence rates with climatic variability. Maintenance of global *Bd* mapping through the website spatialepidemiology.net/bd-maps/ will allow scientists and managers to understand its occurrence and address areas of potential risk to future infections.

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783 General Ichthyology, Parlor ABC, Sunday 26 July 2009

James W. Orr[1], Duane E. Stevenson[1], Gerald R. Hoff[1], Ingrid B. Spies[1], John D. McEachran[1]

[1]NOAA Fisheries Service/Alaska Fisheries Science Center, RACE Division, Seattle, WA, United States, [2]Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX, United States

Skates of the Subgenus *Arctoraja* (Bathyraja: Rajidae): Morphological and Genetic Variation, New and Cryptic Species

We provide morphological and molecular evidence to recognize the North Pacific skate subgenus *Arctoraja* Ishiyama as monophyletic, confirming the validity of the subgenus. *Arctoraja* was previously recognized as a distinct genus of Rajidae and later synonymized with *Bathyraja*. Although the nominal species have all been considered synonyms of *Bathyraja parmifera* by various authors, on the basis of morphometric, meristic, chondrological, and molecular data we recognize four species, including a new species restricted to the western Aleutian Islands. Species of *Arctoraja* are distributed across the North Pacific Ocean and adjacent seas from southern Japan to southeastern Alaska. *Bathyraja parmifera* is abundant in the eastern Bering Sea, Aleutian Islands, and northern Gulf of Alaska; *B. smirnovi* is a western Pacific species common in the Sea of Okhotsk and Sea of Japan; *B. simoterus* is restricted to waters around the northeastern coasts of Hokkaido; and the new species, the Leopard Skate, is restricted to the western Aleutian Islands. The Leopard Skate is diagnosed by its color pattern of light yellow blotches with black spotting on a greenish brown background, high thorn and vertebral counts, chondrological characters of the neurocranium and claspers, and a unique base sequence within the mitochondrial cytochrome oxidase gene. Furthermore, the species we presently recognize as *Bathyraja parmifera* exhibits two haplotypes among specimens from Alaska, suggesting the presence of an additional cryptic species. We also discuss

morphological variation evident among specimens of *B. smirnovi* and aspects of the zoogeography of the North Pacific Ocean and its adjacent seas.

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785 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Guillermo Orti

University of Nebraska, Lincoln, NE, United States

DeepFin Research Coordination Network Update: News and Opportunities to Build the Tree of Life of Fishes

DeepFin is a research coordination network (RCN) of systematic ichthyologists and biologists with expertise in the analysis of fish biodiversity, seeking to integrate knowledge of morphology, paleontology, molecular biology, and bioinformatics. The ultimate goal of the RCN is to establish the phylogenetic tree of all fishes, to decipher their evolutionary relationships. The RCN coordinates activities in three main fronts: group meetings/workshops, website and database development, and student recruitment, training, and exchange. We are funded by a grant from the National Science Foundation (USA). The student exchange program continues in 2009 to provide funding for undergraduate and graduate students with new research opportunities. These students are be able to experience new research environments, not available to them at their home institutions. The goal is to help lower existing barriers between traditionally isolated disciplines by raising a new generation of scientists with broad academic training experiences. DeepFin funds are used to cover travel and room & board expenses for students visiting other labs for periods of up to three months. New website developments include a wiki with commonly used genetic markers, methodological information, and their phylogenetic utility, available from the Deepfin home page (www.deepfin.org). Other resources and opportunities for collaboration will be displayed on the poster.

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733 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Megan Osborne, Thomas Turner

University of New Mexico, Albuquerque, NM, United States

Multi-locus Major Histocompatibility Complex Class IIb and Parasite Diversity in the Rio Grande Silvery Minnow

Genetic variation at immune genes is especially important for aquatic species, whose chemical and microbial environment is impacted heavily by humans, which may increase their risk of exposure to pathogens. In this study we characterized and

measured diversity at genes of the major histocompatibility complex (MHC) Class IIb. We also calculated diversity the mitochondrial ND4 gene and at 9 microsatellite loci in the endangered Rio Grande silvery minnow, *Hybognathus amarus*. These data were used to examine the relationship between MHC variation and pathogen diversity. Three divergent groups of MHC alleles were identified. There were high levels of diversity at these loci in Rio Grande silvery minnow. We also identified relationships between presence or absence of particular alleles and severity of infection with particular parasites. We did not detect associations between gill parasite diversity or abundance and MHC diversity nor did we detect any association between pathogen diversity or abundance and the number of MHC allelic groups expressed by individuals.

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723 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Michael S. Osbourn, Kristen M. Malone, Raymond D. Semlitsch

Division of Biological Sciences, University of Missouri, Columbia, MO, United States

Effects of Land Use on Initial Juvenile Amphibian Dispersal

Movement of animals is imperative for population regulation, metapopulation dynamics, and long-term persistence of species. For amphibians with complex life cycles (aquatic larval phase and terrestrial juvenile-adult phase), movements to and from breeding sites are essential for viability of local populations. Following timber harvesting, dispersing juveniles likely experience increased risk of mortality through desiccation. For predicting the effects of land use on amphibian populations, a better understanding of juvenile dispersal is needed to aid in conservation planning efforts. In 2007 and 2008, we conducted a mark-recapture experiment with experimental forestry arrays, in a Missouri oak-hickory forest. We individually marked recently metamorphosed green frogs [*Rana (Lithobates) clamitans*] and spotted salamanders (*Ambystoma maculatum*) as they emerged from their natal pond. Drift fences encircling each pond provided initial captures and drift fences at 20 m and 50 m determined initial dispersal success. We found that significantly more green frog juveniles were recaptured in controls (32.8%) and partial cuts (14.9%) than in either the unburned clearcuts (2.2%) or burned clearcuts (4.0%). Of green frog juveniles initially released into controls, 93% of recaptures remained there. Less than 10% released into clearcuts were recaptured there and approximately one half moved into controls and a third moved into partial cuts. Juvenile salamander recaptures declined significantly with distance from pond and in 2008 we recaptured a significantly greater proportion in the forested treatments compared to clearcuts. These results should inform policy makers and managers as they attempt to balance the need for forest products with preservation of biodiversity.

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952 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Nicholas Osman, Brad Hauch, Henry Mushinsky, Earl McCoy

University of South Florida, Tampa, FL, United States

Out of Harm's Way: Translocation Success of the Florida Sand Skink (*Plestiodon reynoldsi*) in Differing Habitat Types

The fossorial Florida Sand Skink (*Plestiodon reynoldsi*) inhabits a highly restricted range of scrub and sandhill fragments on the ridges of central Florida. The high rate of urban and agricultural development in this area necessitates conservation strategies other than land acquisition and management because of the limited remaining sand skink habitat available. Our study tests the viability of translocation as a conservation strategy for this species and assesses which features of a recipient site may contribute to successful establishment of a population. In 2007, 300 individuals were collected from a single population, individually marked, and moved to a nearby site with no existing *P. reynoldsi* population. Fifteen 20m^2 enclosures were constructed at the recipient site, and 20 skinks were randomly assigned to each. These enclosures were divided among five treatments, which represented the range of habitat types at the donor site and differed in the presence or absence of a shade giving object and coarse woody debris. Translocated skinks were monitored for two years to measure survival, reproductive success, and growth rate of juveniles as indicators of success in each treatment. Despite the sand skink's extreme habitat specificity in the wild, survival, reproduction, and growth were apparent in all treatments. These variables differed among treatments, however, and were differentially affected by the treatment type. Differences in sun intensity, ground cover, and root mass associated with varying degrees and types of canopy cover had the greatest effect on indicators of success.

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953 Fish Behavior, Parlor ABC, Monday 27 July 2009

Shyril O'Steen

Seattle University, Seattle, WA, United States

Does Guppy Courtship Locomotion Honestly Indicate Performance, and Do Females Care?

The indicator theory of sexual selection suggests that mating displays may honestly signal genetic quality or condition. Locomotor performance is a good candidate for such an honest indicator, as many mating displays include rapid or extended locomotion whose physiological requirements may limit cheating. We previously found that mating display locomotion of male guppies, *Poecilia reticulata*, predicted survival time during subsequent encounters with a natural cichlid predator, supporting the possibility that courtship provides an honest signal. Here we will test two hypotheses, first, that the

mechanism linking male courtship to survival is in fact locomotor performance. Using high-speed video, we quantified swimming kinematics of male guppies first while displaying to females, and second during later encounters with a predator. We will use these data to test the prediction that male courtship kinematics are positively correlated with those anti-predator kinematics known to increase male survival time. We will secondly address the hypothesis that female guppies respond to performance cues provided by courtship. We recorded behavioral responses of females during male mating display trials, and will use these data to determine if females are more attentive to males that display the kinematic traits linked to survival. If so, sexual and natural selection may act in concert in guppies to influence the evolution of swimming performance.

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632 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Patrick Owen[1], Noah Gordon[2]

[1]The Ohio State University at Lima, Lima, OH, United States, [2]University of Missouri, Columbia, MO, United States

Do Testosterone Levels Predict Throat Patch Characteristics In Male Green Frogs?

Male green frogs, *Lithobates* (= *Rana*) *clamitans*, possess a brightly colored yellow throat patch during the breeding season that is variable in its physical extent and its chromatic characteristics. This patch is only visible in dominant resident males that call from a high floating position in the water. Steroid hormone levels have been linked to the expression of color patches in other animals, but this has not been investigated in frogs. During the summer of 2007 we took digital photographs of the ventral regions of male green frogs in a small pond near Ashland, MO, USA. We quantified the characteristics of these color patches using photo analysis software and determined plasma testosterone levels of these individuals. We found that testosterone level did not significantly predict any of the measured properties of the color patches (patch relative area or chromatic characteristics). Given that previous work indicates that some color patch characteristics are linked to body condition in male green frogs, nutritional state may play a more important role than hormonal state in color patch expression.

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91 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Larry Page

Florida Museum of Natural History, Gainesville, FL, United States

The All Catfish Species Inventory (ACSI): A Highly Successful Planetary Biodiversity Inventory

The All Catfish Species Inventory (ACSI) was one of the first projects funded by the National Science Foundation's Planetary Biodiversity Inventories Program (PBI). The goal of PBIs is to accelerate discovery of the world's biodiversity by supporting teams of investigators to conduct worldwide inventories of diverse groups of organisms. ACSI has supported 225 research projects around the world, sponsored workshops in Brazil, Singapore and South Africa, and funded 65 field projects in 22 countries, including major expeditions in Brazil, Cameroon, Central African Republic, Guyana, Indonesia, Papua New Guinea, Peru, Mongolia, Republic of Congo, Tanzania, Thailand, Venezuela, and Zambia. About 400 scientists and students in 53 countries are participating. Since ACSI began in 2003, 482 species of catfishes have been described, 393 papers on catfish systematics have been published, 320,000 specimens and 8,000 tissues of fishes have been collected (in 28 countries), 3 post-doctoral fellows, 10 graduate students, and 18 undergraduates have been trained in the U.S., and support has been provided for dozens of students in foreign countries). Many more descriptions and revisions are in progress; the final counts of new species and publications supported by ACSI are projected to increase by 50%. ACSI websites at ANSP (with 9,000 images of primary types at 55 museums), Auburn University and University of Florida provide an overview of ACSI, descriptions of projects, and taxonomic and distributional information on catfishes.

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201 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Misty Paig-Tran, Adam Summers

University of California, Irvine, CA, United States

Morphology and Selective Particulate Filtration in Cartilaginous Fishes: Models, Mantas and Whale Sharks

There are 13 species of filter feeding elasmobranchs, which include: manta ray, devil rays, whale shark, basking shark, and mega mouth shark. Understanding the basic biology of these fishes including the movement patterns, mechanics of prey capture, and food preference is necessary for successfully predicting migratory patterns and for assessing and maintaining well-managed stocks. Our approach has been to consider the

effect of swimming speed, morphology and water flow on capture efficiency and prey size selection. We found that with simple, cylindrical models of neonatal whale sharks, we could determine parameters that had a significant effect on filtration efficiency and prey selectivity (e.g. gill morphology, swimming speed, etc). We were able to induce passive prey size selectivity by adjusting morphological parameters and swimming speed. This implies that fish with differing physical morphologies could feed in the same plankton bloom, but passively filter different sizes and species of prey. We have catalogued the anatomical differences between the gill raker structures of elasmobranch suspension feeders using computed tomography, physical examinations and permeability measurements. Although there are four main gill raker morphologies, 1) bristle-like gill rakers 2) fur-like, short gill rakers 3) widely spaced, flattened gill rakers and 4) rigid, leaf-like, folded raker structures, the permeability measurements indicate that the resistance through the their raker structures is minimal. The differences in each species' ecology and physiology indicate that these elasmobranchs may filter their prey using a variety of mechanisms (e.g. cross-flow filtration, hydrocyclone filtration, and dead end sieving).

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749 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Brittany Palm, Dave Koester, James Sulikowski

University of New England, Biddeford, ME, United States

Fecundity, Viability, and Gestational Rates of Little Skate, *Leucoraja erinacea*, Egg Cases in the Gulf of Maine

The direct determination of fecundity, viability, and gestation rates of little skate, *Leucoraja erinacea*, egg cases in the Gulf of Maine are unknown. Determining these reproductive parameters, are essential to the effective management of this and other skate species. Thus, the goals of this study were to determine these parameters for little skate specimens collected from the Gulf of Maine and housed under ambient conditions. Sexually mature little skates were maintained in tanks equipped with ambient, free flowing seawater to monitor the effects of seasonal variation over a full year. Fecundity was calculated at 49 eggs per year and egg deposition peaked in June but was consistently high during the summer months (June, July, August). Out of the 346 eggs laid by seven sexually mature females, 75.1% were viable at the termination of the study and viability was statistically lower in the spring when compared to summer, fall, and winter. Gestation lengths ranged from 22 weeks to 54 weeks and eggs that were laid in the fall displayed the longest gestational period (average=44.3 weeks, S.E. ± 0.13 weeks) while those laid in the spring displayed the shortest gestational period (24.8 weeks, ± 0.24 weeks). Skates developed slower and were statistically smaller in colder seasons than skates that developed faster and larger in warmer seasons. To further investigate the variability in gestation and total lengths, metabolic rates of embryonic skates are currently being measured over a full annual cycle under ambient conditions.

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519 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

David Paoletti[1], Deanna Olson[2], Andrew Blaustein[1]

[1]Oregon State University, Corvallis, OR, United States, [2]USDA Forest Service, PNW Research Station, Corvallis, OR, United States

Recognition of an Introduced Predator by Foothill Yellow-legged Frog Tadpoles

The consequences of species introductions into non-native habitats are a major cause of concern in the U.S. Of particular interest are the effects of introduced fishes on native amphibian communities. In Oregon, the Foothill Yellow-legged Frog (*Rana boylii*) has disappeared from more than half of its historical range and is now listed as a state and federal Sensitive Species. These declines may be partly attributed to the recent introduction of Smallmouth Bass (*Micropterus dolomieu*) to some of the rivers systems in which these frogs live. Although Smallmouth Bass have been implicated, very little is known about interactions between these two species. We sought to determine whether tadpoles could recognize bass as a predatory threat. Through a series of experiments, we examined the behavioral responses of tadpoles to a variety of stimuli including native predator (newts), introduced predator (bass), and non-predatory fish (dace). Each experiment examined a different potential mode of sensory detection: 1) chemical cues; 2) visual cues; or 3) a combination of chemical/visual/mechanical cues. Results suggested that individual tadpoles of this species require multiple cues to facilitate predator detection. Consequently, Foothill Yellow-legged Frogs appear to be especially vulnerable to predation by non-native Smallmouth Bass.

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339 AES Ecology II, Galleria South, Sunday 26 July 2009

Yannis Papastamatiou[1], Britanny Graham[2], Dana Bethea[3], John Carlson[3], Enric Cortes[3]

[1]Hawaii Institute of Marine Biology, University of Hawaii at Manoa, Kaneohe, HI, United States, [2]Stable Isotopes in Nature Laboratory (SINLAB), Canadian Rivers Institute, University of New Brunswick, Fredericton, NB, Canada, [3]NOAA Fisheries, Panama City Laboratory, Panama City, FL, United States

Can Bonnethead Sharks Digest and Assimilate Seagrass?

The increasing volume of shark diet studies show that sharks are carnivores, although plant material has been identified in the stomachs. Presently, it is assumed that plant

material is accidentally consumed while sharks forage on benthic prey and that sharks with plant material found in their stomachs are unable to digest or assimilate this material. However, the digestive capabilities of sharks and their ability to assimilate plant material may have been previously underestimated. Sharks are capable of secreting even more acidic gastric fluids than herbivorous fish and may therefore be able to lyse plant cell walls in their digestive tracts. Diet studies conducted on bonnethead sharks (*Sphyrna tiburo*) in three areas of the eastern US Gulf of Mexico revealed that blue crabs are the most important dietary item, but that significant amounts of seagrasses are also found in their stomachs. The contribution of seagrass varies with life stage and geographic location (between 8-60%). Although we cannot conclusively state that bonnetheads digest plant material, it appears likely based on their isotope signatures. Omnivory could have significant implcations for trophic foodwebs in which these sharks are included.

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101 AES Ecology I, Pavilion West, Saturday 25 July 2009

Yannis Papastamatiou[1], Carl Meyer[1], Katsufumi Sato[2], Yuuki Watanabe[3], Kim Holland[1]

[1]University of Hawaii at Manoa, Kaneohe, HI, United States, [2]University of Tokyo, Otsuchi, Japan, [3]National Institute of Polar Research, Tokyo, Japan

New "Ecological" Tags and their Use in the Study of Shark Behavior

While a variety of acoustic, satellite and archival tags are being used to quantify shark movements, very little is known about the factors regulating these movements. We have been deploying and testing "ecological" tags which measure a variety of parameters, in both captive and free-ranging sharks. These include gastric motility data loggers and acoustic pH transmitters to record foraging and digestion; a bio-acoustic probe which documents the external acoustic environment; and an acceleration/speed data logger to record swimming mechanics and detailed diving behavior. Although limitations exist with each type of tag, these new sensors will provide a more detailed insight into the underlying behaviors behind the movement patterns and habitat selection of free-ranging sharks.

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126 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Lynne Parenti

National Museum of Natural History, Smithsonian Institution, Washington, DC, United States

Darwin, Wallace and Biogeographic Classification

Recognition, and mapping, of discrete global biogeographic regions was an early key to the development of a theory of biological evolution for Charles Darwin and Alfred Russel Wallace. At the start, for both, the history of species and the history of Earth were linked. In his early notebooks, Darwin used biological distributions to explore geological theories. Darwin later shifted his focus to process: explanations of the evolutionary significance of distribution patterns rather than of the patterns themselves. Dispersal from a center of origin was assumed a priori as the process of organic distribution. And, he argued forcefully for the permanence of continents. Likewise, Wallace considered continental rearrangement as an evolutionary driver but abandoned that idea in favor of permanence. Wallace proposed a global, continent-based, terrestrial classification for both plants and animals, based on that of ornithologist Philip Sclater. Wallace's area classification contradicted many known global biological distribution patterns; it was convenient, but unnatural. Further, the relationship between a global classification and the distributional history of a taxon was not explored. Thus, study of the history of species and the history of Earth became disjointed. Identification and classification of biogeographically meaningful areas can form a framework for interpreting and understanding organic evolution. It can link biology and geology at all scales. Our job is at a critical stage: accidental dispersal of organisms throughout global trade routes has ushered in what has been called ironically the "Homogocene" - an era being marked by the obliteration of natural biogeographic patterns.

Claire B Paris[1], Jean-Olivier Irisson[1], Jelle Atema[2], Michael Kingsford[3], Gabriele Gerlach[4], Cedric M Guigand[1]

[1]Rosenstiel School of Marine and Atmospheric Science, Miami, FL, United States, [2]Boston University, Boston, MA, United States, [3]James Cook University, Townsville, QLD, Australia, [4]Carl von Ossietzky University Oldenburg, Oldenburg, Germany

In-situ Response of Pelagic Coral Reef Fish Larvae to Reef Odor Conference Workshop: Temperate-tropical Differences in Connectivity – Real and Perceived

Larval reef fishes are often habitat selective and finding a good place to settle is essential for survival. The probability of finding reef habitat could be improved by behavioral decisions guided by sensory cues. For example, larvae are able to discriminate between reef and ocean water in the lab. However, at the scale of the larva, odor cannot be perceived as a directional cue. So the realized impact of these abilities on dispersal will only be known after they are tested in situ, together with other sensory fields. We observed larval behavior in its natural settings using a Drifting In Situ Chamber (DISC) permeable to odors, light, and sound, deployed at various distances around One Tree Island, Great Barrier Reef. The instrument was equipped with a camera that recorded the larva responses, a compass that tracked the instrument's rotation, a GPS which recorded drift, and a CTD that provided information on the water mass. The DISC was deployed at 3 m depth, for 20 minute trials, inside and outside the odor plume leaking out of the lagoon, to test the effect of odor on the behavior of 100 pre-settlement stage larvae (Apogonidae and Pomacentridae). Statistical analyses focus on the effect of reef odor on larval activity, checking whether olfactory stimuli have an effect on behavior in situ, but also orientation, to test the hypothesis that, although reef odor is not directional, it could signal the proximity of a reef and trigger oriented swimming in response to other cues.

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402 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Joshua Parker[1], Charles Peterson[2]

[1]College of Southern Nevada, Las Vegas, NV, United States, [2]Idaho State University, Pocatello, ID, United States

Midget Faded Rattlesnake Biology, Ecology, Population Genetics and Landscape Modeling

The Midget Faded Rattlesnake (*Crotalus oreganus concolor*) is a species of concern that receives state-level protection throughout its range in Wyoming, Utah, and Colorado. I conducted a field study throughout their range in Wyoming between 2000 and 2002 using 50 transmittered snakes to shed some light on their ecology. I also collected blood samples from 350 snakes for genetic analyses. The field data collected helped us to understand the biology, ecology, and population genetics of this secretive animal as well as provided assistance with their management. One particularly sensitive characteristic of this species is their communal denning habits that are complemented by the limited denning habitat in the region. The data made available to management agencies only identified 16 populations and den sites in southwestern Wyoming. With the impending threat of oil and gas development using seismic and strip mining tactics around the Flaming Gorge Reservoir (the extent of their range in Wyoming), management agencies need predictive tools to help evaluate future development sites to determine the level of threat to this species. This year, based on the data from this study, we will be developing landscape models that will predict the presence of populations and location of den sites. We will also be incorporating genetic data into these landscape models to understand how landscape variables influence population genetic structure in this region.

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200 Storm Symposium, Pavilion West, Friday 24 July 2009

M. Rockwell Parker, Robert Cressman, Chris Friesen, Robert Mason

Oregon State University, Corvallis, OR, United States

The Timeline for Male Emergence from a Well-studied Hibernaculum: Optimal Patterns for Emergence and an Experimental Test

The red-sided garter snake (*Thamnophis sirtalis parietalis*) is the most extreme case for studying explosive reproduction in reptiles. In the spring of every year, these snakes emerge in the tens of thousands from limestone hibernacula in the Interlake Region of Manitoba, Canada, following an eight month winter dormancy. The sex ratio at the den is male biased (~10:1), with males emerging before and staying after the females have emerged. We randomly caught groups of males (n=100 ea.) every week for 5 weeks at

the den and recorded SVLs and masses. Males of "greatest" condition (largest body residual values) had emerged coincident with the peak of female abundance. Further, the longest males were in the den at the peak of female abundance, suggesting that there may be an ontogenetic shift in the timing of emergence. We conducted a simple laboratory experiment during hibernation to determine if there was a sex difference in substrate choice that could enable different emergence patterns. We offered snakes a choice between full immersion in water vs. dry land, and there was a significant difference between the sexes. Males spent half of their time on land, whereas females remained partially or fully submerged in water. Given that air has a lower specific heat than water, males may be hibernating near the water/air boundary to quickly assess when air/ground temperatures are changing. By doing so, male garter snakes can ensure an early emergence to maximize their ability to find, court, and mate with females.

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96 Poster Session II, Exhibit Hall, Saturday 25 July 2009

M. Rockwell Parker, Chris Friesen, Robert Mason

Oregon State University, Corvallis, OR, United States

Associated Reproduction in a Model Dissociated Breeder, the Red-sided Garter Snake

Most vertebrates exhibit an associated reproduction pattern, where maximal sex steroid production, mating behavior, and gametogenesis occur simultaneously or at least in close proximity. The other reproductive pattern, dissociated reproduction, is typified by the uncoupling of one of the aforementioned components from the other two. The red-sided garter snake (*Thamnophis sirtalis parietalis*) has long been described as a model dissociated breeder. Maximal courtship and mating in this species occur in the spring of every year following winter dormancy while sex steroid levels are basal (or at least decreasing) and no gametogenesis is occurring. Following the spring mating season, all snakes disperse from the den to various lakes and ponds of the Interlake Region of Manitoba, Canada, where they will undergo gametogenesis and/or folliculogenesis and parturition with a concomitant increase in sex steroid synthesis. Over the past two summers, we have surveyed male snakes for courtship behavior at a specific summer site (Fish Lake) and found that ~50% of the males exhibit courtship behavior (chin rubbing and body alignment). We bled all of the males to measure their total androgen levels via radioimmunoassay. Males that exhibit courtship behavior in the summer have higher total androgen levels than non-courting males, suggesting that androgens may be directly activating courtship behavior during the summer feeding period concomitant with gametogenesis. Future work in the summer of 2009 will test whether this disparity between courting and non-courting males is due to the attractiveness of females at this time or the levels of circulating androgens present.

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202 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

M. Rockwell Parker, Robert Mason

Oregon State University, Corvallis, OR, United States

Sex Expression in Snakes: The Interplay between Hormones and Pheromone Production

Three pheromone phenotypes exist in the red-sided garter snake (*Thamnophis sirtalis parietalis*): females, males, and she-males. Mature females have pheromone profiles dominated by long-chain, unsaturated methyl ketones, while mature males produce low levels of short-chain, saturated methyl ketones. Lastly, she-male pheromones are a mix of short- and long-chain methyl ketones that are mostly saturated. We have shown that estrogen (17β-estradiol) implants induce female pheromone production in male garter snakes. The pheromone profiles produced by these E2 males were dominated by one long-chain, unsaturated methyl ketone, making these males extremely attractive, even compared to females. This past summer, we removed the E2 implants from a set of males (n=12) that had implants since the summer of 2007. At that time, we implanted new males (n=12) with E2 implants. Both groups were artificially hibernated in the lab and then taken back into the field in the spring of 2009 for bioassays. All of the males were bled to validate the success of the implants and removals via radioimmunoassay. If implant-removed males are still attractive, we will have demonstrated a permanent, organizational role for estrogen in adult snakes. If estrogen organizes the skin to become a pheromone producing apparatus, then she-male garter snakes may ultimately be the result of developmental effects of estrogen. Previous work has shown that she-males have higher circulating levels of testosterone, which may be converted to low levels of estrogen in the skin via aromatase. Whether these effects are permanent will be discussed in an activational/organizational context.

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211 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Scott L. Parker, Christopher R. Murphy, Michael B. Thompson

University of Sydney, Sydney, NSW, Australia

Uterine Angiogenesis in the Australian Skinks *Ctenotus taeniolatus* and *Saiphos equalis*

The evolution of viviparity involves modifications to multiple integrated physiological features to support growth of embryos in utero throughout gestation. Embryonic growth during pregnancy depends on oxygen supplied by the maternal uterine vascular system. The uterus must match the increasing embryonic oxygen demand as

development proceeds. We tested the hypothesis that total surface area of blood vessels in the uterine epithelium increases in concert with embryonic growth and oxygen demand during gravidity/pregnancy in the skinks *Ctenotus taeniolatus* (oviparous) and *Saiphos equalis* (viviparous) by quantifying the uterine microvascular density and morphology during gestation. We also tested the hypothesis that uterine angiogenesis is controlled by progesterone during pregnancy; we blocked progesterone using the drug mifepristone (RU-486). In both species, uterine vessel density (Nv) and vessel length-density (Lv) differ spatially between regions of the uterus with the highest vascular density associated with the area apposed to the embryonic chorioallantois. For *C. taeniolatus*, Nv and Lv in the embryonic hemisphere of the uterus are 23% and 17% less than those of *S. equalis* and vascular surface-area does not change through embryonic development. For *S. equalis*, overall Nv, Lv, and vessel diameter (Dv) increases by 36% (Nv), 44% (Lv), and 60% (Dv) late in gestation. The chorioallantoic membrane of *S. equalis* increases in absolute size but vascular density does not differ with embryonic stage. The increase in uterine vascular density and surface-area coincides with the phase of rapid growth in embryonic mass and metabolic rate.

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918 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Daryl C. Parkyn, Debra J. Murie, Douglas E. Colle, Geoffrey Smith, James D. Austin

University of Florida, Gainesville, FL, United States

Capture and Patterns of Recapture to Assess Movements of Greater Amberjack in the Gulf of Mexico

Greater amberjack (*Seriola dumerili*) were captured and tagged as part of a study to assess the potential for mixing of Gulf of Mexico, Atlantic, and Caribbean stocks and its implications for harvest management of this species. We tagged 682 fish from four regions in the Gulf, removing 2-3 pectoral finrays for aging and a finclip for genetics from each fish. To date, tags from 51 fish have been returned, providing both information on distance moved, as well as rate of growth. In general the size distribution of recaptured fish was skewed to larger individuals compared to fish initially released, both because of minimum size limits for recreational and commercial fishers, as well as the fact that amberjack grew at an average rate of 1.5 mm per day. Movements of individual fish ranged from 0-1250 km, with an average of 40 km movement prior to recapture. Number of returned tags was not uniform across tagging areas. The higher rate of recapture in some regions appeared to be indicative of higher fishing pressure on this species in these regions, although a seasonal component was evident. In addition, the overall high rate of recapture (7.5%) may be a function of lower release mortality of these fish, which we attribute, in part, to features of the swimbladder of amberjack that we have not previously observed in other species.

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460 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Jeff Parmelee[1], Neil Bernstein[2], David McCullough[3], Terry VanDeWalle[4], Wendy VanDeWalle[4]

[1]Simpson College, Indianola, IA, United States, [2]Mount Mercy College, Cedar Rapids, IA, United States, [3]Wartburg College, Waverly, IA, United States, [4]Natural Resources Consulting, Inc., Independence, IA, United States

Amphibian and Reptile Use of Mitigation Wetlands in a Predominately Agricultural Landscape

Amphibians, and to a lesser extent reptiles, have been the focus of much attention because of worldwide population declines. Wetlands in an agricultural state such as Iowa are exceedingly rare and amphibians must often rely on anthropogenic habitats such as farm ponds and constructed wetlands for their breeding and survival. We conducted a two year study on the ecological performance of 12 Iowa Department of Transportation mitigation wetlands and three reference wetlands in Iowa. Amphibians and reptiles were intensively sampled at each site over a year by a variety of methods including frog-call surveys, drift fences with pitfall traps, turtle trapping, and opportunistic searching. Species richness and abundance of amphibians and reptiles did not differ significantly between reference and mitigated wetlands, for example the most diverse site for amphibians was a mitigation wetland (9 species) and the lowest number of species was found at Doolittle Prairie, a natural wetland (2 species). Frogs, especially bullfrogs and cricket frogs, were found at high densities at many mitigation wetlands, and at more recently constructed wetlands. We also did not find any species unique to the reference wetlands to use for a rapid assessment of habitat quality. On average we recorded 5 amphibian species and 3 reptile species at our wetland sites and it appears that factors such size, habitat heterogeneity, and connectivity to other wetlands may be more important to amphibians and reptiles than whether the wetland is created or natural.

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956 Fish Genetics I, Pavilion East, Thursday 23 July 2009

Steve Parmenter[1], Yongjiu Chen[2], Frank Pezold[2]

[1]California Department of Fish and Game, Bishop, CA, United States, [2]Texas A&M University, Corpus Christi, TX, United States

Genetic Characterization and Conservation Status of Pupfish in River Springs, California

Pupfish (*Cyprinodon* spp.) are a group of short-lived species found in discrete aquatic systems across the southwest desert of North America. These fishes possess extraordinary tolerance of environmental variables including pH, salinity, temperature, and parasite community. An unidentified pupfish population occurs at River Springs (north of Bishop), eastern California, presumably derived from pupfish in Salt Creek (*C. salinus salinus*) and Amargosa River (C. *nevadensis amargosae*), Death Valley, California introduced by RR Miller in 1940. River Springs and each of the habitats occupied by the two putative ancestral species differ in elevation, temperature, salinity and biotic factors. We investigated the contribution of each ancestral population to the extant River Springs fish using DNA sequence variation in the mitochondrial Cytochrome b gene (1,095bp). Pupfish in River Springs share the identical haplotype with Amargosa River pupfish, and are distinguished from Salt Creek pupfish by 10 diagnostic single nucleotide polymorphisms. The taxonomic status and conservation significance of pupfish in River Springs are discussed.

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676 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jennifer Parris Joice, David Etnier, Darrin Hulsey

University of Tennessee, Knoxville, TN, United States

Tennessee Fish Collection: Strengths and Development

The Tennessee Fish Collection housed in the Department of Ecology and Evolutionary Biology at the University of Tennessee is the largest fish collection in Tennessee. This collection represents over 40 years of work by Dr. David Etnier and continues to grow. In terms of total species it ranks in the top 20 among North American Fish collections. The collection houses 35,220 lots to date, which contain ~425,000 specimens from 206 families. The hyper-diverse fauna east of the Rocky Mountains is well represented in the collection, and it contains the best darter collection in North America based on numbers of species + specimens + lots of rare specimens. The collection and associated information is widely used by government, private, and academic institutions and we would like to encourage increased use of the collection's holdings. Since 2006, the collection has been housed in the Hesler Biology building in the heart of the UT campus.

It is outfitted with modern compactors and its holdings are currently being digitized. The entire collection is projected to be searchable on the web by Fall 2009.

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463 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Susan Parsons, Charles Peterson, Marjorie Matocq

Idaho State University, Pocatello, ID, United States

Landscape Genetics of Great Basin Rattlesnakes, *Crotalus oreganus lutosus*, on the Idaho National Laboratory

The absence of baseline data in pristine environments hinders conservation efforts directed at threatened populations, making ecologically descriptive studies increasingly more important. Sagebrush-steppe ecosystems are among the most endangered terrestrial ecosystems in North America, but the plants and animals living on the Idaho National Laboratory (INL), a federally protected research facility found in the sagebrush steppe of southeastern Idaho, do not suffer from many of the deleterious effects of habitat conversion and fragmentation characterizing more typical western landscapes. This research describes patterns of gene flow within a group of largely undisturbed Great Basin rattlesnake (*Crotalus oreganus lutosus*) hibernacula on the Idaho National Laboratory. Landscape genetics, made possible by high resolution molecular markers and Geographic Information Systems (GIS), combines landscape ecology and population genetics to explain how landscape characteristics affect gene flow and population structure. Six polymorphic microsatellite DNA loci are used to genotype 200 individuals from 10 hibernacula located at spatial distances of 3-45km from each other. Genetic connectivity, estimated using traditional Fst calculations, is correlated with Euclidean and least cost path distances, as well as the proportion of suitable denning habitat found between hibernacula. Genetic analyses show that only modest levels of population substructuring characterize INL rattlesnake hibernacula, and GIS-based landscape analyses produce significant correlations between Fst and the availability of intervening denning habitat, but not with Euclidean or least cost path distances. These findings provide strong evidence that the availability of high quality habitat corridors along movement paths maintain gene flow in a communally denning, temperate snake species.

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358 Poster Session II, Exhibit Hall, Saturday 25 July 2009

James Paterson

Laurentian University, Sudbry, ON, Canada

Microhabitat Selection by Eastern Ribbon Snakes (*Thamnophis sauritus*) in a Coastal Lake Huron Wetland

Habitat selection occurs when an organism uses habitat disproportionately when compared to the available resources. Eastern ribbon snakes (*Thamnophis sauritus*) are a small, at-risk North American species that occurs near bodies of water. A use-availability study was conducted to determine if ribbon snakes were selecting microhabitat sites in a coastal wetland in Ontario, Canada. To determine if habitat selection was occurring at this scale, microhabitats in which snakes were found were compared to random 1m^2 plots located in the available habitat. Comparisons were made using discriminant function analysis (DFA) and a classification and regression tree (CART). Snakes disproportionately used microhabitats in shallow water close to shore similar in temperature to their reported preferred body temperature. However, the results differed between the methods used, emphasizing the use of multiple analyses when using multivariate habitat data. The determination of important habitat characteristics is crucial for the development of management plans for this species-at-risk. This is one of the first descriptions of habitat use by this species in Ontario.

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750 AES Physiology, Galleria South, Sunday 26 July 2009

James Patterson[1], Diego Bernal[1], Chugey Sepulveda[1]

[1]*University of Massachusetts Dartmouth, North Dartmouth, MA, United States,*
[2]*Pflegler Institute of Environmental Research, Oceanside, CA, United States*

A Comparative Study of the Capacity for Aerobic and Anaerobic Metabolism in the Muscle Tissues of the Three Species of Thresher Shark (Family Alopiidae)

A recent study of the three species of thresher shark (Family Alopiidae) has revealed some striking interspecific differences in locomotor muscle morphology. The common thresher (*Alopias vulpinus*) differs significantly in the position of the red myotomal muscle (RM) when compared to the bigeye (*A. superciliosis*) and the pelagic thresher (*A. pelagicus*), and is the only thresher known to have regional muscle endothermy. The objectives of this study were to 1) determine if the pelagic and bigeye threshers have warm RM and 2) to quantify the activity of citrate synthase (CS; an index of aerobic capacity) and lactate dehydrogenase (LDH; an index of anaerobic capacity) in the RM in order to determine if the metabolic biochemical capacities are species-specific.

Temperature readings were taken in six longitudinal positions along the body of the sharks and show that the RM temperatures of common thresher were above that of the ambient temperature at depth caught, while the pelagic and bigeye thresher RM temperatures were closer to ambient temperature at depth caught. The CS and LDH activity at 20˚C in the RM of the common thresher was higher when compared to the other two species. In addition, thermal effects were determined over a wide temperature range (10-30˚C) and showed that the mean Q_{10} for CS and LDH did not differ significantly. These results indicate that although the thermal effect on enzyme activity is similar, the overall activity of these enzymes in the RM is higher for the common thresher shark.

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36 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Daniel Pauly

University of British Columbia, Vancouver, BC, Canada

Darwin's Ichthyological Collection and Musings During his Voyage on H.M.S. Beagle

Charles Darwin's collection of fish during the second voyage of the Beagle (1831-1836) evolved with time from a plan to fill perceived gaps in French ichthyology to the testing of ecological and, yes, evolutionary hypotheses. This presentation, structured chronologically, will also illustrate some of Darwin's early ichthyological musings, and assess the role of fish in his thinking and the elaboration of his later theory.

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900 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Gregory Pauly

University of Texas, Austin, TX, United States

Discordance between Mitochondrial and Nuclear Gene Phylogenies and its Impacts on the Systematics of the *Bufo boreas* Species Group

The *Bufo boreas* species group contains four species in western North America including the widespread Western Toad, *B. boreas*, and the Yosemite Toad, *Bufo canorus*, an endemic of the central Sierra Nevada of California. Results of previous mtDNA phylogenetic studies of these species conflict with current taxonomy and an earlier unpublished allozyme analysis. Mitochondrial DNA studies suggest that northern and southern populations of *B. canorus* are each more closely related to northern and southern populations of *B. boreas* than to each other. In contrast, allozyme studies

recover *B. canorus* as a distinct clade and the sister taxon to the remaining species. Here, I conduct phylogenetic analyses of multiple mitochondrial and nuclear genes with sampling throughout the ranges of *B. boreas* and *B. canorus* to test for discordance between mitochondrial and nuclear loci. These new mitochondrial analyses continue to recover *B. canorus* as non-monophyletic while the nuclear data, including a re-analysis of the allozyme dataset, indicate *B. canorus* is monophyletic. Importantly, a combined analysis of available *B. canorus* mtDNA data (>400 individuals) indicates all *B. canorus* have mtDNA haplotypes from *B. boreas* (i.e., no *canorus* mtDNA haplotypes are found to be nested outside of *B. boreas* as in the nuclear datasets). These results suggest mitochondrial introgression from *B. boreas* into *B. canorus* followed by multiple mitochondrial selective sweeps. This discordance adds to the growing evidence that mtDNA results should not be used as the sole basis for systematic and management decisions.

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207 Fish Systematics II, Pavilion East, Saturday 25 July 2009

John Paxton[1], G David Johnson[2]

[1]Australian Museum, Sydney, NSW, Australia, [2]Smithsonian Institution, Washington DC, United States

Ontogeny and Systematics of Whalefishes (Stephanoberyciformes: Cetomimidae): Resolution of a Deep-Sea Conundrum, Part 2. Biology, Linking of Life Stages, and Relationships

Dave Johnson presented the first part of our study. The larvae feed exclusively on copepods, while females consume a variety of crustaceans. The distinctive caudal-fin streamer is characteristic of the larvae and found at least as a small protuberance in specimens as small as 5 mm, while growing to 10 times SL in one specimen. Some of the largest larvae lack the streamer. Functions of this structure are problematic. Different genera transform at significantly different larval sizes. Males mature soon after transformation, as shown by the presence of prespermatids in one late transformation specimen. Mature females are very rare and a distinct difference in maximum egg diameter is noted in different genera. DNA analyses of 32 individual cetomimids including four larvae, one male, five female genera and nine species, plus three outgroup families, have provided confirmation that these three life stages belong to a single family. The analyses also have indicated linkages of different life stages and provided information about generic and familial relationships. Unique meristic counts link the larva *Parataeniophorus gulosus* with the male *Cetomimoides parri* and the female *Cetostoma regani*; also *Mirapinna esau* is the postlarva, and senior synonym, of the female *Procetichthys kreffti. Parataeniophorus bertelseni* is the likely larva of *Ditropichthys storeri.* Other linkages are more challenging and fresh larvae for DNA are needed. Reconcilliation of generic relationship trees from DNA and anatomy will be discussed.

Barbourisiidae is the sister group of Cetomimidae. Videos of two individual whalefishes at 1400-1700 m indicate two distinct swimming modes.

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889 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Allison Pease[1], Rocio Rodiles-Hernandez[2], Alfonso Gonzalez-Diaz[2]

[1]Texas A&M University, College Station, TX, United States, [2]El Colegio de la Frontera Sur, San Cristobal de las Casas, Chiapas, Mexico

Structure and Morphological Diversity of Stream Fish Communities along a Longitudinal Fluvial Gradient in the Río Grijalva Basin, Mexico

The influence of environmental variables on fish assemblage structure and morphological diversity was examined along a longitudinal gradient in the Río Grijalva basin in Chiapas and Tabasco, Mexico. The ecomorphological diversity of fishes was measured along with a suite of environmental variables in communities across a range of environments, from high-elevation tributaries to lowland streams in the coastal plains. We measured morphological traits with known relationships to feeding ecology and habitat use and compared functional community structure among stream communities using multivariate ordination and ecological distance calculation techniques. Fish species richness and morphological diversity was highest in lowland communities, where habitats are more stable with high productivity and spatial heterogeneity that provide for a broad prey resource base. This diversity decreased in communities further upstream, where the flow regime is harsher and fewer favorable habitat types are available for fishes or their prey resources. In large tropical river basins, few studies have examined changes in fish assemblage structure at the watershed scale, and little is known about how functional community structure responds across environmental gradients in these systems.

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927 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Myron Peck[1], Marc Hufnagl[1], Mark Dickey-Collas[2], Richard Nash[3], Thomas Pohlmann[1]

[1]University of Hamburg, Hamburg, Germany, [2]Wageningen IMARES, IJmuiden, Netherlands, [3]Institute of Marine Research,, Bergen, Norway

Climate-driven Changes in the Survival and Growth of Marine Fish: Individual-based Model Estimates for Larval Herring (*Clupea harengus*) in the North Sea

North Sea herring (*Clupea harengus*) has experienced extremely poor recruitment in recent years despite having high spawning stock biomass. Field survey data suggest that poor year classes stem from processes acting during the first months of life, when cohorts of larvae passively drift eastward across the North Sea from western spawning grounds during the boreal winter. We investigated how intra- and inter-annual changes in climate-driven bottom-up processes might impact early larval growth and survival by developing a coupled 3-d individual-based, biophysical model for Atlantic herring larvae in this region. Physiologically-based foraging and growth subroutines allowed us to examine the impact of key abiotic (e.g., water currents, temperature, light, turbulence) and biotic (prey size and prey concentration) factors on the feeding, growth and survival of young larvae. Model foraging and growth estimates were validated using a variety of field and laboratory studies previously conducted on larval herring and a sensitivity analysis of model parameters was performed. Model simulations employed extensive (>35 yr) time series data on larval herring abundance and distribution and projected large inter-annual differences in prey concentrations required for the survival and growth of this species in this region. In many years, climate-driven changes in average winter water temperature and zooplankton phenology were predicted to markedly influence the survival of the youngest larvae originating from selected spawning grounds. Although projecting future trends remains challenging, climate-driven changes in bottom-up processes should be taken into account for the effective management of North Sea herring.

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713 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Martha Peguero-Icaza[1], S.Guido Marinone[3], Laura Sanchez-Velasco[2], Emilio A. Inda-Diaz[2]

[1]Centro de Investigacion Cientifica y Educacion Superior de Ensenada - Unidad La Paz, La Paz, BCS, Mexico, [2]Departamento de Plancton y Ecologia Marina, Centro Interdisciplinario de Ciencias Marinas - IPN, La Paz, BCS, Mexico, [3]Departemento de Oceanografía Fisica - Centro de Investigación Cientifica y Educacion Superior de Ensenada, Ensenada, BC, Mexico

Larval Fish Assemblages: Seasonal Connectivity in the Gulf of California

Patchily distributed, marine species possessing pelagic larvae have the potential for considerable levels of connectivity among local populations. By larval dispersal, the connectivity is important for determining demography of local populations. The strong seasonal variability in the Gulf of California (GC) and the associated physical processes can play an important role on the larval fish dispersion. Fish larvae collected in the GC in December 2002 and August 2003 were used to describe larval fish assemblages (LFAs). In this work we have tracked particles in a current field coming from a 3D numerical model and we have constructed connectivity matrices for two periods with different circulation conditions (December 2002 and August 2003). The main connectivity path (20% of particles) was following the strongest seasonal current, but short time scale like tides must be consider in areas like the region of the Big Islands and the northern Gulf of California. This connectivity path was according to the gradients of species richness and larval abundance, northward during December and southward to during August. The Lagrangian analysis reveals that the circulation favors the permanency for time periods as long enough to allow fish larvae to remain in a favorable environment until they complete their development or until the climate drastically changes with the seasons. Also, the model shows that the main interchange of larval is between areas that belong to the same LFA.

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699 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Anny Peralta-Garcia[1], Bradford Hollingsworth[2], Tod Reeder[1]

[1]San Diego State University, San Diego, CA, United States, [2]San Diego Natural History Museum, San Diego, CA, United States

Historical Demography and Lineage Diversification of *Urosaurus ornatus*

The Ornate Tree Lizard (*Urosaurus ornatus*) is a widespread and abundant species throughout the southwestern United States and northwestern México. Like many widespread species, it occupies a variety of habitats and environments and exhibits extensive morphological variation. The goal of this study is a molecular phylogeographic analysis of *Urosaurus ornatus* across its distribution, with focus on elucidating patterns of lineage diversification and defining species limits using a multilocus approach (mtDNA and two unlinked nuclear genes). This study will help uncover the biogeographic history of northwest México where few studies have addressed questions regarding lineage diversification processes in the area. Bayesian phylogenetic inference analyses of mtDNA recover four major lineages: 1) a geographically restricted lineage located at the northern portion of the Sierra Madre Occidental; 2) a widespread lineage ranging throughout the southwestern U.S. and northern México; 3) a lowland coastal Sonora lineage; and 4) a Sinaloan lineage. The mtDNA structure found within *U. ornatus* populations indicates the presence of possible cryptic species. The reality of these lineages and the possibility of restricted gene flow is being tested with nuclear data and coalescent based methods. Further analysis on these uncovered lineages will contribute to the knowledge about historical biogeographic patterns and processes affecting species in southwest U.S. and northwestern México.

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428 ELHS/LFC Ecology II, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

Kestrel Perez, Stephan Munch

Stony Brook University, Stony Brook, NY, United States

Bigger is Better, but only for a Little While

CANCELED

Both in marine an[illegible]erres[illegible] t[illegible], [illegible]ess typ[illegible]y inc[illegible]ses w[illegible]y [illegible] and selection [illegible]ssure [illegible]ze is [illegible]er[illegible]y [illegible]sitive. W[illegible] reviewe[illegible] te[illegible] for estimates of size [illegible] m[illegible]ty i[illegible] hi[illegible]ry [illegible]c[illegible]ed standardized selection differ[illegible]ials. We [illegible] tha[illegible] ov[illegible]hel[illegible] sel[illegible]on favored larger size at age and the stren[illegible] of this [illegible] n [illegible]s 5[illegible]mes th[illegible] seen in terrestrial taxa. However, most of these [illegible]udi[illegible] fo[illegible] [illegible] first few weeks of life and it is unclear whether selection

continues to favor larger size throughout fish life history. To address this question, we collected a common annual marine species, Menidia menidia, for the first third of their lifespan. We estimated size at previous ages and selection differentials using otoliths. We found that early in life selection tends to favor larger sizes, but that selection favors smaller sizes in juveniles.

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512 General Herpetology, Galleria South, Sunday 26 July 2009

Gad Perry, Mark Wallace, Howard Curzer, Peter Muhlberger

Texas Tech University, Lubbock, TX, United States

"Filling the Gap": Improving Education on the Ethics of Animal Use in Field Biological Research

Animal research is critical to herpetology, but scientists have few ethics guidelines to direct them: most existing regulations are focused on captive animals and may not be appropriate to field research. The absence of clear and appropriate guiding principles results in both unnecessary restrictions on some research and permission for ethically questionable research in other cases. The latter, and statements by prominent but poorly informed colleagues to the effect that tools such as toe-clipping constitute 'casual barbarity,' can harm the public image of scientists in this field. We are conducting an interdisciplinary project to develop refined ethical criteria for field research and educate graduate students in how to apply these criteria. In addition to the benefits to field studies, this project is attempting to create a unique research and pedagogical context that promises to advance environmental ethics. Our approach combines classroom teaching of new materials as they are being developed and refining them with participation of graduate students alongside IACUC members in the making of real decisions regarding field research. Benefits come from both classroom and apprenticeship pedagogical models. We will also rigorously test this novel pedagogical approach for enhancing professionals' ethical reasoning that could be applied in other scientific fields and may have important implications in the social sciences for how to enhance ethical reasoning on any complex issue. We are looking for appropriate herpetological case-studies that can be used in this program.

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946 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Sean Perry, Mitchell Mulks, Sora Kim, David Capser, Paul Koch, Barry Sinervo

University of California-Santa Cruz, Santa Cruz, CA, United States

The Influence of Hibernation on Diet-to-blood Fractionation Factors in the California Mountain Kingsnake (*Lampropeltis zonata*)

Stable isotope variations are progressively being used as tracers in animal ecology and physiology. Past experiments use stable isotope analysis to look at mammals, birds, and fish species; yet, few studies look at ectothermic animals. Ectotherms depend solely on their environment to regulate their metabolisms. Fluctuating metabolic rates and differences in physiology will change assimilation and allocation of dietary carbon and nitrogen. Captive experiments with endotherms demonstrate predictable fractionation and isotopic enrichment of carbon and nitrogen during times of stress or protein loss. However, no research explores carbon and nitrogen fractionation through hibernation in ectotherms. We used twenty California Mountain Kingsnakes (*Lampropeltis zonata*) to determine if diet-to-blood fractionation factors vary before, during, and after hibernation. The snakes were caught 2-4 years ago, fed mice after being brought into a controlled laboratory setting, allowing their tissues to equilibrate to the mice diet. From October 2008 to March 2009 subjects were hibernated at 13°C. Blood was repeatedly removed by cardiocentisis before, throughout, and after hibernation. Preliminary data suggest a correlation between mass loss/gain and fractionation factor. During hibernation, some individuals' carbon and nitrogen isotope values changed with mass loss. This trend is likely due to protein catabolism and deamination because the animals rely on their body reserves throughout hibernation. If hibernation influences stable isotope fractionation factors, an ectotherm's physiological condition will need to be accounted for in further studies using stable isotope analysis.

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809 Poster Session I, Exhibit Hall, Friday 24 July 2009

Cheston Peterson, Thomas Lankford

University of North Carolina Wilmington, Wilmington, NC, United States

Dental Sexual Dimorphism in Bluntnose Stingrays, *Dasyatis say*: Implications for Male Feeding Ability

Sexually dimorphic dentition has evolved in several species of Dasyatid stingrays wherein males replace their molariform teeth with cuspidate teeth during the mating season. Previous research has revealed that cuspidate dentition may increase male reproductive success through enhanced grip strength and improved ability to grasp and hold females during copulation. The replacement of cuspidate teeth with molariform teeth following each mating season is intriguing as it suggests that cuspidate teeth may

be inferior as feeding structures and may compromise a male's ability to crush hard-shelled prey during non-mating periods. We explored trade-offs in the evolution of dental sexual dimorphism in the bluntnose stingray (*Dasyatis say*) by testing for potential feeding-related costs of cuspidate dentition, including 1) comparing bite forces required by mating and non-mating teeth to crush shelled prey, 2) examining the susceptibility of mating teeth to damage during feeding, 3) testing whether tooth damage compromises male grip strength, and 4) investigating whether the diets of wild individuals vary with dentition type. Preliminary findings suggest there is no significant difference between forces required by either dentition to crush shelled prey; however, we found cuspidate teeth to be significantly more prone to damage when used to feed on shelled prey. Results and implications of cuspidate tooth damage on grip strength will be presented and discussed.

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314 Fish Ecology III, Pavilion West, Monday 27 July 2009

Mark Peterson, John Lopez

University of Southern Mississippi, Ocean Springs, MS, United States

Distribution and Habitat Characterization of the Saltmarsh Topminnow, *Fundulus jenkinsi*, Along the North-Central Gulf of Mexico

Fundulus jenkinsi occurs sporadically along the Gulf Coast from Galveston, TX to Escambia Bay, FL, appears to prefer Spartina marsh, and is generally believed to occur in low salinity. It is on the Federal Species of Concern list because of its connection to coastal wetlands which are being impacted by development although little is known about its habitat characteristics. We sampled across its range for two years and obtained 661 *F. jenkinsi* with associated habitat characteristics that were delineated by Principal Components Analysis (PCA). PCA explained 51.24% of the variation with PC I interpreted as a geomorphic marsh axis (33.00%) whereas PC II interpreted as a seasonal/spatial axis (18.24%). Sampling over a wide range of conditions, higher CPUE values occurred in low to moderate stem density (<50 stems), shallow to moderate depth (<30cm), and less steep slope sites (<20°) coupled with spring and very early summer water temperatures (>15°C), lower turbidity (<60 NTU), and low to moderate salinity; the majority (77.5%) of them were collected when salinity <16. We verified their distribution Barataria-Terrebonne, LA through Escambia Bay, FL with the majority being collected from Weeks Bay, AL. PCA showed a narrow distribution within these basins as compared to other fundulids with more individuals during the spring and summer (increased juveniles). Our data suggests seasonal cues such as water temperature, salinity, and turbidity may be influencing reproduction and spawning whereas water depth, bank slope and stem density (geomorphic characters) influenced CPUE and distribution when nested within the seasonal/spatial axis.

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850 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Frank Pezold, Yongjiu Chen

Texas A&M University - Corpus Christi, Corpus Christi, TX, United States

Genetic Variation in the Genus *Kribia* (Eleotridae) in Guinea, West Africa

African pygmy sleepers (*Kribia*) are a group of small morphologically conservative freshwater fishes native to Nilo-Sudanian and west central Africa. In this study, we characterize DNA sequence divergences among different geographically isolated populations in Guinea, West Africa, using mitochondrial cytochrome-b (Cyt-b) and the nuclear S7 ribosomal protein intron (S7-I) genes. We recovered 1,136 base pairs Cyt-b DNA sequences from 106 specimens of *Kribia* sp., and identified a total of 44 distinct mitochondrial haplotypes. A phylogeny based on Cyt-b sequence variation shows three significantly distinct lineages, among which the overall sequence divergences are in the range of 10-20%, and several distinct clades within those lineages. Primary sequence data of S7-I (784 base pairs) present less variation than those of Cyt-b, but the two genes share a concordant topology of phylogeny. All haplotypes, but one, were site specific. Preliminary studies suggest some concordance between molecular divergence and differences in pigmentation.

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427 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Nicole Phillips[1], Jennifer Chaplin[1], David Morgan[1], Stirling Peverell[2]

[1]Centre for Fish & Fisheries Research, Murdoch University, Murdoch, Western Australia, Australia, [2]Queensland Department of Primary Industries & Fisheries, Sustainable Fisheries, Northern Fisheries Centre, Cairns, Queensland, Australia

Conservation Genetics of Pristis Species in Australian Waters

Information on the conservation genetics of the Critically Endangered (IUCN) sawfishes *Pristis microdon*, *P. zijsron* and *P. clavata* in northern Australia, which is believed to be their last stronghold, is vital to the development of management plans. Since these three species have different habitat requirements, such information also provides the opportunity to investigate whether their population structures vary with habitat usage. Nucleotide sequence variation in a portion of the control region of the mitochondrial DNA was used to investigate the extent to which the assemblages of each of these three species in the northwest and northeast of Australia are connected and also to compare the levels of genetic diversity in these assemblages. The results indicate that *P. microdon*, which utilizes freshwater rivers as juveniles and marine waters as adults, exhibits strong genetic subdivision between these two regions (F_{ST}=0.314; P = 0.000; N = 92). In contrast, *P. zijsron* and *P. clavata*, which spend their entire life in marine and/or estuarine waters, exhibited less genetic subdivision between the northeast and northwest. The overall

level of genetic diversity for each species was moderate, however, the assemblages in the northeast appear to have lower genetic diversity than those in the northwest of Australia. The results suggest that populations of *Pristis* sawfishes tend to be spatially restricted and management plans should be developed accordingly.

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364 Herp Biogeography, Galleria North, Saturday 25 July 2009

Ivan Phillipsen[1], Anthony Metcalf[2]

[1]Oregon State University, Corvallis, OR, United States, [2]California State University, San Bernardino, CA, United States

Phylogeography of a Stream-dwelling Frog (*Pseudacris cadaverina*) in Southern California

Recent phylogeographic studies of animal taxa in southern California have revealed common geographic patterns of evolutionary divergence and genetic diversity that are generally attributable to landscape influences. However, few studies have focused on the evolution of freshwater taxa in this region. Here, we investigate phylogeographic patterns in a stream-dwelling frog (*Pseudacris cadaverina*). Using sequence data from 1100 bp of mitochondrial DNA, we conducted phylogenetic analyses, analysis of molecular variance, and nested clade phylogeographic analysis to gain insight into the factors contributing to the distribution of genetic diversity in *P. cadaverina*. We tested hypotheses that genetic diversity in this species is partitioned into 1) major watersheds, 2) mountain ranges, and 3) coastal and desert regions. There is strong support for two major phylogenetic clades and evidence for a "Transverse Range Break," found in several other taxa. Genetic diversity appears to have been influenced by barriers in the form of watershed boundaries and lowlands separating mountain ranges, whereas no strong division exists between coastal and desert populations. Our results suggest that the eastern Transverse Ranges are the center of origin for extant *P. cadaverina* lineages and that the overall phylogeographic pattern for this species is the result of restricted gene flow among largely disjunct populations, with connectivity among populations mediated by landscape barriers.

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68 Snake Ecology, Pavilion East, Monday 27 July 2009

Josh Pierce, Craig Rudolph

US Forest Service, Nacogdoches, TX, United States

Home Ranges and Movement Patterns of Louisiana Pine Snakes (*Pituophis ruthveni*) in Texas and Louisiana

A limited number of studies on the ecology of the Louisiana Pine Snake (*Pituophis ruthveni*) have been published despite the thought that they have been extirpated from large portions of their historic range. Extant populations are currently known from a limited number of small and fragmented localities in eastern Texas and west-central Louisiana. Using radiotelemetry, we determined the home ranges and movement patterns of Louisiana Pine Snakes (8 males, 8 females) in 5 study areas (2 in Louisiana and 3 in Texas). Annual active season home ranges ranged from 4.0 - 117.4 ha using 95% Minimum Convex Polygons. Annual home ranges within and among individuals often overlapped. The mean annual active season (Mar. - Oct.) home range size of 41 ha is relatively large for the genus. This is, at least partially, due to fragmentation of suitable habitat. Individual snakes that crossed unsuitable habitat to access blocks of suitable habitat, had larger home ranges than those that did not. Movements during the colder months (Nov. - Feb.) were greatly curtailed compared to the remainder of the year, and we had no evidence that snakes fed during this period. However snakes still often undertook substantial movements. Snakes exhibited no winter dormancy site fidelity within or among individuals. The increased understanding of home range parameters provided should assist those involved in management of *P. ruthveni* as they make decisions concerning the size of landscapes necessary to maintain viable populations.

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748 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Lindsey Pierce, James Willey, Erin Crawford, Carol Stepien

University of Toledo, Toledo, OH, United States

Developing a Rapid Molecular Assay with Internal Controls for Detecting the VHS Fish Virus

The emerging viral hemorrhagic septicemia (VHS) disease is caused by a unique new strain of rhabdovirus (IVb) that broke out Great Lakes regions during the springs 2006-8, causing massive fish die-offs that threaten fisheries, economic development, tourism, and public health perception. The virus is transmitted at spawning time and can live for days in the water; causing deaths in yellow perch (*Perca flavescens*), muskellunge (*Esox masquinongy*), and drum (*Aplodinotus grunniens*), among others. The danger of spread to aquaculture systems is potentially high, and the virus appears to spread in some baitfish. Our goal is to develop a key genetic tool for rapid and accurate detection of the

virus in infected fish, and test our results against the current "gold standard" conventional cell culture (a month-long process). We are developing an accurate and reliable molecular genetic test based on standardized reverse transcriptase polymerase chain reaction (StaRT-PCR) technology, which has built-in internal controls, enabling rapid and cost-effective detection of the virus. Our test is designed with intrinsic quality control, a low detection threshold, and detects and identifies among all variant VHS strains; eliminating problems with false negatives and positives inherent in most other PCR tests. This test will markedly improve rapid, reliable, and accurate verification of VHS outbreaks within hours, aiding fishery management and disease control efforts.

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189 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Kyle Piller[1], Carys Kenway-Lynch[1], Rebecca Blanton Johansen[2]

[1]Southeastern Louisiana University, Hammond, LA, United States, [2]Florida Museum of Natural History, Gainseville, FL, United States

Habitat Fragmentation and Genetic Population Structure of Three Etheosotomatine Darters in the Duck River, TN

The greenside (*Etheostoma blennioides newmanii*), fantail (*Etheostoma flabellare*), and rainbow darters (*Etheostoma caeruleum*) are three abundant species found throughout the Duck River, Tennessee. We assessed genetic variation and structure from multiple populations for these species throughout the river system. Due to their varied ecological niches and life histories, we expected differing levels of population structure. A total of eight different microsatellite loci were analyzed from six different locations along Duck River. Five loci from 3 to 4 populations were scored for each individual species and were analyzed using multiple population genetics tools. It was found that the highest level of genetic structure (F_{ST}=0.0842) was present in *E. flabellare* with the lowest levels being found in *E. blennioides newmanii* (F_{ST}=0.0338). *Etheostoma caeruleum* had an intermediate level of population structure (F_{ST}=0.0454). Significant isolation by distance effects were shown for *E. blennioides newmanii* (r=0.5494) and *E. flabellare* (r=0.5027). The results of this study are consistent with the predictions based on previous life-history studies of these species.

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776 Poster Session I, Exhibit Hall, Friday 24 July 2009

Danillo Pinhal[1], Otto B. F. Gadig[2], Mahmood Shivji[3], Cesar Martins[1]

[1]Sao Paulo State University - UNESP, Botucatu/SP, Brazil, [2]Sao Paulo State University - UNESP, Sao Vicente/SP, Brazil, [3]Nova Southeastern University, Oceanographic Center, Dania Beach, FL, United States

Genetic Identification of *Rhizoprionodon* Shark Species Employing Nuclear DNA Sequences

The sharpnose sharks *Rhizoprionodon lalandii* and *R. porosus* account for approximately 50 to 60% of all sharks caught by commercial and artisanal fisheries in Brazil. One problem concerning the *Rhizoprionodon* group is that they are difficult to distinguish based on morphology alone which, in combination with the common finning practice, hinders the monitoring of catch and trade of meat, fins and derivatives in a species-specific manner. Here, a molecular approach based on nuclear 5S rDNA sequence variability was applied successfully to correctly identify samples from the two *Rhizoprionodon* species collected in the wild or sold in markets. The sequence of the non-transcribed spacer (NTS) of the 5S rDNA showed high interspecific variability and no intraspecific polymorphism, making it a useful marker for sharpnose shark identification. Polymorphisms in the NTS sequences of *Rhizoprionodon* sharks also created unique restriction patterns for each species after PCR-RFLP analysis. This approach represents an efficient way to differentiate the two closely related shark species and can be used to reinforce morphological identification, allowing effective traceability of *Rhizoprionodon* sharks in future management studies.

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264 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Susanna Piovano

Dept. Animal Biology, Torino University, Torino, Italy

Hooks, Baits and Lights - Mitigation of Pelagic Stingrays Fishing Bycatch

The reduction of incidental catch of unwanted species during fishing operations has been identified among top priorities in fisheries management. The pelagic stingray *Pteroplatytrygon violacea* is listed among the main unwanted captures in longlining. In 2005-2007, 97 experimental longline fishing sets were run in the Strait of Sicily, central Mediterranean Sea, to verify the importance of hooks size and shape, baits size, and light attractors presence and type on the stingray capture rate. 9 vessels targeting swordfish were involved. A total of 222 pelagic stingrays were captured. Results highlighted the importance of hooks size and, among wide hooks, of the circular shape, that obtained the lower stingrays bycatch rate. On the contrary, nor the size of the fish

baits, neither the presence and type of light attractors had a significant effect. *P. violacea* is now listed among IUCN Near Threatened species in the Mediterranean Basin. Results suggest that the introduction of wide circle hooks into local management planes for swordfish longline fisheries can play an important role in the conservation of the pelagic stingray in the Mediterranean Sea.

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532 Snake Conservation, Pavilion West, Monday 27 July 2009

Renata Platenberg, Daniel Harvey

Division of Fish and Wildlife, St. Thomas, Virgin Islands, U.S.

Endangered Species and Land Use Conflicts: Identifying habitat for the Virgin Islands Tree Boa (*Epicrates monensis granti*)

Wildlife conservation often takes a back seat to economic development, particularly on islands where land is limited. This is especially so in the US Virgin Islands (USVI), where coastal areas are being converted into upscale developments. Intense and unmitigated development pressures in recent decades has presumably resulted in significant loss of habitat for the endangered Virgin Islands Tree Boa (*Epicrates monensis granti*). This species is cryptic, nocturnal, and difficult to locate, and as such baseline information on its status and distribution is incomplete. In the face of ongoing development, it has become urgent to identify areas where this species is likely to occur in order to initiate conservation measures. Using geographic information systems and ad hoc observations collected over 25 years, we created a habitat suitability model for E. m. granti that allowed for the prediction of presence in any particular area within its known range. Microhabitat assessments were conducted to better understand habitat associations at a fine scale. Using this information, we developed a habitat delineation protocol for identifying habitat patches within a specific location. We use the habitat suitability model to prioritize areas for conservation, and require developers to conduct habitat delineation to identify areas requiring protective measures. Although this process is still in its infancy, there has been some success in scaling back development and directing restoration efforts.

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669 Lizard Ecology, Pavilion East, Friday 24 July 2009

Steven Poe, J. Tomasz Giermakowski, Eric Schaad, Ian Latella, Erik Hulebak, Mason Ryan

University of New Mexico, Albuquerque, NM, United States

Ancient Colonization Predicts Recent Naturalization in *Anolis* Lizards

Invasive species are a global concern due to resulting economic losses and extinction of indigenous wildlife. Three general hypotheses may explain the distributions and characteristics of invaders. First, invasive patterns may be due to novel anthropogenous processes of world biogeography such as transport of propagules on ships. Conversely, the unprecedented connectivity of humans may cause a simple acceleration of omnipresent ecological and evolutionary forces. Finally, as a null hypothesis, there may be no human effect. The first hypothesis predicts that invaders will possess unusual characteristics specific to interactions with humans. The latter two hypotheses predict similarity between ancient colonizers and recent invaders. Here we present the first tests of the latter hypotheses and show how they may be reconciled with the former. We show that species of Anolis lizard that are ancient colonizers share characteristics of anatomy, geography, phylogeny, and ecology with recently naturalized species of *Anolis*. Remarkably, characteristics of ancient colonizers are better predictors of naturalized invaders than are characteristics of naturalized species themselves. These results indicate that contemporary patterns of invasion are at least partially explained by omnipresent natural processes. However, some of the unusual traits of ancient colonizers are known to be associated with species that inhabit human-altered environments. Thus although modern invaders appear analogous to ancient colonizers—a basic assumption of invasion biology since Darwin—the unusual traits of ancient colonizers seem also to favor modern coexistence with humans.

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473 Herp Conservation II, Grand Ballroom II, Monday 27 July 2009

Karen Pope[1], Jonah Piovia-Scott[2], Hartwell Welsh[1], Sharon Lawler[2]

[1]US Forest Service Pacific Southwest Research Station, Redwood Siences Lab, Arcata, CA, United States, [2]UC Davis, Davis, CA, United States

Lentic-breeding Amphibians of the Mountains of Northern California: Status and Threats

The Klamath-Siskiyou Mountains and southern Cascades support a high diversity of native lentic-breeding amphibians including the Cascades frog (*Rana cascadae*), long-toed salamander (*Ambystoma macrodactylum*), rough-skinned newt (*Taricha granulosa*), western toad (*Bufo boreas*) and Pacific treefrog (*Pseudacris regilla*). Since 1999, we have studied

their distributions, status and threats throughout these ranges in California using both large-scale surveys and whole-lake experiments. Primary known threats include introduced species, disease, and altered hydrologic regimes. Based on extensive surveys, we found a negative correlation between introduced trout and three species, *R. cascadae*, *A. macrodactylum*, and *P. regilla*. We followed with a replicated experiment in which we removed fish from four lakes and quantified the impact of fish and the recovery of R. cascadae following fish removal. We found dramatically increased survival and recruitment of frogs at the trout removal lakes. Currently we are studying the distribution and virulence of the deadly amphibian disease chytridiomycosis caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*). In the summer of 2008 we performed a 140-lake survey of amphibians at sites that were inhabited by *R. cascadae* 6 - 9 years ago. We collected over 2000 swabs from seven species of amphibians; 1030 swabs have thus far been tested for *Bd* using qPCR. Approximately 14% of these swabs tested positive for the pathogen. Positive sites occur throughout the Trinity Alps Wilderness and southern Cascades, as well as in the Marble Mountains Wilderness and the Shasta-Trinity National Forest. The implications for populations of *R. cascadae* and other native amphibians will be discussed.

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228 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Marianne E. Porter, John H. Long Jr.

Vassar College, Poughkeepsie, NY, United States

Non-linear Viscoelasticity of Cartilaginous Vertebral Columns during Bending

The number and shape of vertebrae are important predictors of body curvature in sharks during routine turns. However, morphological correlates such as these predict only about 50% of body curvature among five species. We are interested in determining what other non-morphological and non-muscular features may be correlated with body curvature during swimming. Specifically, we predict that dynamic mechanical properties of the vertebral column in bending will be important determinates of whole-body curvature. As a first step in testing this prediction, we sought to determine the dynamic mechanical properties of cartilaginous vertebral columns and their response to varying frequencies, amplitudes, and length of the moment arm to reflect the loading of a shark swimming at varying speeds. We designed a rig that allowed us to measure the mechanical properties using a MTS Tytron 250 one-axis testing machine. In these tests, we used ten–centra-long segments of vertebral columns from three *Squalus acanthias*. Stiffness, a structure's ability to resist loading, measured by the elastic modulus (E, in MPa), increases with frequency and is almost 2X greater at bending frequencies of 2.0 Hz than at 0.5 Hz. Additionally, stiffness increases with testing amplitude by more than an order of magnitude, and stiffness is greatest at the shortest moment arms. These data

contribute to the growing understanding of how cartilaginous skeletons respond to loads, and how those responses are correlated with morphology and swimming performance. This work was supported by NSF DBI-0442269.

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690 Herp Biogeography, Galleria North, Saturday 25 July 2009; ASIH STOYE AWARD GENERAL HERPETOLOGY

Daniel Portik

Villanova University, Villanova, PA, United States

Phylogeography of a Skink Species from Southwestern Africa

Trachylepis sulcata is a species of lygosomine skink that is broadly distributed in the western portion of southern Africa. It exhibits chromatic variation across its range from southwestern Angola to the Eastern Cape of South Africa, and a melanistic subspecies, *T.s.nigra*, has been described from Lüderitz Bay, Namibia. To examine population structuring in *T. sulcata* and the validity of the subspecies *T. s. nigra*, three nuclear genes (totaling 2644 bp) and two mtDNA genes (totaling 2075 bp) have been analyzed for 86 individuals sampled across 64 unique localities. Results indicate nearly all genetic diversity in *T. sulcata* is contained in northern Namibia, and remarkable genetic homogeneity is maintained across populations from southern Namibia to the Eastern Cape (a distance of 1175 km). This is most appropriately explained by a southward range expansion of this species during a period of rapid warming (5-10°C) and increased humidity following the last glacial maximum (17,000-18,000 yr BP). *T. s. nigra* is not genetically distinct from *T. sulcata*, and the melanism in this population represents an adaptation to the high number of fog days present in this geographic area. Melanistic forms have been recorded from at least five localities in southern coastal Namibia, all within 60 km of the coast with 75-125 fog days per year. *T. sulcata* is excluded from Walvis Bay, a more northern area with greater than 125 fog days per year. This result is consistent with similar studies of melanistic forms of cordylid lizards also found in southern Africa.

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765 Fish Genetics II, Parlor ABC, Monday 27 July 2009

David Portnoy, Mark Renshaw, Chris Hollenbeck, John Gold

Texas A&M University, College Station, TX, United States

Linkage Mapping in the Red Drum, *Sciaenops ocellatus*

In protecting biota modern conservation and management efforts should strive to preserve genetic resources and evolutionary potential within individual species. For

widely distributed, exploited marine species, this means identifying geographic assemblages that possess localized adaptive variation. This poses a problem for traditional population-genetic approaches because high gene flow tends to homogenize neutral genetic variation, even in the face of localized selection. A population genomics approach that surveys large portions of the genome to distinguish between areas under selection and those that are neutral is required. Linkage mapping is a vital first step in this process. Red drum, *Sciaenops ocellatus*, are heavily exploited in recreational fisheries along both the Gulf of Mexico and southeast Atlantic coasts of the United States. The intense overfishing has precipitated stock-enhancement programs in Texas, Florida, Georgia, and South Carolina, where hatchery-raised fingerlings are released into coastal waters. The current status of the species, its wide distribution, and access to progeny from known mating pairs make this an ideal species for genomic mapping. Here we present results of sex-specific genetic linkage mapping. The present map is constructed with more than 200 microsatellite loci and will provide a new 'tool' for stock identification and more effective conservation and management of red drum resources. Implications and future directions of red drum genomics are also discussed.

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385 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Gary Powell

Aquatic Science Associates, Austin, TX, United States

Graduate School in the 1970's with Professor Clark Hubbs

Not all graduate students came from famous academic families like Hubbs. Quoting Mark Twain, Dr. Hubbs reminded us that a "cauliflower is nothing but a cabbage with a college education." And in his own way, he constantly reminded us that an advanced education is primarily a progressive discovery of our personal level of ignorance. He showed us that a successful career in science involves the ability to go from one failure to another with no loss of enthusiasm for the outcome. He knew that evolution had given us two ends-one to sit on and the other to think with, and he believed that success would depend upon which one we used the most! Moreover, he cautioned us not pursue science for wealth, saying that we will find that the wretchedness of being rich is that you have to live among other rich people.

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514 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD I, Galleria North, Sunday 26 July 2009

Sean Powers, Roger Anderson

Western Washington University, Bellingham, WA, United States

How Does Spatial Variation in Climate Cause Spatiotemporal Patterns in Lizard Energetics?

CANCELED

A lizard's ability to be active and to acquire food for growth, stor[illegible] r[illegible]ion is expected to be seasonally constrained by the comp[illegible] of phe[illegible] that comprise climate. Hence variation in climate [illegible] lo[illegible]es sh[illegible] ho[illegible] they constrain lizard activity and pr[illegible]n. [illegible]he we[illegible]rn fe[illegible] lizar[illegible] (*S[illegible]porus occidentalis*) occupies a [illegible] ecosyst[illegible] Californ[illegible] central Washington. T[illegible] loca[illegible] that co[illegible]asted m[illegible] in climate [illegible]ington state, in the [illegible]ern e[illegible] of th[illegible] g[illegible]graphic [illegible] temperate forest and the w[illegible] p[illegible] w[illegible] of [illegible]'s [illegible]. How *S. occidentalis* is affected by t[illegible] geogra[illegible] [illegible] exa[illegible]ned by correlating daily and seasonal patterns of [illegible] pr[illegible]pitation, and cloud cover with the patterns of lizard daily [illegible] e[illegible]penditure, feeding rates and food availability along with related a[illegible] of lizard population structure. Despite the greater food availability in summer for coastal lizards, the lizards in the warm, sunny woodland were larger, perhaps because of greater annual growth , associated with longer daily activity periods and longer activity seasons. Currently, the optimum climates for this species are not known, but future investigations of elevational and mesic-xeric gradients may enable predictions of population structure and population density patterns in the face of climate change.

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571 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Daniel Preston[1], Craig Mosley[2], Robert Mason[1]

[1]Oregon State University, Corvallis, OR, United States, [2]Canada West Veterinary Specialists & Critical Care Hospital, Vancouver, BC, Canada

Improved Anesthesia Protocol Using Brevital Sodium in Snakes

Variability in the depth and duration of anesthesia in individuals within a species is frequently observed, yet few studies have investigated its causes in reptiles. To evaluate potential causes of variability in reptile anesthesia, we conducted experiments to test for effects of body temperature, body condition, gravidity and time post-feeding on the duration of brevital sodium anesthesia in Red-sided Garter Snakes (*Thamnophis sirtalis parietalis*). Mean times to righting ability of snakes anesthetized at 21°C were twice as

long as snakes at 31°C. Lean snakes (those with lower mass/SVL ratios) regained righting ability 60% more slowly than heavy snakes. Gravid snakes anesthetized within 5 weeks of parturition had a mean time to righting ability that was twice as long as nongravid snakes of a similar mass. Time post-feeding did not have a statistically significant effect on the time to righting ability in snakes that were anesthetized one, three and ten days after consuming 30% of their body mass in food. Recommendations for producing more predictable results when using brevital sodium in reptiles are given and an equation to predict the effective dosage based on body temperature and body condition in *T .s. parietalis* is proposed.

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318 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Margaret Ptacek

Clemson University, Clemson, SC, United States

Using Mollies as a Model for the Evolution of Mating Signal Divergence

Sailfin mollies provide a model of how divergence in mating behaviors has led to speciation. Using a comparative approach to understand signal divergence, I quantified mating behaviors and associated morphology among the sailfin mollies, *P. latipunctata*, *P. velifera* and *P. petenensis*. Males of all sailfin species perform three mating behaviors: courtship displays, gonopodial thrusts and gonoporal nibbles, despite males of *P. latipunctata* having secondarily lost the exaggerated dorsal sailfin. The two species of sailfin mollies from the Yucatán peninsula, *P. velifera* and *P. petenensis*, differ primarily in individual variation in mating behavior profiles. Males of *P. velifera* show evidence of an alternative male mating strategy where small males perform few to no courtship displays, but high rates of gonopodial thrusts. Males of all size classes of *P. petenensis* perform courtship displays and gonopodial thrusts at similar rates. The range of variation in male size is greatest for *P. velifera* (22 – 89 mm SL) and this species shows the strongest allometry between male SL and dorsal fin size (slope = 4.5). Greater divergence in morphology among males of different sizes may promote the expression of the alternative male mating behaviors (courters versus sneakers) that appears to be lacking in other species of sailfin mollies. Sailfin molly species share characteristic courtship displays that are associated with divergence of the sailfin lineage from shortfin molly ancestors. Yet, variation within species in relative reliance on different mating strategies likely promoted the species differences observed in mating behavior profiles among sailfin species.

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445 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Jennifer Purrenhage[2], Michelle Boone[1]

[1]Miami University, Oxford, OH, United States, [2]University of New Hampshire, Durham, NH, United States

Canopy Cover Impacts American Toads (*Bufo americanus*) in Multiple Life Stages

Individual performance and species richness of pond-breeding amphibians have been shown to transition across environmental gradients, including canopy cover. However, very few studies have followed individuals beyond metamorphosis to determine the influence of canopy cover on both aquatic and terrestrial life stages. We conducted complementary aquatic and terrestrial field experiments to evaluate the impacts of open-canopy and closed-canopy aquatic and terrestrial habitats on larval and juvenile American toads (*Bufo americanus*). Toads from closed-canopy pond mesocosms exhibited greater survival to metamorphosis and were on average larger at metamorphosis than toads from open-canopy ponds. However, although toads from open-canopy ponds were smaller at metamorphosis, they exhibited compensatory growth as terrestrial juveniles in forested habitats. Toads from both open- and closed-canopy ponds had very low survival as juveniles in unforested (i.e., open field) relative to forested terrestrial habitats. Both aquatic and terrestrial canopy cover had strong impacts on growth and survival of larval and juvenile toads; taken together, our findings suggest that the availability of suitable terrestrial habitat may ultimately determine juvenile recruitment, and thus the likelihood of population persistence, for this species.

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205 Fish Ecology I, Pavilion East, Friday 24 July 2009

Brad Pusey, Mark Kennard, Angela Arthington, Ben Stewart-Koster

Australian Rivers Institute, Queensland, Australia

Sources of Variation in Trophic Structure of Fish Assemblages in Rivers with Variable Flow Regimes

Variability is a key feature of the flow regimes of many Australian rivers. In this study we examine the trophic structure of fish assemblages in the Burdekin River, a large subtropical basin with a variable flow regime. Dietary information was collected from 12 locations throughout the river over a three year period encompassing a 1/20 year flood and entry into severe drought. When data were pooled across locations, sampling occasions and size classes, fish diets were found to be highly similar and chiefly centred

on benthic micro-algae and small invertebrates such chironomid larvae and Trichopteran and Ephemeropteran nymphs. Subsequent examination of spatial, temporal and ontogenetic variation revealed that spatial and temporal variation in trophic structure were inconsequential (1.8 and 2.2% of total variation, respectively). Species identity accounted for 37.6 % of the perceived variation whereas fish size and the interaction between species and size accounted for an additional 4.3% and 2.1%, respectively. Clearly, generalism in food use was widespread. We postulate that in a highly variable river such as the Burdekin River, generalism may be the most profitable trophic strategy. We use two recently developed tools, the Australian Hydrological Classification and the Northern Australian Freshwater Fish database to show that many rivers of northern Australia have a similarly variable flow regime as the Burdekin River and share a fauna similar to that studied in the Burdekin River. Consequently, we are confident that the trophic pattern observed in the Burdekin River is likely to occur across much of northern Australia.

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635 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Breanna Putman

Cal Poly State University San Luis Obispo, San Luis Obispo, CA, United States

Comparative Home Range Sizes of a Population of the Northern Pacific Rattlesnake (*Crotalus o. oreganus*) in Central California

The Northern Pacific Rattlesnake (*Crotalus o. oreganus*) is a relatively poorly studied species of rattlesnake. Different populations and species of rattlesnakes exhibit varying behaviors, movement patterns, and spatial ecology. This study on *C. o. oreganus* allows us to compare its natural history to that of other species. Twenty snakes were tracked using radiotelemetry in the Carrizo Plain of Central California. Home range estimates of male and female snakes were constructed using a set of global positioning system (GPS) location points collected over a 3 year period. The GPS points in conjunction with geographic information system (GIS) software were used to construct minimum convex polygon and kernel density estimates to determine the approximate home range sizes of the snakes. Males have significantly larger home ranges than females using all estimates (about 8 times larger). However, males also have longer snout to vent lengths (SVL) and are higher in mass than females, meaning that larger snakes have larger home ranges. Most long movements of the snakes occurred during the spring when males are seeking mates, and females rarely made long movements. Therefore home range size and spatial ecology of *C. o. oreganus* is affected by many variables including sex, size, and season.

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23 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Mark Pyron[1], Lance Williams[2], Stephen Jacquemin[1], Jayson Beugly[1]

[1]Ball State University, Muncie, IN, United States, [2]University of Texas at Tyler, Tyler, TX, United States

Detection of Stream Fish Assemblage Structure with Functional Groups and Taxonomy

The predominant approach to examining fish assemblage variation for streams is taxonomy-based. These analyses are useful in examination of spatial and temporal variation in and among watersheds. However, Hoeinghaus et al. (2006) showed that functional guilds in analyses at the scale of watersheds of Texas provided additional correspondence with local habitat or ecosystem variation. We examined two datasets of stream fish assemblages to compare the use of taxonomic and functional guilds in identification of spatial and temporal trends using multivariate analyses. Our Wabash River dataset includes 25 years of boat electrofishing collections over a 230-km river distance. The Indiana Department of Environmental Management dataset includes 1220 stream sites in the state of Indiana that were collected from 1996-2007. We compared several functional group approaches: reproductive guilds of Balon (1975), life history axes of Winemiller and Rose (1992), index of biotic integrity metrics as scored by Hitt and Angermeier (2008), functional guilds of Poff and Allan (1995), and the ecosystem effects guilds from Matthews (1998). The taxonomic analysis of the Wabash River dataset was proficient at identification of the river distance assemblage variation. The reproductive, functional groups, and IBI functional categories provided the best explanation of temporal variation for the Wabash River data. The taxonomic analysis of the IDEM data provided reasonable explanation of geographic variation. The strongest explanation of habitat variation was using Balon's reproductive guilds, followed by Matthews ecosystem guilds, and the other approaches.

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365 Fish Ecology II, Pavilion East, Sunday 26 July 2009

Andrea Quattrini[1], Michael Carlson[2], Steve Ross[2], Martha Nizinski[3]

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Fish-Habitat Relationships at a Deepwater Coral Mound off North Carolina, USA

Deep-sea corals provide important habitat for many species; however, the extent of species-specific associations with corals or other physical variables is uncertain. Deep

coral reefs on the southeastern U.S. slope were surveyed (2000-2007) using multibeam sonar and the Johnson-Sea-Link (JSL) submersible, allowing examination of faunal-habitat relationships. The Cape Fear mound, an isolated, topographic high off North Carolina (368-449 m depth), appears to be formed by successive growth, collapse, and sediment entrapment of *Lophelia pertusa*. A digital terrain model (from the multibeam data) of the Cape Fear mound allowed calculation of altitude, slope, aspect, curvature, and rugosity (Landserf, ArcGIS). Four general substrata types were classified using video from nine JSL dives: sand, sand-rubble, rubble, and hard coral. Hard coral habitat was further differentiated by vertical profile, percent bottom coverage, and percent live coral coverage. Fish abundances from video transect data were linked to habitat characteristics along each corrected, navigational dive track. Canonical correspondence analysis indicated that habitat characteristics, particularly profile, aspect, altimetry, and coral coverage, influenced observed faunal spatial patterns. Dominant fishes, *Beryx decadactylus* and *Conger oceanicus*, were most abundant on the southwest facing (upcurrent) slope near the top of the mound in high profile, high coverage, hard coral areas. *Laemonema barbatulum* and *Helicolenus dactylopterus* were most abundant in low profile habitats, while *Polyprion americanus* was most abundant in moderate profile, high coverage hard coral. Applying these methods to additional deep reef data collected off the southeastern U.S. coast would incorporate more diverse habitat types and elucidate regional-scale, faunal-habitat relationships.

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525 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Cristina Rade, Andrea Ward

Adelphi University, Garden City, NY, United States

Fin Reduction and Loss in Ostariophysan Fishes

Highly elongate body forms are found in most major groups of vertebrates. Limb reduction and loss has often been linked to body elongation in tetrapods. Fewer studies have focused on whether there is a correlation between body elongation and reduction or loss of the paired fins in fishes. In this study, we examined the relationship between body shape and fin size and morphology in ostariophysan fishes. We collected morphometrics of the body and fins from 22 species including members of Cypriniformes, Gymnotiformes, and Siluriformes. To determine whether reduction of the fins is correlated with a simplification of the musculoskeletal anatomy, we also described fin anatomy from two species: the stout-bodied *Carassius auratus* and the highly elongate *Apteronotus albifrons*. All of the species we examined had pectoral fins. Six species did not have pelvic fins and those species without pelvic fins were significantly more elongate than species with pelvic fins. In addressing the question of reduction of the paired fins, we found that body elongation was negatively correlated with length and width of the pectoral fins. Surprisingly, we found that the musculoskeletal anatomy of the pectoral fin was more complex in the elongate knifefish. It is likely that the increase in number of fin muscles is associated with fin use during

locomotion. This work will provide an understanding of how fin size and anatomy differs among related species that range in body elongation. We are extending this work to include other lineages of actinopterygian fishes that have elongate members.

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37 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Gabrielle Radik, Donald Miles

Ohio University, Athens, OH, United States

Assessing Risks of Amphibian Declines Using Multiple Stressors in Field Surveys and Lab Experiments

We used an integrative approach to investigate the impact of *Batrachochytrium dendrobatidis* infection and atrazine contamination on amphibian populations in Southeastern Ohio. We conducted a survey of amphibian communities by testing water samples from breeding pools for atrazine, and testing tissue samples from over 200 adults of 8 amphibian species for *B. dendrobatidis* DNA. In addition, *Rana pipiens* tadpoles were reared in aquaria and exposed to *B. dendrobatidis* or atrazine or both in a factorial design. Several breeding ponds near cultivated land in SE Ohio were contaminated with atrazine. None of our tissue samples tested positive for *B. dendrobatidis*. The absence of *B. dendrobatidis* from this area, when it has been found in many adjacent localities, raises questions about local resistance to the pathogen, as well as the transmission patterns in North America since the first known infections of five decades ago. Tadpoles in the combined atrazine and *B. dendrobatidis* treatment did not experience increased mortality, but there were significant sublethal effects. These tadpoles weighed less than tadpoles of the same developmental stage and length in other treatments. Tadpoles in poor condition may have less energy to put toward survival, so this cross-factor effect may have a notable impact on population recruitment. The independent effects of chytridiomycosis and atrazine exposure are already serious threats to amphibian populations. Both factors can influence amphibian species over broad geographic regions. We suggest that amphibian populations in areas subject to both of these factors should be more closely monitored for decline.

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757 Herp Ecology, Galleria North, Monday 27 July 2009

Thomas Radzio[1], David Delaney[2], Joseph Hackler[1], Matt Hinderliter[3], Andrew Walde[1]

[1]ITS Corporation, Atascadero, CA, United States, [2]U.S. Army Construction Engineering Research Laboratory, Champaign, IL, United States, [3]The Nature Conservancy, Camp Shelby Field Office, Camp Shelby, MS, United States

Overwintering Ecology of Gopher Tortoises in Southern Mississippi

During cool fall and winter months, Gopher Tortoises (*Gopherus polyphemus*) inhabiting middle to northern regions of the species' range may remain in their burrows for long periods and limit surface activity to particularly warm days. However, many aspects of this period of greatly reduced activity remain undocumented, including energetics, thermal ecology, and emergence cues. Using video cameras, activity monitoring systems, and temperature data loggers, we conducted a 6-month (October 2006-March 2007) study of the overwintering ecology of adult Gopher Tortoises in southern Mississippi. From mid-November until early March, tortoises only emerged on unseasonably warm days. However, even on days when they were not active above ground, they occasionally made movements within their burrows, which may play some role in their ability to detect favorable surface conditions. Potential cues for winter emergence may include reduced burrow thermal heterogeneity and thermal inversions near the burrow entrance. We did not observe tortoises to forage between mid-December and late February. However, some tortoises foraged in the fall until the final day(s) before they were no longer observed above ground for weeks or months, suggesting that they may have continued to digest consumed vegetation from within their warm burrows. A better understanding of the digestive physiology of Gopher Tortoises may be necessary to fully understand their overwintering strategy and how this species may benefit from occasional activity during the coolest months of the year.

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691 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Sarah Rages[1], Gloria Arratia[1], Miles Coburn[2]

[1]University of Kansas, Biodiversity Research Center, Lawrence, KS, United States, [2]Biology Department, John Carrol University, University Heights, OH, United States

Cypriniformes Tree of Life: Morphology of the Dorsal and Anal Fins of Cypriniforms and Their Potential Phylogenetic Importance

One of the distinctive characters of the actinopterygians, or ray-finned fishes, is the relationship between the lepidotrichia and their supports. However, fin rays, their supports and their relationships to other bony structures have received little attention in

actinopterygians, especially teleosts, with a few exceptions, such as characters related to the position of the dorsal and anal fin or the presence of spiny rays. Among ostariophysans, three dorsal and anal fin characters support the monophyly of gymnotoids, one supports the siluriforms, and one supports the siluriphysans. In the past, phylogenetic analyses of Cypriniformes based on morphology have suggested numerous characters as potential synapomorphies of certain families, especially the Catostomidae and Cyprinidae. However, a comprehensive survey of patterns of variation of the cypriniform dorsal and anal fins is still needed. Our survey of many species representing all cypriniform families demonstrates that the variation is of such a magnitude that no character is synapomorphous for the order, but there are numerous characters that can be recognized for characterizing certain subfamilies (for example, several subfamilies in the Cyprinidae show distinct characteristics, as does the tribe Plagopterini), and also certain particular genera. This variation likely represents a potentially rich source of phylogenetic characters, which may contribute significantly to the understanding of cypriniform interrelationships. We will present our findings on the morphology of dorsal and anal fins and their variation in Cypriniformes.

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856 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Jason Ramsay, Cheryl Wilga

University of Rhode Island, Kingston, United States

Hyoid Anatomy and Hypobranchial Muscle Function During Feeding in White-Spotted Bamboo Sharks

White-spotted bamboo sharks exhibit many characters associated with suction feeding such as labial cartilages to occlude the lateral portions of the gape and hypertrophied hypobranchial musculature to power hyoid depression against high negative pressures generated in the buccal cavity. The hyoidiomandibular ligament (LHMM) may assist in lower jaw depression by harnessing and amplifying force generated by the in-series coracohyoideus (CH) and coracoarcualis (CA) and transferring it to the lower jaw to assist the coracomandibularis (CM) in depressing the jaw. Hyoid, upper and lower jaw kinematics and fascicle shortening in the CM, CH and CA were quantified using sonomicrometry, while muscle activity and buccal pressure were recorded simultaneously. Active shortening of the CM occurs prior to the onset of jaw opening and buccal pressure decrease, while jaw depression to peak gape occurs during CM lengthening. The CH actively lengthens and the CA actively shortens by 13% prior to onset of jaw and hyoid depression. Peak active CM shortening, onset of active CH shortening, depression of the hyoid and buccal pressure decrease occur simultaneously. A catch mechanism involving the LHMM and CM that would allow the CH to be lengthened by the CA and released, resulting in high powered expansion during suction feeding is proposed. Consequently, the CM initiates lower jaw depression while the CH and CA drive the jaw and hyoid to peak depression. The LHMM in bamboo sharks

appears to be a biomechanical link coupling lower jaw and hyoid depression that is convergent with the mandibulohyoid ligament in bony fishes.

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245 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Tauna Rankin, Su Sponaugle

RSMAS/University of Miami, Miami, FL, United States

Behavioral Basis for Selective Mortality in a Coral Reef Fish

Fast growth and large size are thought to increase survivorship during the early life stages of marine fishes (growth-mortality hypothesis, GMH). Further, growth-related early life history traits (ELHTs) can carry over to juvenile survival. Recently we analyzed the otoliths of 13 monthly cohorts of settling larvae and early juveniles of the bicolor damselfish *Stegastes partitus* and found that mortality was selective for several ELHTs. Controlling for temperature, comparison of overall mean traits among cohorts indicated that survivors generally grew faster during the larval period and were larger at settlement. However, in contrast to the GMH, juveniles that survived to 2-3 wks exhibited slower juvenile growth during the first week. To test the underlying behavioral mechanism, we paired behavioral observations and otolith analysis with manipulated and naturally settled juvenile *S. partitus*. We collected and tagged 52 settlement stage larvae and placed them on the reef in pairs with one large and one small settler. Daily 5 min observations of total sheltering time, number times shelter was sought, and maximum vertical and horizontal distances traveled were made over approximately one week and survivors were collected at the end for their otoliths. Daily observations and collections of 236 naturally settled juveniles were taken over the same interval. The survivors of the experimental manipulations did not reveal significant trends among risk-taking behaviors and juvenile growth, however, larger settlers spent less time sheltered and traveled higher in the water column.

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818 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Josh Rasmussen, Mark Belk

Brigham Young University, Provo, UT, United States

Body Shape Variation of a Neotropical Liverbearer in Relation to Predation Environment and Selected Intrinsic Factors

Morphological shape is an important phenotypic trait that may be correlated with ecological or evolutionary factors. Variation within this trait potentially reflects differences in selective pressures or patterns and therefore can provide information on such processes. We examined the morphological shape variation of a species of Neotropical livebearer (*Brachyrhaphis rhabdophora*: Poeciliidae) in relation to predator environment and selected intrinsic factors (i.e. sex, size, and behavioral movement phenotype) using morphometric techniques and multivariate linear mixed model analysis for each sex separately. Predator environment and size are significantly ($p < 0.05$) related to shape variation for both males and females. Behavioral movement phenotype, as assessed using a portable swim chamber, is significantly related to shape variation in females, but not in males; however, the factor was retained as it significantly interacts with size in males. This interaction is due to a difference in the direction of shape change. In males, predator environment and size also significantly interact due to a difference in the magnitude of shape change. Our results indicate that shape is indeed correlated with several factors, including intrinsic behavioral traits (e.g. movement behavior), which have important implications in further understanding the complex dynamics of livebearers.

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461 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Megan Rasmussen, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

Habitat Selection by Spotted Turtles (*Clemmys guttata*): Effects of Season and Scale of Analysis

Determining which habitats are important for life processes is a crucial step in the conservation of species. Selection of these habitats occurs when they are used disproportionately to their availability; however, the determination of 'available' habitat depends on the biology of the species under investigation. The habitat selection of a population of Spotted Turtles (*Clemmys guttata*) in Ontario, Canada, was studied over two consecutive years using radiotelemetry. Selection was assessed at two scales using compositional analysis. Spotted turtles are documented to have different habitat use and behaviours throughout the annual cycle, thus seasonal habitat selection was also analyzed. Selection occurred at both scales tested (2nd order, home range from

population range and 3rd order, locations from home range), and the ranking of preferred habitats differed based on the scale of analysis. Meadow marshes were most preferred when considering the selection of home range from population range, whereas open wetlands were most preferred within home ranges. The largest discrepancy was in the ranking of open uplands which were preferred at the 2nd order, but were ranked lowest at the 3rd order. Males and females selected similar habitats, but selection differed for both sexes based on the season. The variability in habitat selection based on seasons supports the need for surveys at multiple points within the year to fully understand the critical habitat requirements of this species.

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465 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Megan Rasmussen, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

Patterns of Maternal Investment in Spotted Turtles (*Clemmys guttata*): Implications of Trade-offs, Scale of Analyses, and Incubation Substrates

To maximize potential fitness, reproductive females should invest excess resources into either larger propagules (increase hatchling size), or more propagules (increase clutch size). Nest site selection can also affect hatchling phenotypes, such that females should choose areas that create ideal thermal and hydric conditions for developing eggs. This study examined maternal investment in a population of Spotted Turtles (*Clemmys guttata*) in Ontario, Canada over two years using radio telemetry, x-ray photography, and indirect assessments of hatchling fitness. Analyses were conducted at two scales (clutch and female), utilizing two measures of excess resources (body size and body condition). Larger females produced wider eggs, and similarity in the slopes of egg width and maternal pelvic aperture on body size may reflect a physical constraint on egg size. However, body size did not explain variation in egg morphometrics when considering the reproductive output of each female for the entire study. Instead, females in better body condition produced more eggs. With respect to nest site selection, no selection for thermal properties was observed; however, females exhibited fidelity to nest substrates but not locations. Hatchling locomotor performance was not related to hatchling body size or condition, but was related to incubation substrate. Thus, females in good condition maximize clutch size at coarse temporal scales, and incubation conditions may be more important in determining hatchling success than hatchling morphometrics.

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954 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jesse Ray[1], Richard King[1], Mel Duvall[1], Jace Robinson[1], Mike Dreslik[2], Brad Swanson[3], H. Lisle Gibbs[4]

[1]Northern Illinios University, DeKalb, IL, United States, [2]University of Illinois, Champaign-Urbana, IL, United States, [3]Central Michigan University, Mount Pleasant, MI, United States, [4]Ohio State University, Columbus, OH, United States

Genetic Variation of the Eastern Massasauga Rattlesnake: Implications for Conservation and Captive Breeding

The eastern Massasauga rattlesnake (*Sistrurus catenatus catenatus*) is declining throughout its range and is a candidate for federal listing under the Endangered Species Act. In addition, it is a species for which the Association of Zoos and Aquariums has initiated a Species Survival Plan which will include a captive breeding program. To aid in the conservation of wild populations and help structure a captive breeding program, mitochondrial DNA sequences from the NADH dehydrogenase subunit-II (ND2) gene were generated for 126 eastern Massasaugas. These sequences represent 33 different wild populations and 26 captive animals in AZA institutions. From these sequences, 16 different ND2 haplotypes were identified, representing three reciprocally monophyletic geographic subunits. The western subunit consists of the populations in Iowa, Illinois, and Wisconsin; the central subunit consists of populations in Indiana, Ohio, southern and central Michigan, and southwestern Ontario; and the eastern subunit consists of populations from northern Michigan, Pennsylvania, New York, and other parts of Ontario. Based on this information, the AZA has proposed a breeding plan that seeks to maintain these subunits as distinct and hopes to augment the captive population with wild-caught animals belonging to underrepresented subunits. These subunits appear to represent distinct geographic and genetic entities and wild populations should be managed to maintain existing genetic variation and ongoing evolutionary processes.

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336 Fish Biogeography, Pavilion East, Monday 27 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Joshua Reece

Washington University in Saint Louis, Saint Louis, MO, United States

Panmixia across the Indo-Pacific in Two Species of Moray Eels

Phylogeographic studies of coral reef fishes have revealed patterns ranging from ocean-wide gene flow among populations to oceanic-island endemism. Coral reef fishes typically disperse only as larvae in pelagic currents, and their dispersal capability is limited by their larval duration. Moray eels maintain the longest larval durations among

all coral reef fishes, and are thus likely to disperse further and maintain population genetic connectivity over greater distances than other species of coral reef fish. We tested this prediction by surveying two species of moray eels (*Gymnothorax undulatus* and *Gymnothorax flavimarginatus*) for phylogeographic structure in two mitochondrial (*COI*, *Cytb*) and two nuclear genes (*RAG1*, *RAG2*). Tests for geographic genetic structuring among populations (Mantel tests, AMOVA, permutation tests on haplotype networks) reveal that both species are panmictic across the Indo-Pacific, a distance of approximately 22,000 kilometers. The distribution of pairwise distances among mitochondrial haplotypes indicates that genetic variation in *G. undulatus* and *G. flavimarginatus* coalesces to 2.3 and 5.7mya, respectively, more recent than comparable estimates for reef fish of the genus *Naso*. These results are consistent with predictions from their extended larval durations and identify *G. undulatus* and *G. flavimarginatus* as the most broadly-distributed panmictic species of coral reef fishes in the Indo-Pacific.

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802 Snake Conservation, Pavilion West, Monday 27 July 2009

Robert N Reed[1], Julie A Savidge[2], James W Stanford[1], Ginger Haddock[1], Amy A Yackel Adams[1]

[1]USGS Brown Treesnake Project, Ft. Collins, CO, United States, [2]Colorado State University, Ft. Collins, CO, United States

Canine Detection of Free-Ranging Brown Treesnakes on Guam: Field Validation and Lessons Learned

Detector dogs are used in various contexts to locate substances ranging from explosives to mold, and are increasingly used to detect animals for conservation purposes (whether to control unwanted species or to find threatened species). Dogs have been infrequently used to detect herpetofauna, and validation of detection ability often stops once dogs can successfully discriminate between target and non-target scent cues under artificial conditions. However, such tests offer little information on the actual efficacy (rate of finding the target organism) under realistic field condition. We trained dogs to detect, locate, and alert their handlers to the presence of the Brown Treesnake (*Boiga irregularis*), an invasive predator responsible for the loss of many of Guam's birds. Dogs were selected after preliminary screening of hundreds of candidates, and received initial training with professionals before arriving on Guam. After extensive validation in both controlled conditions and in the field, we conducted field trials to determine the rate at which canine teams could locate free-ranging radiotelemetered Brown Treesnakes in pre-defined search blocks. Dog handlers were blind to the location of the snake, and dogs were successful in >35% of 85 trials. Such intensive validation is necessary to examine the relative efficacy (in cost and/or capture rate) of canine teams as compared to other available tools (visual searching by humans, traps, etc.). For many herpetofaunal species and for most research programs, there are significant challenges to successful implementation of a detector dog program, and we discuss how such challenges have affected our program.

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131 Herp Development & Morphology, Galleria North, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL HERPETOLOGY

Lisa Regula Meyer

Kent State University, Kent, OH, United States

Tadpole Growth and Development in Invaded Pools

Invasive species are second only to habitat loss in the list of threats posed to native flora and fauna, and the ways in which invasive species can affect native species are numerous. At the same time, amphibians are facing declines across the globe. Understanding the mechanisms by which invasive species may affect native amphibians is critical to the work of conserving amphibian biodiversity. This study followed enclosed *Rana clamitans* and *Rana catebeiana* tadpoles in non-invaded wetlands, and wetlands invaded by either *Typha angustifolia* or *Phragmites australis* over the course of the summer of 2008. The tadpoles consisted of threee clutches each of early-lain green frogs, late-laid green frogs and bull frogs. All individuals came from a non-invaded pond that was not one of the study sites. Tadpoles were monitored weekly, and measurements of abiotic factors in the ponds were also taken each week. Abiotic measures included nitrate, ammonium, dissolved oxygen, pH, and temperature, and biotic measures included survival and total length. Wetlands varied in dissolved oxygen, nitrate, and ammonium based on wetland type, and temperature and pH varied both among wetland types and within wetland types. Temperature, wetland type, and frog group all influenced growth and survival, but in different ways. There were also numerous interaction effects across the study. The host of interactions and confounding variables makes interpretation difficult, but affects are there, even if the mechanisms are not clear at this point. This work is part of an ongoing dissertation research project.

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82 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Michael Retzer

Institute of Natural Resource Sustainability, Illinois Natural History Survey, University of Illinois, Champaign, IL, United States

Taxonomy of Auchenoglanis (Siluriformes: Auchenoglanididae)

Results of the first comprehensive taxonomic review of *Auchenoglanis* (Siluriformes: Auchenoglanididae) indicate that all of the nominal species and subspecies (seven taxa in total) should be recognized as valid species. In addition, several undescribed species are identified primarily from coastal drainages of West Africa. The species are

diagnosable on the basis of barbel lengths, shapes of the supraoccipital and nuchal plates, various mensural characters such as spine lengths and caudal depth, size and shape of the adipose fin, and pigmentation of the body and fins.

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426 Herp Biogeography, Galleria North, Saturday 25 July 2009

AHM Ali Reza[1]

[1]Texas Tech University, Lubbock, TX, United States, [2]Jahangirnagar University, Savar, Dhaka, Bangladesh

Conservation Assessment and Prioritization of the Tropical Forest Habitats of Bangladesh: A Look on Amphibians and Reptiles

Between 1990 and 2005, Bangladesh lost more than 1.3% of its forest cover which sums up to 11,000 hectares of tropical forests. On the other hand, roughly 85% of the amphibians and reptiles of the country are facing conservation threats of various kinds which includes the 46 data deficient species. Majority of this herpetofaunal diversity is restricted to the already identified 19 protected areas of the country. But however, many of these forested areas are losing cover at a rate that we might have to sacrifice some of these protected habitats in the next few decades, mostly to respond the ever increasing human demands. My research aims to study the geographical distribution patterns of amphibians and reptiles in different forest types of the protected area system and to prioritize the habitats for immediate conservation measures. Using ArcGIS and ecological niche modeling, I am working to produce species distribution and habitat prioritization maps for Bangladesh which would ultimately help to re-assess the protected area network system of the country. Result, to date indentified an evergreen forest in the northeast part of the country, Lawachara National Park as the most diverse habitat in terms of herpetofaunal diversity, whereas a deciduous forest in central Bangladesh, Madhupur National Park supports the highest number of critically important species. Once done, the study results will be shared with the management authority of the country to produce a national conservation management plan for the amphibians and reptiles of Bangladesh.

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148 Poster Session III, Exhibit Hall, Sunday 26 July 2009

AHM Ali Reza[1], Gad Perry[1]

[1]Texas Tech University, Lubbock, TX 79409, United States, [2]Jahangirnagar University, Savar, Dhaka 1342, Bangladesh

Diversity and Biogeography of the Herpetofauna in Bangladesh

Roughly 85% of the amphibians and reptiles of Bangladesh are facing conservation threats of various kinds. This is obviously an under-estimate since it includes 46 'data deficient' species and is based on survey efforts that have mostly been conducted over a century ago. Our study aims to prepare an updated species list with their geographical distribution patterns in different habitat types to prioritize the habitats in Bangladesh for immediate conservation measures. We have selected eleven sampling sites covering all major habitat types of the country. Visual encounter surveys (VES) were used for studying the herpetofauna of all these habitats. We also collected tissue samples of selected species for studying DNA sequence, mostly using cytochrome b gene (cyt b) with known primers. Using ArcGIS and Maxent niche modeling, we are working to produce a species distribution and habitat prioritization map for Bangladesh. Result, to date includes 15 additional species for the country and one undescribed species of microhylid frog. At least 15 more specimens are being examined for their proper taxonomic identity. An evergreen forest in the northeast part of the country, Lawachara National Park, has been initially identified as the most diverse habitat, whereas a deciduous forest in central Bangladesh, Madhupur National Park supports the highest number of critically important herpetofaunal species. Conservation activities have been initiated by training local students, forming conservation groups in and around the forested areas and providing local media coverage for conservation.

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443 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Justin Rheubert

Southeastern Louisiana University, Hammond, LA, United States

Preliminary Report of Reproductive Morphology of Iguanian Lizards as Displayed by Phrynosomatidae and Polychrotidae

Tissues from *Sceloporus undulatus* and *Anolis carolinensis* are continuously being examined histologically to determine the reproductive morphology of iguanian lizards in comparison with other squamates. *Sceloporus undulatus* and *Anolis carolinensis* have been collected in southern Louisiana from September 2008-current dates, the reproductive tracts were removed, fixed in formaldehyde, and processed histologically. Gross and cellular morphologies appear similar in both species. Grossly the testes lie anterior to the kidneys and the efferent ducts run laterally off the testes and ventrally

over the kidneys. The kidneys appear to have a junction posteriorly beneath the pubic symphysis; however, histological analysis has not been performed on this junction. Both species display inactive testes during the month of September with residual amounts of sperm located in the efferent ducts. Recrudescence begins in October with mitotic activity increasing in germ cells and the efferent ducts become devoid of sperm. During these months the renal sexual segment of the kidney appears to be inactive although minor secretory activity is occurring. A single ductus efferentes leads from the testis and divides posteriorly into 3-4 ductuli epididymides. Sperm pass sequentially from the ductuli epididymides through the ductus epididymis, ductus deferens, and ampulla ductus deferens. The data collected thus far are consistent with some previous descriptions of squamate reproductive morphology. We have found no evidence, however, of an extratesticular rete testis or regionalization of the ductus epididymis, as reported for the Agamidae and Lacertidae.

1025 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Greg Riccardi, Austin Mast

Florida State University, Tallahassee, FL, United States

Illustrating Ontologies with Morphbank and Phenoscape

This talk will discuss some ways that image management and annotation, ontology development, and studies of physical features of organisms are integrated to facilitate research in evolution and development. The management of metadata and annotations of images is a primary capability of the Morphbank system, an on-line image repository system that has over 250,000 images of a variety of organisms. The metadata in Morphbank for an image includes information about the content of the image-that is, characteristics of the objects shown in the image. This includes information about the specimen with Darwin Core fields and information about the anatomy and views that are presented. Morphbank and Phenoscape have combined to integrate anatomical and phenotype annotations on images. An image of a portion of a fish skeleton in Morphbank includes references to the Teleost ontology terms that describe that bone (c. f., http://www.morphbank.net?id=459110). 1500 skeletal images from CToL are currently in Morphbank. A Search of Morphbank for the term will produce a collection of relevant images. An annotations of an image in Morphbank attaches one or more ontology terms to a specific part of the image. The integration of Morphbank with the Morphster ontology browser [ref] provides an illustration of ontology terms. A user may select a term in Morphster and see annotated Morphbank images that are relevant to that term. The inference capabilities of Morphster allow a user to find all images of "bone" or just those of "ceratobranchial" or those that exhibit a specific phenotype.

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484 ELHS/LFC Ecology II, Broadway 1&2, Saturday 25 July 2009

David Richardson, Jonathan Hare

NEFSC/NMFS/NOAA, Narragansett, RI, United States

Does Haddock Egg Predation Decouple the Abundance of Atlantic Herring Larvae from Spawning Stock Biomass on Georges Bank?

We sought to explore the hypothesis that the mortality rate of benthic Atlantic herring (*Clupea harengus*) eggs on Georges Bank from 1971-2005 was a function of the intensity of haddock (*Melanogrammus aeglifinus*) predation. An index of Georges Bank haddock predation intensity was developed using stock assessment abundance-at-age data, adult trawl survey length-at-age and length-weight data, and a function describing daily ration versus weight. The equation linking predation intensity to egg mortality assumed a Type III functional response: at low egg densities, haddock switch to other prey and at high egg densities haddock were satiated. The parameters of the model were determined by fitting the predicted abundance of newly hatched Atlantic herring larvae (a function of spawning stock biomass and egg survival) to an Atlantic herring larval abundance index for Georges Bank. Estimated herring egg mortality from haddock predation ranged from a low of 30% in the early 1990's to a high of 99% in recent years. Both the observed and predicted larval index had two instances (1975-1976 and 2003-2004) of large declines (over an order of magnitude), which followed the two strongest year classes of George Bank haddock in the time series. Overall this retrospective analysis provides a conceptual basis for how egg predation can drive the alternation between extended periods of high and low abundance in a population of Atlantic herring. Further support for this hypothesis will require field work focused directly on Atlantic herring eggs, a life stage that has received relatively little attention in the northwest Atlantic.

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61 General Herpetology, Galleria South, Sunday 26 July 2009

Corinne Richards-Zawacki[1], Ian Wang[2], Molly Cummings[3], Kyle Summers[4]

[1]Tulane University, New Orleans, LA, United States, [2]University of California, Davis, CA, United States, [3]University of Texas, Austin, CA, United States, [4]East Carolina University, Greenville, NC, United States

Coloration as a Pre-mating Barrier to Reproduction in the Strawberry Poison Dart Frog (*Oophaga pumilio*): Have Differences in Female Preference Lead to Assortative Mating?

Strawberry poison-dart frogs (*Oophaga pumilio*) exhibit an amazing array of color and pattern variation on and around the islands of the Bocas del Toro Archipelago of

Panama. This variation has apparently arisen rapidly since the Archipelago took on its present form about 6,000 to 9,000 years ago. Due to their recent divergence, geographic proximity, and unusual mating and parental care behaviors, *O. pumilio* populations provide a unique opportunity to study the process of speciation in action and elucidate the relative roles of various selective agents in that process. These frogs' bright colors are thought to be aposematic, suggesting that natural selection may have shaped the pattern of variation across the archipelago. However, sexual selection could also have played a role in the diversification process as well, as color appears to also be important in mate choice. Using a combination of mate choice experiments and molecular techniques, we investigated the extent to which differences in coloration act as a pre-mating barrier to reproduction among individuals from a polymorphic population. Our results provide important insight into the mechanisms driving the rapid evolution of morphological diversity among *O. pumilio* populations.

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595 Herp Biogeography, Galleria North, Saturday 25 July 2009

Jonathan Richmond, Robert Fisher

United States Geological Survey, San Diego, CA, United States

Patterns of Evolutionary Diversification in South Pacific Scincid Lizards of the Genus *Emoia* based on Multilocus DNA Sequence Data

Skinks of genus *Emoia* are a major component of the diurnal lizard community on many South Pacific islands, ranging from Southeast Asia to Hawaii and Clipperton Island. Previous studies suggest that the 75 species of *Emoia* form a natural group within the Lygosominae, the largest subfamily within the Scincidae. Most species have restricted ranges and occur within isolated archipelagos, while a few are apparently wide ranging. The center of origin for *Emoia* is presumed to be in New Guinea; however, strict tests of this hypothesis have not been performed, nor has the monophyly of the group or its evolutionary affinities with other Lygosomine skinks been validated. It is also unknown whether *Emoia* species assemblages occurring on different archipelagos evolved in situ, or if speciation preceded major oceanic dispersal events. We used DNA sequences from one mitochondrial and three nuclear genes to build gene genealogies for reconstructing the historical biogeography and evolutionary history of the major lineages within *Emoia*, and to reconstruct their ancestral morphology and ecology. We also estimate a joint posterior distribution for the species tree using a method that accounts for differences in the coalescence times among individual genes. Phylogenetic results across all genetic markers indicate *Emoia* as a whole are not monophyletic, yet clusters of lineages within the genus form well-supported clades that are largely consistent with taxonomic groupings based on osteology and scutellation. Our findings also provide critical data for developing conservation priorities for several insular and cryptic *Emoia* species on the verge of extinction.

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421 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Stephen Richter, Natochia Henry, Erin Madeen

Eastern Kentucky University, Department of Biological Sciences, Richmond, KY, United States

Conservation Genetics of the Critically Endangered Dusky Gopher Frog, *Rana sevosa*

Habitat loss, alteration, and fragmentation are major causes of population declines and extinction. Dusky gopher frogs, *Rana sevosa*, represent an extreme case in which the geographic distribution has been reduced to two geographically isolated populations. As a result, the species is listed as critically endangered by the IUCN and federally endangered by the USFWS. Isolated populations tend to become inbred and genetically differentiated from each other, and if local extinction occurs, recolonization is impossible. Therefore the probability of persistence for *R. sevosa* is low without human intervention. Along with other conservation efforts, captive populations have been established in zoos to allow the possibility of future reintroductions. Our research objectives were to compare contemporary genetic variation and affinities between the two natural populations and to assess to what degree natural variation has been captured in captive populations. Genetic analyses were performed using genotypic data of seven nuclear microsatellite DNA loci and sequence data of the mtDNA control region. Analyses revealed that natural populations have severely reduced genetic variation due to consequences of population bottleneck events, geographic isolation, enhanced effects of genetic drift, and inbreeding. Additionally, we found differentiation of populations due to small population sizes and lack of gene flow between them. As landscape alterations continue, our ability to rescue imperiled taxa is dependent on an understanding of historical, demographic, and genetic parameters of diminishing populations. Results of this research will be discussed in the context of known demography, management, and long-term viability of this federally endangered species.

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313 Poster Session I, Exhibit Hall, Friday 24 July 2009; AES CARRIER AWARD

Cyrena Riley[1], Serge Parent[2], Nathalie Le François[2]

[1]Université du Québec à Rimouski, Rimouski, Quebec, Canada, [2]Biodôme de Montréal, Montréal, Quebec, Canada

Biodôme de Montréal: Captive Breeding of the Barndoor Skate (*Dipturus laevis*) and Work on Early-Life Stages

The Biodôme de Montréal (Quebec, Canada) is an institution with conservation, educational and research purposes. Five different American ecosystems are represented

as large open exhibits; one of these is the aquatic representation of the Gulf of the St-Lawrence, housing species found within its boundaries. In 1997, the Biodôme obtained five barndoor skates (*Dipturus laevis*; IUCN status: endangered) from the Massachusetts coast. The barndoor skates started reproducing six years later, with the first eggcases collected in 2003. Production of eggcases was observed throughout the year and annual fecundity was calculated for the first time for one female in 2006 (85 eggcases), and then in 2007 (115 eggcases). The incubation period ranged from 342 to 494 days, and the average size of juveniles at birth was 193mm in total length for a disk width of 128mm. An eggcase identification system was developed, along with a photo identification system to keep track of the growing juveniles. Microchips were inserted into one year old individuals. Morphological measurements taken at birth and at 2 years of age indicate similar growth trajectories for the captive-bred specimens in comparison to their wild conspecifics. Breeding in captivity of the winter skate (*Leucoraja ocellata*) has also been achieved. Current and future work on skate propagation efforts and research on early life stages at the Biodôme de Montréal are outlined and discussed.

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303 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Alexis Ritzer, Taylor Jones, Benjamin Pierce

Southwestern University, Georgetown, TX, United States

Two-Year Population Survey and Microhabitat Ecology of the Georgetown Salamander *Eurycea naufragia*

The Georgetown salamander, *Eurycea naufragia*, is a paedomorphic spring and cave-dwelling salamander known from only 13 sites in the San Gabriel River drainage of central Texas. Rapid urbanization places all known populations at risk and conservation strategies are hindered by a lack of information on the ecology of the species. We conducted salamander surface counts at one site over a two-year period and examined microhabitat preferences of salamanders at two sites. Numbers of salamanders and percent of cover objects occupied by salamanders varied from month to month, with a general trend of higher abundance in spring and summer. Within the spring flow, salamander abundance decreased with distance from the spring origin. Salamanders were more likely to be found under rocks than other types of cover objects and preferred larger rocks. Larger salamanders occupied larger cover objects; rocks covering multiple salamanders were larger than those covering single salamanders. Analysis of research literature suggests that salamander abundance will be negatively impacted by increasing urbanization, small substrate particles, water velocity, and variation in water temperature; salamander abundance will positively affected by increases in cover objects, factors that maintain substrate interstitial spaces, and by increasing aquatic invertebrates.

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422 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Adela Roa-Varon, Steve W. Ross

Center for Marine Science UNCW, Wilmington, NC, United States

Species Composition and Diel Vertical Distribution of *Cyclothone*, Bristlemouths, (Stomiiformes: Gonostomatidae) in the North-central Gulf of Mexico

We document depth patterns of size, abundance, and time of capture for six species of the genus *Cyclothone* (*Cyclothone acclinidens*, *C. alba*, *C. braueri*, *C. obscura*, *C. pallida*, and *C. psedopallida*) collected in the Gulf of Mexico. As part of a larger study on the mesopelagic fauna, discrete depth Tucker trawling was conducted during the day and night (9-29 Aug 2007) over three cold seep sites (AC601, GC852, AT340) and one deep-coral site (VK826) in the north-central Gulf of Mexico (surface to 1377 m). *Cyclothone* was the dominant fish genus (5,353 total specimens), and 3,366 individuals were resolved to six species Two different morphotypes did not match described species and may represent new taxa. Diel vertical migration (DVM) was analyzed for the most abundant species (*C. alba*, *C. braueri*, *C. pallida*, and *C. pseudopallida*) at GC852, AT340, and VK826. *Cyclothone* spp. generally did not undertake DVM, being concentrated between 400 and 700 m with peak abundance at about 400-550 m both day and night. Although, these species did not exhibit a DVM, some fishes were captured at night as shallow as 150 m and there was a general tendency to expand the range upward at night. They occurred in overlapping depth ranges in the water column with the exception of *C. obscura* which was only collected at night at 1149 m. In general, species captured at night in the mesopelagic were nearly identical in size to those captured in the epipelagic.

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598 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Dominique Robert[1], Stéphane Plourde[2], Martin Castonguay[2], Jeffrey A. Runge[3]

[1]*Kyoto University, Fisheries Research Station, Maizuru, Kyoto-fu, Japan,* [2]*Institut Maurice-Lamontagne, Department of Fisheries and Oceans, Mont-Joli, Québec, Canada,* [3]*School of Marine Sciences, University of Maine, Portland, Maine, United States*

Importance of Prey Field Definition for the Assessment of the Relationship Linking Year-Class Strength to Prey Availability During the Early Larval Stage of Marine Fish

Since Johan Hjort proposed the "Critical Period" hypothesis nearly 100 ago, the availability of adequate prey during early larval life has generally been considered the main factor accounting for year-class fluctuations in marine fish populations. This idea still remains the central tenet of most contemporary marine fish recruitment hypotheses.

Despite the importance of this assumption, reports of a link between recruitment strength and prey production remain few. In a previous study, we showed a strong positive relationship between Atlantic mackerel year-class strength and the production of preferred prey during the first-feeding stage (nauplii stages of the calanoid copepods *Pseudocalanus* spp., *Calanus finmarchicus* and *Temora longicornis*). In this study, we explore the effects of modifying prey field definition on the strength of our recruitment-prey availability relationship. The proportion of variance explained by the relationship largely decreased when prey field definition was based on species selection only (i.e. all developmental stages considered) or on total zooplankton density. In the latter case, the relationship was mainly obscured by the abundant small cyclopoid *Oithona similis* and large calanoid *Calanus hyperboreus* when density was defined in number or organisms per litre and in µgC per litre, respectively. These results point to the importance of relying on prey selectivity data when linking prey abundance to recruitment. We argue that the absence of a positive link between these two parameters reported in several studies is principally attributable to imprecise prey field definition.

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970 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Luiz Rocha[1], Ross Robertson[2], Harilaos Lessios[2]

[1]*University of Texas Marine Science Institue, Port Aransas, TX, United States,*
[2]*Smithsonian Tropical Research Insitute, Panama City, Panama*

Molecular Phylogenetics of the Reef Fish Genus *Stegastes* (Teleostei: Pomacentridae)

Stegastes is a diverse genus of damselfishes associated to coral and rocky reefs in tropical oceans. Most species are solitary territorial herbivores that aggressively defend their feeding grounds, but a few are gregarious and feed on plankton. Juveniles are usually brightly colored and common in the aquarium trade. We sampled all Indo-Pacific species while scuba diving or snorkelling and preserved tissue samples in ethanol. Standard laboratory procedures were used to obtain sequences of one ribosomal RNA gene (16S) and one mitochondrial DNA gene (ATPase 6). As part of the phylogenetic analyses we performed maximum parsimony, maximum likelihood and Bayesian inference. The monophyly of the genus was rejected in all analyses. The genus has to be split into two groups, one (clade I) with all Atlantic and eastern Pacific (indicating that the radiation originated from a single invasion of the Atlantic before the closure of the Isthmus of Panama) as well as some Indo-Pacific species, and a second clade (clade II) containing only Indo-Pacific species. Species of the genus *Microspathodon* form the base of clade II, whereas species of *Plectroglyphidodon* are present in both clade I and II. Additional taxon sampling is necessary to revise the current nomenclature. Cryptic speciation was also detected within many widely distributed species, the most notable case being *Stegastes fasciolatus*, which seems to be comprised of four different species.

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747 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Marcelo Rocha[1], Renildo de Oliveira[1], Lúcia Rapp Py-Daniel[1], Mário de Pinna[2]

[1]INPA, Manaus, AM, Brazil, [2]MZUSP, São Paulo, SP, Brazil

Two Putative New Syntopic Species of *Phreatobius* Goeldi (1905) From Aripuanã Basin, Amazonas, Brazil (Siluriformes: Heptapteridae)

The Neotropical catfish genus *Phreatobius* is one of the most peculiar Siluriformes in South America. This small catfish is known to occur in subterranean waters accessed by artificial wells. Few specimens, however, have been recently sampled in pools and marginal habitats of forests streams in the Amazon basin. The genus has three valid species, its type *P. cisternarum* and two additional species recently described, *Phreatobius dracunculus* from rio Madeira basin in Brazil, and *Phreatobius* sanguijuela from Itenéz Basin, in Bolivia. Despite the inclusion of *Phreatobius* in Heptapteridae, the position of the genus within Siluriformes has been reported as uncertain. Recently an expedition to rio Aripuanã basin, supported by the "All Catfish Species Inventory", produced two new species inhabiting roots of riparian vegetation in a bank of a small stream. These two putative new species can be distinguished from their congeners by the position of dorsal fin located well anterior to the pelvic-fin base, morphometric characteristics and number of dorsal-fin rays. These new species herein were found together in the rio Aripuanã basin, Central Brazilian Amazon, and are located approximately in the middle of the large geographic range area comprising the current localities of *Phreatobius*, suggesting that there might be more species still to be discovered.

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268 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Helen Rodd[1], Anna Price[1], James Burns[2], Rosemary Gibson[1]

[1]University of Toronto, Toronto, ON, Canada, [2]Centre Nationale de la Reserche ScientifiqueG, Gif sur Yvette, France

Various Roles of Pigment-based Coloration in Guppies

The role of carotenoid-based coloration in mate choice in guppies is well established. There is also evidence that females from some populations base their mate choice decisions on males' melanin-based, black spots, with some females showing a preference for black spots and others showing distaste for them. I will discuss evidence from my lab that suggests that the black coloration of male guppies is also involved in signalling to rivals in male-male competition and to conspecifics of both sexes in stressful situations (e.g. simulated predator attacks). In addition, we have found that the coloration of the

brain covering (meninx) can change rapidly from being nearly translucent to black and may be a useful indicator of stress in this species.

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21 General Ichthyology, Parlor ABC, Sunday 26 July 2009

Cara Rodgveller, Chris Lunsford, Jeffrey Fujioka

NOAA, Juneau, AK, United States

Effects of Maternal Age on Larval Viability of Quillback Rockfish in Alaska

Studies have shown that older females may produce more fit larvae which can survive in environments that progeny from younger fish can not. Most fisheries select for larger and older fish, which can reduce the larval quality of the population and therefore the population recruitment. Rockfishs' (*Sebastes*) slow growth and longevity are thought to be adaptations for successful reproduction, even when optimal environmental conditions are periodic. Studies of west coast rockfish have shown that larvae of old embryos have larger oil globules at parturition than larvae from younger mothers, and higher rates of survival in the laboratory. However, little work has been done in Alaska. The environment in Alaska differs from the west coast, and the age structure of many rockfish populations in Alaska still contain older fish. Additionally, the rockfish studied so far have been relatively shallow-water species with different life histories than many of the deep-water species in Alaska. Our objectives were to collect pregnant quillback rockfish (*S. maliger*) in southeast Alaska and measure the oil globules of their developing embryos. In 2008 and 2009 we collected 90 pregnant quillback rockfish. Some samples were analyzed for protein, lipid, and fatty acid concentrations to examine body composition during embryogenesis. Measurements of oil globules from photographs of developing embryos will be analyzed to determine the relationship between maternal age and larval quality. From samples already analyzed for composition, it appears that oil globule size is highly related to total body lipid and protein content and is a good indicator of energetic status.

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536 Herp Conservation II , Grand Ballroom II, Monday 27 July 2009

Carlos A. Rodríguez[1], Alberto L. López[2], Héctor J. Claudio[1], Rafael L. Joglar[1]

[1]University of Puerto Rico, Río Piedras Campus, San Juan, Puerto Rico, [2]Puerto Rico Conservation Trust, San Juan, Puerto Rico

***Iguana iguana* in Puerto Rico: Is It Time for Management?**

Iguana iguana is native to Central and South America, and was introduced in Puerto Rico in the 70's. Since 1985, the species has been established and appears to be abundant.

Because its ecology and natural history has not been studied, its effects on local biodiversity are still unknown. Our objectives were to: (1) estimate population densities; and (2) study its reproductive biology. Population surveys were performed on 1 ha quadrants at Canal Blasina (CB) in Carolina and Parque Lineal (PL) in San Juan. Reproductive biology was studied at Las Cabezas de San Juan (CSJ), in Fajardo. Population survey results revealed that iguanas at CB are three times more abundant than those at PL (223/ha and 85/ha, respectively). Population densities increased during the colder and dryer months of the year. Analyses testing for relationships between population densities, mean daily temperature, and mean daily precipitation, revealed that temperature was the only variable that significantly explained changes in population densities at CB and PL (P= 0.0210 and P= 0.004, respectively). Iguana densities in Puerto Rico are four times higher than in some localities of Central America where they encounter native predators. Our study of iguana reproductive biology revealed that it is similar to that reported for its native range. Average egg clutch size was 23.136 ± 11.613 eggs (n=44), with a clutch success rate of 88 % (n = 19). Given their high population densities and successful reproductive biology a management plan to control the species should be considered.

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242 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER HERPETOLOGY AWARD

Serena Rogers

University of Nevada Reno, Reno, NV, United States

Genetic Variation in Three Remnant Populations of Northern Leopard Frog in Western Nevada

The Northern Leopard frog (*Rana pipiens*) was once the most widely distributed and commonly encountered amphibian in Nevada. In a recent resurvey of 97 historical sampling locations this frog was relocated in only eight sites. In the watersheds of the Truckee and Carson rivers of western Nevada extant leopard frog populations are only known from three locations. The statewide decline has been attributed to loss of habitat, nonnative amphibians and disease. Here we report on preliminary genetic analyses for the three wild and one captive population(s) of leopard frogs from these drainages. Tissue samples were collected from 121 adult and subadult individuals. We used five polymorphic nuclear microsatellite loci developed for *R. pipiens* and *R. sevosa* to explore within and among populations levels of genetic diversity and population differentiation. Levels of observed and expected heterozygosities per locus per population ranged from 0.03-0.80 and 0.1-0.66 respectively. The number of alleles across populations ranged from four to nine per locus which is similar to that reported for other *R. pipiens* populations while levels of heterozygosity tended to be lower. The two wild populations for which we had a sufficient sample size show evidence of genetic bottlenecks under both the IAM and TPM mutation models. The wild Truckee populations are highly differentiated from the Carson River populations (pairwise F_{ST} = 0.3588, 0.3969).

Bayesian genotype clustering analysis revealed two distinct genotype clusters with little overlap in membership between river drainages.

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714 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009; ASIH STOYE AWARD GENETICS, DEVELOPMENT & MORPHOLOGY

Dawn Roje

University of Washington, Seattle, WA, United States

Mitigating the Effects of Substitution Saturation on Phylogeny Estimation: A Case Study from the Molecular Phylogenetics of the Flatfish Family Pleuronectidae

Substitution saturation occurs when enough mutation has taken place between DNA sequences such that the phylogenetic signal is overwritten by multiple changes at the same sites. This problem is usually dealt with in two ways: it's either ignored or the data are excluded from phylogenetic analysis. To evaluate the effect of the saturated data on tree topologies and clade support, two data sets (one with the saturated data and one without) were analyzed for the flatfish family Pleuronectidae. Of 2391 sites, 780 were variable, with the saturated sites providing an enormous 40.8% of the variability. The exclusion of these data from further phylogenetic analysis would almost certainly result in poor phylogeny estimation, but their inclusion could do the same. To address this, it's necessary to implement some criterion to evaluate the effect of the saturated data. By determining the point where the saturation curve plateaus, a threshold pairwise genetic distance that corresponds to unsaturated substitutions was determined. Topology of and statistical support for clades in which all members had pairwise distances less than this value can be thought of as inferred from unsaturated data. Surprisingly, the effect of saturation on clades corresponding to the deeper nodes was minimal. It follows that the phylogeny inferred from the entire data set can be considered the best possible, regardless of the inclusion of saturated substitutions. This implies that saturated data can and probably should be used, given a threshold pairwise distance can be implemented to evaluate the effects on topology and clade support.

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450 Poster Session I, Exhibit Hall, Friday 24 July 2009

Jorge A. Rojo-Vázquez, Carmen Franco-Gordo, Enrique Godínez-Domínguez, Gabriela Lucano-Ramírez, Salvador Ruiz-Ramírez, Victor H. Galván-Piña, Salvador Hernández-Vázquez

Universidad de Guadalajara, San Patricio-Melaque, Jalisco, Mexico

Influence of the El Niño Southern Oscillation on the Recruitment of Lutjanidae Species from the Central Mexican Pacific

In order to explain the interannual variability of the abundance of fish larvae of the family Lutjanidae there was analyzed the abundance of breeding, the reproductive seasonality and environmental variability from December, 1995 to December, 1998. The fish larvae come from 316 samples collected during 27 months in the central Mexican Pacific. The variation of the reproductive season considered for the group is based on the reproductive pattern of *Lutjanus guttatus*. For the adults' abundances were considered a series of catches from the artisanal fishery. The environmental variables that better define the variability are the sea surface temperature, the index of El Niño and the rate of upwelling. There was a coincidence in the seasonal variation of the abundance of the Lutjanidae fish larvae with the reproductive seasonality, with a lack of peak of one month. According with the abundances of both fish larvae and adults and hydrological conditions of the study area, two periods were identified: the first defined as Pre-ENSO (December, 1995 to March, 1997), characterized by lower abundances of fish larvae, and the second named ENSO (July, 1997 to September, 1998), characterized by the increase in the abundances of fish larvae. The abundance of adults presents an opposite trend that might be an effect to the fishing pressure. The high abundances of the Lutjanidae fish larvae during El Niño event might be due to the ability to perform in impoverished conditions, as during El Niño, more than to the size of the population of parents.

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605 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jennifer Rollins, Joel Snodgrass

Towson University, Towson, MD, United States

Growth of Juvenile Blacknose Dace (*Rhinichthys atratulus*) Along an Urban to Rural Gradient

Blacknose dace (*Rhinichthys atratulus*) stream minnows are a persistent species capable of withstanding the rapid environmental changes associated with urbanization. Previous research revealed increased somatic growth rates among dace from urban streams. To explain differential growth rates in urban vs. rural populations of dace, we measured

instantaneous (using RNA concentration per mg of tissue) and recent (using otolith band width) growth rates, with collections from two urban and two rural sites spanning the first year of life. Urban fish sustained significantly higher instantaneous and recent growth rates compared to rural conspecifics. Geometric mean instantaneous and recent growth for an average-sized fish were 1.106 μg/mL RNA*mg tissue^{-1} and 2.537 μm*seven bands^{-1} at urban sites and 0.814 μg/mL RNA*mg tissue^{-1} and 2.474 μm*seven bands^{-1} at rural sites, respectively. Models comparing growth measures to standard length, mean temperature over one to ten days prior to collection, and site nested within urban vs. rural categories were analyzed with AIC. Only site differences (urban vs. rural) and standard length affected RNA concentration in the most supported model for instantaneous growth. The most supported model for recent growth included mean temperature over four days prior to collection, standard length, and site differences as independent variables. Increased recent growth may be due to higher temperatures in urban environments, while fish size and differences in unknown variables along an urbanization gradient explained differences in instantaneous growth. Future research will determine whether faster growth among urban dace relate to adaptive changes or phenotypic plasticity resulting from urbanization pressures.

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685 AES Ecology I, Pavilion West, Saturday 25 July 2009

Jason Romine[1], Johanna Imhoff[1], Christina Conrath[2], George Burgess[1]

[1]Florida Program for Shark Research, Florida Museum of Natural History, University of Florida, Gainesville, FL, United States, [2]RACE/AFSC/NOAA Fisheries, Kodiak, AK, United States

Movement Patterns of Two Species of Rays in Mosquito Lagoon, Florida, USA

Several species of batoids utilize coastal lagoonal habitats of eastern Florida, USA. In general, behavioral ecology of batoids within this region has been overlooked despite their significance to the ecosystem. We utilized passive acoustic tracking methods to elucidate movement patterns, habitat use and home range of two common ray species, *Dasyatis say* (Bluntnose Stingray) and *Gymnura micrura* (Smooth Butterfly Ray), within Mosquito Lagoon. Smooth butterfly rays exhibited larger mean home range than bluntnose stingrays within this region. Both species exhibited similar diel activity patterns, with greatest activity occurring during early morning hours and least activity during afternoon hours. Seasonal movement patterns were also similar with both rays utilizing larger areas and displaying greater activity during the summer months. Sites near grass-bed margins were most commonly frequented by both species. Ray emigration and immigration patterns suggest the Mosquito Lagoon may serve as a nursery area for these two species.

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429 Herp Physiology, Galleria North, Monday 27 July 2009

Adam Rosenblatt[1], Michael Heithaus[1], Frank Mazzotti[2]

[1]Florida International University, North Miami, FL, United States, [2]University of Florida, Gainesville, FL, United States

Seasonal Salinity Variability and its Impacts on Alligator Behavior in the Florida Coastal Everglades

American alligators (*Alligator mississippiensis*) are some of the largest predators in the Florida Coastal Everglades (FCE), but little is known about their movements, trophic position, and ecological role in this ecosystem. Proposed restoration of the Everglades is likely to influence alligator movements, residence times, and the spatiotemporal patterns of their ecological effects making studies of alligator behavior important at this time. In October 2007, we initiated a study of alligators in the Shark River Slough of Everglades National Park using passive acoustic telemetry to quantify their movements and stable isotopes to elucidate their trophic position. In general alligators move away from high salinity waters near the Gulf of Mexico during the dry season, but are found more often in waters near the Gulf of Mexico during the wet season. There was a surprising degree of individual specialization in movement patterns and possible sub-structuring of the resident alligator population into two relatively distinct sub-populations. Stable carbon isotopes suggest that alligators primarily use freshwater and estuarine-based resources, but movements of some individuals suggest reliance on marine-derived food webs. Stable nitrogen isotopes suggest that, surprisingly, alligators feed at a relatively low trophic level (below large teleosts and juvenile sharks). Our preliminary studies suggest that alligator movements likely are influenced by a complex of physical and biological factors that may vary in importance across different spatiotemporal scales and that alligators may feed from diverse food webs but at a relatively low trophic level.

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325 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Gil Rosenthal

Texas A&M University, College Station, TX, United States

Mate Choice and Evolutionary Eenetics in *Xiphophorus* Hybrid Zones

Mate-choice behavior is an important determinant of reproductive isolation, and therefore of speciation and hybridization. I review the use of genetic and behavioral techniques to understand the impact of female mate choice on the evolution of hybrid zones between the poeciliid fishes *Xiphophorus birchmanni* and *X. malinche*. Hybridization itself arises from a breakdown in chemical communication mechanisms in mate choice. Using computer-animated playback techniques showed that hybrid fitness

may be elevated due to the reorganization of phenotypic correlations among sexually selected traits in a way that addresses female preferences. Sexual selection acting on abundant natural variation has caused rapid trait evolution in the wild. Reproductive behavior has thus been a critical component in the evolution of novel communication systems.

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296 Fish Ecology II, Pavilion East, Sunday 26 July 2009

Steve W. Ross[1], A.M. Quattrini[2], A.Y. Roa-Varón[1], J.P. McClain[1]

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Species Composition and Distributions of Mesopelagic Fishes Over the Slope of the North-central Gulf of Mexico

Research on the midwater fauna of the Gulf of Mexico (GOM) has been relatively restricted and often has not included diel or vertical distribution data. We sampled midwater fauna over three cold seep habitats (1300-2500 m) and over a cold-water coral bank (450-650 m) in the north-central GOM. Day and night discrete depth sampling (9-29 Aug 2007, 159 Tucker trawls) yielded 126 species (9,802 individuals, 30 families) of juvenile and adult fishes. Collections were dominated by Myctophidae (38 species), Stomiidae (17 species), Gonostomatidae (12 species) and Sternoptychidae (10 species). Gonostomatidae dominated overall relative abundance (56% of total catch), followed by Myctophidae (28%), Phosichthyidae (6%) and Sternoptychidae (6%). Despite the wide separation of study sites, geographic and temporal patterns in fish assemblages were not evident in multivariate analyses. Station groupings were more related to similarities in sampled depths. Upper water column stations (< 400 m) comprised four groups typified by *Lepidophanes guentheri*, *Diaphus dumerilii*, *Vinciguerria nimbaria*, *V. poweriae*, *Valenciennellus tripunctulatus*, *Argyropelecus aculeatus*, *Notolychnus valdiviae*, *Benthosema suborbitale*, *Gonostoma elongatum* and *Hygophum taaningi*. Deeper stations (> 300 m) clustered into three groups typified by *Cyclothone alba*, *C. acclinidens*, *C. braueri*, *C. obscura*, *C. pallida*, *C. pseudopallida*, *V. tripunctulatus* and *H. benoiti*. A variety of depth, size and temporal distribution patterns were revealed for the dominant species. The mesopelagic ichthyofauna seems to be similar throughout the GOM. However, this fauna varies by depth: some species remaining deeper at all times (*Cyclothone* spp.), while others occur at mid-depths and exhibit various diel migrations (many myctophids).

1019 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Betsie B. Rothermel[1], Michael J. Yabsley[2], Debra L. Miller[3], Jessica L. Gonynor[2], John B. Jensen[4]

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Disease Dynamics of Pond-breeding Amphibians at a Blue Ridge Mountains Site in Georgia, USA

Reports of amphibian disease outbreaks and occurrences of the pathogenic fungus, *Batrachochytrium dendrobatidis* (*Bd*), have recently increased in the southeastern U.S. However, there is little information regarding population-level effects of emerging diseases on this region's diverse amphibian fauna. We sampled amphibians in a single pond in the Blue Ridge Mountains at 3- to 6-week intervals for one year. We used PCR assays to detect *Bd* in skin swabs (postmetamorphic amphibians), mouth swabs (large ranid larvae), and tissue samples (oral discs of small anuran larvae). *Bd* prevalence in adult red-spotted newts (*Notophthalmus v. viridescens*) was higher in February-June (mean 63.6%) than in July-November (mean 12.2%). Prevalence of *Bd* infection in larval ranids also varied seasonally, declining to near-zero (95% CI: 0.0-7.0%) in October. *Ranavirus* (but not *Bd*) was detected in early-stage wood frog (*Lithobates sylvaticus*) larvae collected in late March. The subsequent absence of wood frog larvae in April suggests we may have missed a ranaviral outbreak. We found 7 dead or sick green frog (*L. clamitans*) larvae in October. According to realtime PCR and histopathology, all were infected with *Ranavirus* but not *Bd*. Finally, several adult newts and larval green frogs collected in May were subclinically infected with both *Bd* and *Ranavirus*. Despite the high prevalence of *Bd* infection and, in some cases, co-infection with *Bd* and *Ranavirus*, no species have been extirpated from this site. The interactions between *Ranavirus* and *Bd* deserve further investigation. Our observations also highlight the need for intensive surveillance to detect disease outbreaks.

1037 Poster Session II, Exhibit Hall, Saturday 25 July 2009

John Rowe, Susan Dalgarn

Alma College, Alma, MI, United States

Body Temperature Variation During Nesting Forays in Midland Painted Turtles (*Chrysemys picta marginata*) on Beaver Island, Michigan

During terrestrial nesting forays, north-temperate freshwater turtles may experience a range of environmental temperatures that could cause over-heating or that could constrain movement if temperatures are too low. We studied T_b variation in *Chrysemys picta marginata* from a small marsh in northern Michigan, 2003–2004. Turtles emerged, nested, and returned to the marsh in a single day, or nesting forays lasted for up to three days. While terrestrial, T_b and air temperature (T_a) showed parallel, diel oscillations. Mean T_b of mobile turtles exceeded prevailing T_a values but was similar to T_b recorded for those same individuals while they were aquatically active (one week before and after the nesting foray). Therefore, active turtles on nesting forays may have maintained suitable T_b values by use of sun or shade. Data indicated that low light levels, that could limit navigation, and T_b values that could impede movements, did not directly cause turtles to seek terrestrial refugia after nesting. Rather, we suggest that impending low environmental temperatures, waning light levels that would eventually impair navigation abilities, and ultimately the risk of predation while returning to the marsh, caused turtles to seek terrestrial refugia.

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361 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009; ASIH STOYE AWARD PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Zane Ruddy

Texas A&M University-Corpus Christi, Corpus Christi, TX, United States

The Role of Handling Stress in the Survival of Hatchery-Reared Spotted Seatrout (*Cynoscion nebulosus*) when Subjected to a Predator

The spotted seatrout (*Cynoscion nebulosus*) is one of the most sought after sport fish along the Gulf and Atlantic Coasts. Due to increasing recreational fishing pressure, the rearing of juvenile fish in hatcheries for release in bays and estuaries has been utilized. However, there is concern that these fish may not be behaviorally and physiologically prepared to survive in the wild after being subjected to stressors in the hatchery environment and during transport. This study aimed to determine whether handling stress increases the vulnerability of these fish to predation. Each group of 16 hatchery spotted seatrout (n=240) were chased and handled with a mesh dip-net until one mortality in each group was observed, resulting in 15 experimental fish presumed to be

approaching critically high stress levels. The fish were placed in a 30-l tank containing an artificial seagrass bottom and two adult pinfish (*Lagodon rhomboides*)-an abundant natural predator of juvenile spotted seatrout. Control groups of unstressed fish (n=240) were permitted a 24 hr acclimation period within the experimental tanks before exposure to predators. Mortality was calculated each hour until all fish were eaten. Results indicate that stressed hatchery spotted seatrout experience significantly higher ($p<0.05$) levels of predation than unstressed fish, most notably within the first hour. The ability of a fish to evade predators until it reaches reproductive size is essential to the success of the fishery. This study shows that the ability of hatchery spotted seatrout to survive post-release may be influenced by handling stress.

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973 Herp Conservation II, Grand Ballroom II, Monday 27 July 2009

Ronald Russell, Sara Collins

Saint Mary's University, Halifax, Nova Scotia, Canada

Multiple Road Effects on Amphibian Community Structure in Roadside Wetlands

The negative effects of roads are a major concern in amphibian conservation. Habitat loss, isolation, direct mortality, edge effects, disturbance, and toxic runoff are considered to be important factors affecting amphibians inhabiting roadside wetlands. We describe a series of field surveys and laboratory experiments conducted in Nova Scotia examining the effects of direct mortality, chronic disturbance, and toxic road runoff of deicing chemicals on amphibians. We surveyed 42 km of paved roads of varying traffic density through forested habitat for amphibian mortalities. Mortalities ranged from 0 to over 80% and were positively related to vehicle frequency and amphibian incidence; however species with low vagility were under-represented in road mortality. Wood frog chorus sizes were reduced in wetlands adjacent to high traffic roads while green frog and spring peeper choruses showed no similar reductions with traffic disturbance. A series of laboratory toxicity experiments indicated that spotted salamander and wood frog larvae were the most sensitive to NaCl contamination from runoff in acute exposures. Amphibian species showed different responses to environmentally significant chronic salt exposures at different life stages. The differential in effects of direct mortality, chronic disturbance, and particularly salt contamination to amphibians are important structuring factors in amphibian communities occupying roadside wetlands. Increasing urbanization and road construction are serious threats to amphibians.

1029 Snake Ecology, Pavilion East, Monday 27 July 2009

Pamela Rutherford, Nicholas Cairns, Chelsea Jaeger, Drew Hoysak

Brandon University, Brandon, Manitoba, Canada

Hibernation in Small-bodied Snakes in South-western Manitoba

Mounds abandoned by ants of the Formica genus are known to be used as hibernacula for small-bodied snakes. In Manitoba, these mounds are used by hibernating red-bellied (*Storeria occipitomaculata*), smooth green (*Ophepdrys vernalis*), juvenile plains garter (*Thamnophis radix*), and juvenile red-sided garter (*Thamnophis sirtalis parietalis*) snakes (Criddle 1937). The objective of this study is to examine the species' composition of these mounds, and their related thermal profiles. Five mounds were selected in the Souris River Bend Wildlife Management Area (SRBWMA), Manitoba. Drift fences and traps were monitored at each mound in the fall and spring, and thermal probes were installed from September to May of 2008 and 2009. Smooth green snakes and the two garter snake species arrived first at the hibernacula. Red-bellied snakes were the most common species, and arrived last. Temperatures in the mound remained steadier and warmer than temperatures at or near the surface. The average temperature of the ant mounds was 2.5C with a minimum and maximum of -6.5C and 15.5C. Snakes that were caught in the traps, as well as in the vicinity, indicate that the species using the ant mounds are consistent with previous work done by Criddle (1937) in Manitoba. The thermal profiles of each mound are similar to previous hibernacula studies (Brown et al. 1974; Jacob and Painter 1980) which provides an understanding of the thermal requirements for successful hibernation of small-bodied snakes in Manitoba.

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320 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Maureen Ryan[1], Jarrett Johnson[1], Benjamin Fitzpatrick[2]

[1]University of California Davis, Davis, CA, United States, [2]University of Tennessee, Knoxville, TN, United States

Ecological Impacts of Tiger Salamander Hybridization: Invasive Genotypes Impact Native Amphibians

We examined the ecological effects of tiger salamander hybridization (*Ambystoma californiense* x *Ambystoma tigrinum mavortium*) on three native amphibian species in central California: *Ambystoma californiense* (native, threatened California Tiger Salamander), *Pseudacris regilla* (Pacific Chorus Frog) and *Taricha torosa* (California Newt). In a series of mesocosm experiments, we examined the impacts of early generation

hybrid cross types (first two generations of parental crosses) and contemporary hybrids (from the center of the hybrid zone) and found that most classes of hybrid tiger salamander larvae dramatically reduced the survival of Pacific Chorus Frog tadpoles and California Newt larvae. Most classes of hybrid larvae also negatively impacted native California Tiger Salamanders by reducing survival and size at metamorphosis and increasing time to metamorphosis. We also observed a large influence of Mendelian dominance on size, metamorphic timing and predation rate of hybrid tiger salamanders. Results from a field enclosure experiment support our mesocosm findings and highlight additional selective factors influencing the relative fitness of native and hybrid tiger salamanders (e.g., pond water quality). Our results suggest that both genetic and ecological factors are important in the dynamics of admixture and that hybrid tiger salamanders may pose a threat to pond-breeding species within the hybrid zone.

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786 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Mark Sabaj Pérez[1], Mariangeles Arce H.[2], José Birindelli[3], Leandro Sousa[3]

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Doradidae: In Complete Classification

Doradidae (thorny catfishes) is a monophyletic family of freshwater fishes endemic to South America that is promptly diagnosed by a single unique and unreversed synapomorphy: presence of infranuchal scute, a bony laminar expansion of ligament between posterior nuchal plate and first rib that is associated with lateral-line canal and either contacts, underlies or closely approaches medial face of posterior cleithral process ventrally. Doradid taxonomy began with Linnaeus' (1758) descriptions of *Silurus cataphractus* and *S. costatus*, valid in *Acanthodoras* and *Platydoras*, respectively. Eigenmann (1925) compiled the first comprehensive classification and recognized 68 valid species in 26 genera. Doradid taxonomy languished over the next 78 years with the introduction of nearly as many synonyms (12 species, 6 genera) as valid taxa (15 species, 8 genera), and no work published from 1991-2002. A checklist by Sabaj and Ferraris (2003) resolved a number of taxonomic and nomenclatural impediments, and provided a modern benchmark for the classification of 129 nominal species and 41 genera of which 72 species and 30 genera were considered valid. Recent years have witnessed a rebirth of doradid taxonomy with descriptions of 15 new species (including one Miocene fossil) and one new genus since 2005. Our current understanding of doradid taxonomy and systematics will be summarized for all nominal genera (43) and species (144) from which 30 genera and about 90 species are currently recognized as valid. Recent museum and field work as well as unpublished systematic studies have identified about 12 species and two genera yet to be described.

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663 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Allison Sacerdote, Richard King

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Dissolved Oxygen Requirements for Hatching Success in Spotted Salamanders and Blue-Spotted Salamanders

Spotted salamanders (*Ambystoma maculatum*) were extirpated from a Chicago-region wetland preserve and the surrounding area due to land use. Blue-spotted salamanders (*Ambystoma laterale*) persisted in the region despite habitat degradation. As a feasibility assessment for reintroduction following restoration, spotted salamander hatching success was monitored using in situ enclosures and was compared to hatching success of spotted salamander eggs in source sites, and to hatching success of the resident blue-spotted salamanders. Low hatching success was consistently correlated with hypoxic conditions in certain restored vernal pools. Hypoxic pools had undergone canopy closure and mesophication. Decomposition of mesophytic leaf litter in historically open-canopy pools reduced available dissolved oxygen in vernal pools. Laboratory experiments were used to determine threshold levels of oxygen necessary for hatching success in spotted salamanders and blue-spotted salamanders to guide restoration management. Gradients were created including 0, 2, 4, 5, 6, 7, and 8 mg/l dissolved oxygen for spotted salamanders, and 2, 4, and 6 mg/l dissolved oxygen for blue-spotted salamanders. Spotted salamander egg masses only hatched successfully in treatments greater than 4 mg/l or 50% saturation. Blue-spotted salamander eggs exhibited hatching success in all oxygen treatments. The results of the laboratory experiment demonstrate that additional restoration management was necessary to increase dissolved oxygen levels in restored vernal pools. Prescribed burns of leaf litter in dried pool basins and selective canopy thinning were used to increase dissolved oxygen levels in hypoxic pools. These restoration management prescriptions resulted in increased dissolved oxygen levels and increased hatching success.

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231 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Daniel Saenz, Cory Adams

Southern Research Station , US Forest Service, Nacogdoches, TX, United States

An Examination of Anuran Habitat Associations and the Relationship with Larval Activity Levels

Constraints posed by drying aquatic habitats and predation are important causes of mortality for many organisms that inhabit freshwater systems and have profound effects

on ecological communities. A generally accepted paradigm in anuran community ecology is that tadpoles of anuran species that live in ephemeral habitats are relatively active, grow rapidly, and reach metamorphosis quickly, thus enabling them to survive by escaping drying ponds. By contrast, species that inhabit permanent water sites tend to develop slower and are less active. Lower activity levels are known to be correlated with higher tadpole survivorship in the presence of predators. We tested these paradigms by determining activity levels of 12 different tadpole species native to eastern Texas. Preliminary analyses indicate that species that primarily inhabit permanent ponds do have lower activity levels compared to species that tend to occur in ephemeral ponds, however there are exceptions. Also, ontogenetic shifts in activity appear to occur in most anuran species in our study, with smaller less developed tadpoles having higher activity levels than larger more developed ones. While generalizations about tadpole habitat associations and activity levels do seem to be well founded, anuran communities are quite complex and much remains to be discovered about the relationships between tadpole behavior and community assembly.

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119 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Kenji Saitoh[1], Wei-Jen Chen[2], Richard L. Mayden[2]

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Cypriniformes Tree of Life: Nuclear and Mitochondrial DNA Analysis of Tetraploid *Cobitis biwae* and *C. striata* Indicates Extensive Past Hybridization Events

Hybridization, unisexuality and polyploidy are particular characteristics of cypriniform biodiversity among teleostean fish. Some *Cobitis* loaches show these specific processes of diversification in natural habitats. In Japan, sexually reproducing tetraploids are reproductively isolated from the sympatric diploids. To infer ancient parentage of the tetraploids, we compare nuclear (RAG1, RH, EGR2B, and IRBP loci) and mitochondrial (ND4-ND5 region) sequences from two tetraploids (*C. biwae* tetraploid race; 2n=4x=96 and *C. striata* large race; 2n=4x=98) with several diploid populations of *C. biwae* (2n=48), *C. striata* (mostly 2n=50) and related species. Nuclear sequences divided monophyletic diploid *C. biwae* and *C. striata lineages*. These two major lineages further consist of three and two clusters of populations respectively. Mitochondrial gene tree also showed these three *C. biwae* and two *C. striata* haplotype groups, but one *C. biwae* group is close to *C. striata* indicating past hybridization. The tetraploid *C. biwae* comprises both nuclear and mitochondrial sequences close to the diploid *C. biwae* group which shows mitochondrial introgression from *C. striata*. The tetraploid *C. striata* has both *C. biwae* and *C. striata*-related nuclear alleles with *C. biwae*-related mitochondrial DNA indicating allotetraploidy with *C. biwae* as the mother. Alleles of the tetraploid *C. striata* from different loci showed affinity with different allele groups in each of diploids. At least three genomes are thus involved in the establishment of tetraploid *C. striata*. An allele of

RAG1 out of eight chromosomes from the tetraploid harbored 10nt gap in a coding region showing an onset of genome reshaping after the allotetraploidization.

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688 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Melody Saltzgiver[1], Ed Heist[1], Phil Hedrick[2], Josh Geltz[1]

[1]Southern Illinois University Carbondale, Carbondale, IL, United States, [2]Arizona State University, Tempe, AZ, United States

Genetic Management Plan for Endangered Pallid Sturgeon Captive Broodstock Maintained at Gavin's Point National Fish Hatchery

Pallid sturgeon (*Scaphirhynchus albus*) are a native North American fish that were listed as a federally endangered species in 1990 .The upper Missouri River basin pallid sturgeon have been shown to be genetically distinct from other pallid sturgeon. Since there has been no natural recruitment in the upper Missouri River for several decades, perpetuation of this genetically distinct unit is reliant on propagation using remaining wild fish as broodstock. It has been proposed that rearing progeny of wild broodstock fish in a hatchery setting as captive broodstock may be feasible alternative to wild collections. The genetic risks associated with the creation of a captive broodstock needed to be investigated and a captive management plan needed to be developed prior to the implementation of a captive broodstock program. The relatedness values and the effective population size for the wild caught founders were determined by genotyping wild upper Missouri River pallid sturgeon at 16 microsatellite loci. The founding wild broodstock were shown to encompass an ample amount genetic variation and a sufficiently large effective population size. The broodstock currently housed as Gavin's Point National Fish Hatchery can be used exclusively for the propagation of pallid sturgeon to be stocked in the upper Missouri River with the caveat that descendants from each wild fish will be spawned in the future and that the reproductive variance of the broodstock be controlled to maximize N_e and thus minimize the loss of genetic variation.

1033 Storm Symposium, Pavilion West, Friday 24 July 2009

Jerod Sapp

Oregon State University, Corvallis, OR, United States

The Circular Tail-straddling Walk of the Clouded Salamander, *Aneides ferreus*: A Deviation from the Highly Conserved Linear Tail-straddling Walk of the Plethodontidae

Courtship in the family Plethodontidae is characterized by a linear tail-straddling walk, in which the female follows the male as he moves forward in a straight line. *Aneides ferreus* courtship differs from typical plethodontid patterns in three noteworthy ways: the duration of their courtship is long in comparison with other plethodontids, a circular tail-straddling walk precedes the typical plethodontid linear tail-straddling walk, and the female exhibits assertive behavior atypical of other female plethodontids. These behavioral differences of *Aneides ferreus* may be an outcome of limited space for courtship activities.

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816 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Anna Savage

Cornell University, Ithaca, NY, United States

Experimental Infection with *Batrachochytrium dendrobatidis* Demonstrates Genetic Resistance to Chytridiomycosis in *Lithobates yavapiensis*

The fungal disease chytridiomycosis is implicated in the decline or extinction of over two hundred amphibian species worldwide. Susceptibility to chytridiomycosis is known to vary across amphibian species, both within taxonomic groups and among sympatric species. However, two central epidemiological questions about host disease dynamics remain unanswered: (1) Does variation in chytridiomycosis susceptibility occur within a species? and (2) If intraspecific variation in susceptibility occurs, does it have a genetic basis? To answer these questions, I performed experimental chytridiomycosis infections on lab-reared individuals of *Lithobates yavapaiensis* (Ranidae) collected from five natural populations in Arizona, USA. All individuals became infected with the chytridiomycosis-causing fungus *Batrachochytrium dendrobatidis* within seven days of exposure. After thirty days, infected frogs from three populations had 0% survival, while infected frogs from the remaining two populations had 36% and 48% survival, respectively. There was a significant effect of source population on chytridiomycosis survival, but no effect of replicate group or mass at the time of infection. Fourteen-locus microsatellite genotyping of all infected individuals confirmed that frogs from each source population were significantly genetically differentiated. Relative risk calculated for all microsatellite loci across individuals within each genetic group identified one allele that was associated with a significant reduction in the likelihood of dying from chytridiomycosis. This association indicates linkage with a gene region contributing to chytridiomycosis resistance in *Lithobates yavapaiensis*, and provides a target for future functional genetic studies of chytridiomycosis susceptibility across amphibian species.

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662 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER HERPETOLOGY AWARD

Eric Schaad

The University of New Mexico, Albuquerque, NM, United States

Variation Between Island and Mainland Communities of *Anolis* lizards

Adaptive radiations resulting in communities of closely related, sympatric species have been best studied in island systems with classic examples being finches on the Galapagos, Silverswords in Hawaii and *Anolis* lizards in the Caribbean. It has been suggested that differences exist between island and mainland communities in morphological and ecological characteristics possibly due to reduced geographical space and decreased predation on islands. *Anolis* lizards provide an excellent system in which to test evolutionary differences between island and mainland communities. We have visited several island and mainland localities with anole communities of five to 13 sympatric species. These sites provide an ideal system in which to compare the evolution of island and mainland communities. We compiled a data set containing 255 species of anoles scored for seven morphological characters. We compared the morphological and phylogenetic structure of mainland and island communities. Our results show that mainland and island species occupy different morphological space and display contrasting phylogenetic structure of communities.

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362 Lizard Ecology, Pavilion East, Friday 24 July 2009

Richard Schaefer[1], Robert Fleet[2], Craig Rudolph[1], Nancy Koerth[1]

[1]*Southern Research Station, USDA, Forest Service, Nacogdoches, TX, United States,* [2]*Department of Mathematics and Statistics, Stephen F. Austin State University, Nacogdoches, TX, United States*

Relationships between Green Anole (*Anolis carolinensis*) Abundance and Shrub Density, Structure, and Species Composition in Open Pine Forests

We related Green Anole (*Anolis carolinensis*) abundance to shrub-level (≥ 0.5 m and < 3 m) vegetation, including vines, at 40 plots of varying shrub densities in open pine forests in eastern Texas. We surveyed anoles during late spring (4-17 June) and mid-summer (10-24 August) for three consecutive years. Anoles were more common at plots with a greater number and greater volume of shrubs. Shrub-level vegetation was the most commonly used perch substrate (n = 252 obs.) followed by midstory (≥ 3 m and below the canopy) vegetation (n = 19 obs.). Certain shrub species were preferred while others

were avoided. Shrub-level plants harboring Green anoles averaged wider, taller, and greater in volume than those available in plots where anoles were detected.

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225 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Scott Schaefer[1], Mark Sabaj[2], Anthony Geneva[2], Prosanta Chakrabarty[3]

[1]American Museum of Natural History, New York, NY, United States, [2]Academy of Natural Sciences of Philadelphia, Philadelphia, PA, United States, [3]Louisiana State University, Baton Rouge, LA, United States

Andean Astroblepid Catfishes: Pattern and Scale of Species Diversity

The 54 nominal species of Astroblepidae are widely distributed in Andean freshwaters from Panama to Bolivia and span an elevation range of nearly 4000 m. Such a continent-scale distribution rivals the geographic distributions of the majority of catfish families of the Neotropics, yet stands in stark contrast to the comparatively more limited scales of morphological and taxonomic diversities recognized for astroblepids thus far. We compared patterns of covariation between morphology and DNA sequence divergence (ctyb, Rag1, 16S, COI) among astroblepid morphospecies at multiple geographic scales. Relationships among populations and morphospecies were generally concordant with variation in meristics, morphometrics, and coloration at the geographic scale of the major river drainage basins. Three or more species may co-occur in single collections and span multiple elevations. At smaller spatial scales and within morphospecies, however, genomic variation was concordant only with general patterns of pigmentation, and geographically proximate populations, otherwise indistinguishable, are frequently not closely related. These results suggest that relatively high levels of genetic variation within and among astroblepid species occurring at small spatial scales are masked by the presence of discontinuous variation in morphology.

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886 ELHS/LFC Ecology I, Galleria South, Broadway 1&2 25 July 2009

Fred Scharf

University of North Carolina Wilmington, Wilmington, NC, United States

Variable Juvenile Growth in a Temperate Estuarine Fish: Consequences for Cohort Strength and Population Dynamics

Many marine fishes experience size-dependent mortality during juvenile life stages. Here, I assess the influence of current spatial and temporal variability in growth of age-0 juvenile red drum, and then explore the potential consequences for cohort strength and population dynamics. Field sampling was completed in

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southeastern North Carolina estuaries during the fall recruitment period of four different years. Otolith microstructural analyses were completed to assign ages, estimate birth timing, and calculate growth rates. Variability in body size at the end of the fall growing season was also assessed using a long-term data set for red drum collected by the state of North Carolina. Coupled variability in birth timing and estuarine growth led to differential body sizes prior to winter both within and among cohorts. Similarly, long-term data indicated that the body sizes at the end of the fall varied considerably among years throughout the state. A size-structured life history model combined size-dependent mortality functions with the observed variability in growth to estimate cohort success and potential contribution to fishery recruitment. Results from the model were used to explore the influence of variable (size-dependent) juvenile survival on red drum population growth rate and reproductive output. Model analysis revealed the potential for early growth variation to have a strong influence on the number of fish recruiting to the fishery and overall population growth rates, indicating that timing of estuarine arrival and initial settlement habitat may have important implications for red drum population dynamics in this portion of the species range.

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168 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Ingo Schlupp

University of Oklahoma, Norman, OK, United States

Sex and Asex in Livebearing Fishes

The evolution and maintenance of recombination has been a puzzle for a very long time. I use a mating system involving a sexual and an asexual fish of the livebearing genus *Poecilia* to tackle this problem. The Amazon molly, *Poecilia formosa*, is unisexual, and produces clonal offspring from unreduced eggs. Interestingly, these females nonetheless have to mate with males of a different species, because they need sperm to trigger embryogenesis. This unusual mating system can be used to address many important questions in evolutionary biology. I will focus on the stable coexistence of the unisexual Amazon molly and the species that provide sperm, the Atlantic molly (*Poecilia mexicana*) and the Sailfin molly (*Poecilia latipinna*).

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860 Fish Systematics, Pavilion East, Monday 27 July 2009

Ray Schmidt, Henry Bart

Tulane University, New Orleans, LA, United States

Diversity of African Suckermouth Catfishes (Mochokidae: Chiloglanis) in Guinea, West Africa

Members of the genus *Chiloglanis* are widely distributed throughout Africa. Currently, only two species, *C. occidentalis* and *C. lamottei*, are known from Guinea, West Africa. *Chiloglanis* specimens and tissues were collected from the Fouta Djalon highlands and Zone Forestiére during 2003 expeditions. All specimens collected were initially diagnosed as *C. occidentalis*. Here we discuss the phylogeography of West African *Chiloglanis* in the context of other recently studied taxa from the area. We compare *Chiloglanis* from Guinea to species from the surrounding countries of Liberia and Sierra Leone, including type material. Phylogenetic analysis of the complete cytochrome b gene from 27 specimens revealed three distinct clades. These clades are divergent from each other by 5-8%. The morphology of the sucker, premaxillary tooth pads, and number of mandibular teeth are also variable across the watersheds. At five locations within the Niger River watershed two taxa are sympatric. One possesses moderately long mental barbels and a mandibular teeth count of 4+4. The other has severely reduced or absent mental barbels and a mandibular teeth count of 6+6.

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565 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Susana Schönhuth[1], Anabel Perdices[2], Lourdes Lozano-Vilano[3], Francisco García de León[4], Héctor Hespinosa[5], Phillip M. Harris[6], Richard L. Mayden[1]

[1]Department of Biology, Saint Louis University, Saint Louis, MO, United States, [2]Department of Biodiversity and Evolutionary Biology, Museo Nacional de Ciencias Naturales (CSIC), Madrid, Spain, [3]Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, Nuevo Leon, Mexico, [4]Centro de Investigaciones Biológicas del Noroeste, S.C. (CIBNOR), La Paz, Baja California, Mexico, [5]5 Instituto de Biologia, Universidad Nacional Autónoma de México, Mexico City, Mexico DF, Mexico, [6]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL, United States

Cypriniformes Tree of Life: Phylogenetic Relationships of Species of *Gila* in Mexico and Related Western Genera (Cypriniformes: Cyprinidae)

The genus *Gila*, or chubs, is widespread in aquatic habitats of western North America from northern USA to central Mexico. The number of species in the genus remains unclear (Fishbase: up to 23 spp.) and is a topic of debate, but they range from 11 to 62 cm

SL. Most of the taxonomy of this group is based on morphology, the genus includes several different forms that inhabit a variety of habitats. Systematic of these cyprinids have a chaotic systematic history, and even closely related species have been placed in different genera by early workers. The relationships of the genus relative to other North American cyprinids has been studied using morphological (Uyeno, 1961; Coburn and Cavender, 1992) and molecular data (Simons and Mayden, 1998). Uyeno (1961) proposed to combine *Siphateles* and *Snyderichthys* with *Gila*, and unite *Clinostomus* with *Richardsonius*; later studies did not followed these proposed combinations and placed the genus *Gila* within a Western Clade. We present a molecular phylogeny, using mitochondrial and nuclear genes, for 12 different genera from the Western Clade (mainly species of *Gila*, *Ptychocheilus*, *Agosia*, *Algansea* and *Siphateles*), with a focus on the genus *Gila* in Mexico. Phylogenetic analyses recover a well-supported clade that included most of the species currently included in the genus *Gila* analyzed here plus several other Western genera. While relationships within among the taxa in this clade are not fully resolved, our results indicate some genera are not monophyletic groups.

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667 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Eric Schott, Jerald Johnson

Brigham Young University, Provo, UT, United States

Female Preferences for Males in the Livebearing Fish *Poeciliopsis baenschi*: Sympatric versus Allopatric Population History Predicts Preference Strength

Mating with a heterospecific individual can be evolutionarily costly. If such costs are present, species recognition behaviors to avoid heterospecific mating should evolve. In this study, we evaluate the behavior of females of the livebearing fish species *Poeciliopsis baenschi* when offered a choice to associate with conspecific males versus males of the closely related species *Poeciliopsis turneri*. We predict that *P. baenschi* females from locations where they naturally co-occur with *P. turneri* (sympatric populations) will show stronger preferences for conspecific males than females from locations where they are the only livebearing fish species present. We assessed preferences using a dichotomous choice test. Consistent with our hypothesis, we found that sympatric females spent more time with conspecific males than their allopatric counterparts. These data suggest that in environments where females could potentially mate with heterospecific males, that preferences for conspecific males are stronger to avoid the potential cost of mating with a different species. Using similar preference assays, we also tested the hypothesis that females from sympatric populations would also show stronger preferences for males from their own population relative to conspecific males from allopatric populations, and that females from allopatric populations would not show the same strength of preference. Again, our data were consistent with expectations.

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425 Herp Genetics, Galleria North, Saturday 25 July 2009

Aaron Schrey, Alicia Fox, Earl McCoy, Henry Mushinsky

University of South Florida, Tampa, FL, United States

Effects of a Managed Burn Regime on Florida Sand Skink Analyzed with Microsatellite Loci

The threatened Florida Sand Skink, *Plestiodon reynoldsi*, is restricted to scrub habitat on the central ridges of peninsular Florida. Scrub habitat is dependent on fire and infrequent fires may play an important role for Florida Sand Skink. We investigated the effect of fire on the Florida Sand Skink by screening eight microsatellite loci in individuals (n>600) from the Archbold Biological Station. There is an active, long-term managed burn regime over a heterogeneous scrub habitat at Archbold Biological Station. Tissue samples were collected from locations described by three burn frequency categories (long unburned, intermediate burned, recently burned), with four sites per category and three enclosures per site. Our objectives were to estimate the genetic population structure over the sampled area, to determine how genetic diversity was related to burn history, and to use individual assignment testing to infer dispersal patterns associated with fires. Bayesian model-based clustering identified multiple populations of Florida Sand Skink. Pairwise estimates of F_{ST} were significant for 61 of 65 among site comparisons. A decrease in homozygosity by locus was observed with an increase in time since fire. Two recently burned sites had higher heterozygosity and allelic richness, one had lower heterozygosity and allelic richness, and one was not different from the intermediate and long unburned sites. Assignment testing showed individuals in a recently burned site were most similar to proximate populations. Results indicate that the Florida Sand Skink's response to fire may be context dependent. Fires may stimulate movement of individuals, or may isolate the burned area.

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833 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

Tiffany Schriever, Dudley Williams

University of Toronto, Toronot, ON, Canada

Food Web Ecology of Ponds Along A Hydroperiod Gradient: A Stable Isotope Investigation

Temporary pond ecosystems support diverse amphibian, insect, and plant communities, yet little work has investigated the food web dynamics within these systems. We used stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) to examine food web structure (food chain length and trophic position of common species) and resource quality of seven ponds varying in habitat duration. Preliminary results indicate food chain length, amphibian community, and nutritional quality of basal resources (measured by C: N ratio) varies among ponds.

Generally, temporary ponds have shorter food chains than permanent ponds, and mean trophic position of two amphibians common to all ponds, Spring Peepers and Blue-spotted salamanders, showed slight changes among ponds. This study provides baseline information on the structure and function of temporary pond food webs. These results further stress the importance of temporary water bodies for the maintenance of amphibian diversity.

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601 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Eric Schultz[1], Richard Blob[2], Margaret Ptacek[2], George Rawitscher[1]

[1]University of Connecticut, Storrs, CT, United States, [2]Clemson University, Clemson, SC, United States

Copulation Kinematics in *Poecilia*, a Genus of Livebearing Fish

Pronounced interspecific variability indicates that copulatory organs evolve rapidly. We are studying inter- and intraspecific variability in form and function of the gonopodium, the copulatory organ of livebearer fishes (subfamily Poeciliinae). The goal of this work is to reconstruct the evolution of copulatory organ form in a functional context. Our focus at present is on intraspecific variability in gonopodium length. Copulatory organ size in many animals scales hypoallometrically: small individuals have disproportionally large organs. This pattern is widespread in the Poeciliines. In an effort to clarify functional consequences of this scaling pattern, we have developed a biomechanical model of circumduction, the motion of the gonopodium during copulation. The model quantifies how the angular velocity of circumduction depends on time as a function of various physical input parameters. The model suggests that a consequence of hypoallometric scaling is that circumduction speed will be invariant with size. We test this prediction using high speed (500 frames per second) digital videography of Poeciliine copulations. We recorded the copulation of five species in the genus *Poecilia*, including a range of male sizes within each species. Circumduction speed varied among species, and males within species. Male differences in circumduction speed were not influenced by their body size, a result consistent with the biomechanical model. Further work is being done on anatomical assumptions and kinematic predictions of the model.

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330 Poster Session II, Exhibit Hall, Saturday 25 July 2009

David Scott[1], Yurena Yanes[1], Betsie Rothermel[1], Melissa Pilgrim[1], Chris Romanek[1]

[1]SREL, Aiken, SC, United States, [2]SREL, Aiken, SC, United States, [3]Archbold Biological Station, Lake Placid, FL, United States, [4]USC-Upstate, Spartanburg, SC, United States, [5]SREL, Aiken, SC, United States

Using Stable Isotope Spikes to Determine Amphibian Dispersal: A Pilot Study

Stable isotope techniques have been used to understand dispersal of animals at different scales. For example, ^{15}N addition to wetlands has been used to mark millions of insect larvae and subsequently determine dispersal patterns via captures of ^{15}N-enriched adults at non-enriched sites. Understanding the extent of dispersal among wetlands is similarly important for conservation of pond-breeding amphibians, which function as metapopulations that are spatially disjunct and dependent on immigration for persistence. We conducted a pilot study using ^{15}N enrichment of the aquatic habitat, thereby "marking" metamorphic amphibians. Because newly metamorphosed amphibians may not be recaptured until adulthood one or more years later, we sought to determine whether ^{15}N enrichment would persist to sexual maturity. Marbled salamanders (*Ambystoma opacum*) were reared in artificial mesocosms enriched with $^{15}NH_4Cl$ (0.217 g/m^2). Initial doses to larvae resulted in $\delta^{15}N$ levels in metamorphs elevated >1000 times above controls (4.76 ± 0.45 ‰). Metamorphs were held in the laboratory for up to seven months and fed on non-enriched crickets; juvenile ^{15}N levels were determined at 1 mo and 7 mo post-metamorphosis to estimate the biological half life (BHL) of ^{15}N. Seven months after metamorphosis, $\delta^{15}N$ remained high (1800 ‰) in salamanders from the spiked treatment, approximately 225 times controls. The mean BHL for $\delta^{15}N$ in the ^{15}N-added treatment was 3.67 ± 0.19 months. Therefore, our BHL estimates suggest that the enrichment technique is feasible for amphibians, as metamorphs will leave isotopically enriched sites with a stable isotope signature that will persist for at least two years.

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480 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Laura E. Scott, Ashley A. Camargo, Jerald B. Johnson

Brigham Young University, Provo, UT, United States

Are Spotting Patterns Used as a Cue in Mate Choice and Species Recognition in the Livebearing Fish *Poeciliopsis baenschi*?

Conspecific mate recognition in sympatric environments should be strongly selected for to avoid the deleterious effects of hybridization with other species. Cues used in mate

choice recognition can include stereotypic behaviors or pigmentation patterns. In the livebearing fish genus *Poeciliopsis*, species vary significantly in their pigmentation patterns. Most patterns include horizontal and vertical bars, spots, a combination of the both, or no observed pattern. *Poeciliopsis baenschi* is a species found in central-western Mexico that co-occurs with a close relative, *P. turneri*. Both species are superficially similar in their pigmentation patterns; they are described as having 3-7 or 6-10 (respectively) bars or spots on their lateral flank. However, given that these species exist in sympatry, we suspect that subtle differences in their pigmentation patterns could play a role in mate choice or conspecific recognition. In this study, we test the hypothesis that spotting patterns are more different in sympatry than in allopatry by quantifying variation in pigmentation patterns between allopatric and sympatric populations. Our results show that sympatric populations of *P. baenschi* have significantly fewer spots than both their allopatric counterparts and their close relative, *P. turneri*; and yet the total amount of pigmentation for all groups compared does not differ indicating a divergence in the distribution (as opposed to amount) of pigmentation. This work preludes our current research to determine if differences in spotting patterns are actually used as cues in mate choice and species recognition.

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847 Fish Ecology I, Pavilion East, Friday 24 July 2009

Laura E. Scott, Jerald B. Johnson

Brigham Young University, Provo, UT, United States

Phenotypic Divergence Among Multiple Traits in Sympatric Populations of the Mexican Livebearing Fish, *Poeciliopsis baenschi*

Understanding why some species coexist and others do not remains one of the fundamental challenges of ecology today. While several lines of evidence that suggest closely related species are unlikely to occupy the same habitat because of competitive exclusion, there are many cases where closely related species do co-occur. Research comparing sympatric and allopatric organisms have been shown to be a great study system to address the challenge of understanding species coexistence and divergence. However, most of these studies often compare only one trait (i.e. morphology or conspecific mate recognition), leaving much to be questioned about which traits are under the most selective pressure to diverge in sympatry. In this study we examine this question by comparing three fundamentally distinct traits: morphology, life history strategies, and spotting patterns in the livebearing fish, *Poecililiopsis baenschi*. We take advantage of a natural experiment where *P. baenschi* co-occur with a close relative, *P. turneri*, but also exist in isolation in several river drainages. We ask if sympatric populations of *P. baenschi* differ significantly in these traits from their allopatric counterparts and if so, to what extent. In brief, we found that sympatric populations of *P. baenschi* differed significantly in morphology, life history traits, and spotting pattern when compared to both their allopatric counterparts and to their close relative, *P.*

turneri. These results provide valuable insight to better understand the phenomenon of trait-divergence to permit species coexistence.

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619 Poster Session I, Exhibit Hall, Friday 24 July 2009

Peter Scott[1], Brian Sullivan[2], Tod Reeder[1]

[1]San Diego State University, San Diego, CA, United States, [2]Arizona State University, West Campus, Phoenix, AZ, United States

Mitochondrial DNA in the Tiger Whiptail (*Aspidoscelis tigris*) Exhibits Significant Population Structure Conflicting with Past Morphological Based Subspecific Boundaries in Southwest Arizona

The Tiger Whiptail (*Aspidoscelis tigris*) is a lizard species widely distributed throughout the aridlands of western North America. Much of its extensive morphological variation has been attributed to its wide distribution throughout these heterogeneous landscapes. Differences in size, scalation, and coloration has led to the recognition many subspecific taxa. In southeastern California and southwestern Arizona, morphological variation across the boundaries of two subspecies (*A. t. tigris* and *A. t. punctilinealis*) was studied by Taylor et al. (1994). They evaluated specimens sampled along two west-east transects across the transition zone between the Colorado and Arizona Upland Deserts and documented the presence of a gradual cline in ventral pigmentation across this region. In our study, we sampled individuals across the same region in order to evaluate the genetic population structure through this ecological transition zone. Phylogenetic analyses of ND1 mtDNA for >120 individuals indicate significant population structure across this region. Most individuals of the respective northern and southern W-to-E transects fall within respective transect mtDNA clades, with evidence of dispersal and/or lack of lineage sorting between the two groups. Our data suggest there is more population structure in a north-south orientation between transects, than a west-east orientation across the desert transition zone. There is evidence of west-east substructuring, but this appears to be the result of effects of the Colorado River than the ecological gradient across the desert transition zone. Further molecular population biology analyses will further document and define the levels of genetic population structure across this region.

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335 Storm Symposium, Pavilion West, Friday 24 July 2009

Catherine Searle[1], Lisa Belden[2], Andrew Blaustein[1]

[1]Oregon State University, Corvallis, OR, United States, [2]Virginia Polytechnic Institute and State University, Blacksburg, VA, United States

Effects of UV-B Radiation and Pathogens on Amphibians in the Pacific Northwest

Ultraviolet-B radiation (UVB) is a ubiquitous stressor with negative effects on many aquatic organisms. In amphibians, ambient levels of UVB can result in impaired growth, slowed development, malformations, altered behavior and mortality. UVB can also interact with other environmental stressors to amplify these negative effects on individuals. In outdoor mesocosm and laboratory experiments we studied potential synergistic effects of UVB, a pathogenic fungus, *Batrachochytrium dendrobatidis* (*Bd*), and varying temperatures on larval Cascades frogs (*Rana cascadae*). First, we compared survivorship, growth and development in a mesocosm experiment with UVB and *Bd* exposure treatments. We then investigated the effects of UVB on larvae in the laboratory under two temperature regimes, monitoring survival and behavior. We found reduced survival of *R. cascadae* larvae with exposure to ambient levels of UVB radiation in all experiments. In the mesocosm experiment, growth and development were not affected in either treatment, and no effect of *Bd* was found. In the laboratory experiment, larvae exposed to UVB demonstrated decreased activity levels. We also found a trend towards reduced survival when UVB and cold temperatures were combined. Our results show that amphibian larvae can suffer both lethal and sublethal effects when exposed to UVB.

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156 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Greg Seegert, Joe Vondruska, Elgin Perry

EA Engineering, Deerfield,IL, United States

The Longitudinal Pattern of Various Fishes in the Ohio River

We used a generalized additive model to analyze electrofishing data collected seasonally in 2005 near 17 power plants that spanned nearly the entire length of the Ohio River. We examined 31 fish species and five measures of community health (e.g., catch rate and species richness) to determine if these species or measures were uniformly distributed throughout the river or were significantly more common in one portion of the river compared to other areas. Based on our statistical comparisons, species or measures were assigned to one of seven categories:

- Similar abundance throughout the river - 3 species

- Most abundant in the middle river--- 5 species
- Noticeably more common in the upper half of the river --- 5 species
- A nearly linear decline from upstream to downstream --- 10 species
- A general decline from upstream to downstream, but with an increase near the lower-most power plant --- 1 species and all community measures
- An increase from upstream to downstream --- 2 species

Another 18 species were essentially confined to one end of the river or the other. The species largely confined to the upper river were primarily percids and round-bodied suckers, especially redhorse. Species confined to the lower river were those typical of the Mississippi River.

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35 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Will Selman

The University of Southern Mississippi, Hattiesburg, MS, United States

The Pascagoula Map Turtle (*Graptemys gibbonsi*): Overlooked, Declining, or Both?

Turtles in the genus *Graptemys* (Map Turtles) are highly aquatic, freshwater turtles with many of the 14 Graptemys species being endemic to single rivers, as well as considered threatened. The Pascagoula Map turtle (*Graptemys gibbonsi*) occurs throughout much of the Pearl and Pascagoula River systems of southern Mississippi and southeastern Louisiana, but little is known about its status and/or life history/ecology. It occurs sympatrically with two Federally listed turtles, the ringed sawback (*Graptemys oculifera*) of the Pearl River and the yellow-blotched sawback (*Graptemys flavimaculata*) of the Pascagoula River. Therefore, we determined to conduct thorough surveys within the Pascagoula River system, while also studying the basking behavior of *G. gibbonsi* in comparison to the *G. flavimaculata*. We found *G. gibbonsi* present in all the major rivers and some new localities within the Pascagoula River system, but they were absent from several documented localities. *G. gibbonsi* was the third most abundant turtle observed during surveys, behind *Pseudemys concinna* and *G. flavimaculata*, and they are only locally abundant in some river stretches. Mark-resight estimates were lower for *G. gibbonsi* in comparison to *G. flavimaculata* and trapping survey results also found *G. gibbonsi* to occur at lower abundances in comparison to *G. flavimaculata*. *G. gibbonsi* basking behavior was found to reflect a similar basking pattern as *G. flavimaculata*. Therefore, considering the current and historical data, it appears that *G. gibbonsi* is declining and should be considered for state protection status in Mississippi and Louisiana, as well as Federal protection.

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741 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Matthew Semcheski, Kent Carpenter, Millicent Sanciangco

Old Dominion University, Norfolk, VA, United States

Congruence Between Morphological and Molecular Phylogenies of Snappers (Percoidei: Lutjanidae)

The 17 genera of snappers have been classified into five subf[illegible] morphological phylogenetic evidence. These subfamilies, in phylet[illegible] sequenc[illegible] are[illegible] Etelinae, Apsilinae, Paradicichthyinae, Lutjanina[illegible] C[illegible]sionina[illegible] Th[illegible] c[illegible]ion[illegible]s have been variously placed in their ow[illegible] mil[illegible] inclu[illegible]d with[illegible] lut[illegible]in[illegible] A molecular phylogeny based o[illegible] two[illegible] in[illegible] he[illegible] i[illegible] a[illegible] one[illegible] clear[illegible] g[illegible]om representatives of[illegible]5 lut[illegible]d[illegible] he[illegible] corrobo[illegible]g the[illegible] eneric[illegible] it[illegible] of the Etelina[illegible]psilin[illegible] and[illegible] ad[illegible]ch[illegible]yinae a[illegible] confir[illegible]t[illegible] Lutjaninae are para[illegible] wi[illegible] th[illegible] [illegible]or[illegible] f t[illegible] c[illegible]e genera. Molecular evidence sug[illegible]ts that s[illegible]e[illegible] th[illegible]p[illegible] co[illegible]ion[illegible] lutjanine genera, including the long-sta[illegible]ng genu[illegible] *us* may need to be revised. The molecular phylogeny of the sub[illegible]mili[illegible]di[illegible]s [illegible]ir[illegible]ly from the one based on morphological evidence. A slight rei[illegible]ati[illegible] of morphological characters can account for this discrepancy.

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712 General Herpetology, Galleria South, Sunday 26 July 2009

Stanley K Sessions[1], Brandon Ballengée[2]

[1]Hartwick College, Oneonta, NY, United States, [2]University of Plymouth, Drake Circus, Plymouth, United Kingdom

An Explanation for Missing Limbs in Deformed Amphibians

We present evidence that the most commonly found deformities in wild-caught amphibians, those featuring missing limbs and missing limb segments, may be the result of selective predation. Here we report that predatory dragonfly nymphs can severely injure and even fully amputate developing hind limbs of anuran tadpoles. Developmental responses of the injured/amputated tadpole limbs range from complete regeneration to no regeneration, with intermediate conditions represented by a wide variety of idiosyncratic limb deformities, depending mainly on the developmental stage of the tadpole at the time of injury/amputation. These findings were reinforced by experimental amputations of anuran tadpole hind limbs that resulted in similar deformities. Our studies suggest that selective predation by dragonfly nymphs and other aquatic predators may play a significant role in the most common kinds of limb deformities found in natural populations of amphibians.

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45 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

David M. Sever[1], Stanley E. Trauth[2]

[1]Southeastern Louisiana University, Hammond, LA 70402, United States, [2]Arkansas State University, State University, AR 72467, United States

The Anterior Testicular Ducts of Snakes

The anterior testicular ducts that connect the seminiferous tubules to the ductus deferens are, from proximal to distal, as follows: the ductuli efferentia, ductuli epididymides, and ductus epididymis. In this paper, we discuss our recent observations on the anterior testicular ducts of *Agkistrodon piscivorus* and *Seminatrix pygaea*, including the first ultrastructural descriptions of the ducts in snakes. Contrary to earlier reports, all of these ducts are secretory. The carbohydrate/protein products, however, are not stored in granules until a signal for release is received. Instead, the mode is a constitutive secretory pathway in which the product is transferred in small vesicles to the lumen, and the product is not concentrated or stored. Ultrastructure data on *S. pygaea* indicate that the process is continuous throughout the year, although greatest activity occurs during spermiogenesis. The ductuli efferentia and the proximal ductuli epididymides are similar, except the former exhibit simple squamous epithelium whereas the later are simple cuboidal. The proximal ductuli epididymides divide into numerous, tortuous distal ductuli epididymides, which remain simple cuboidal but are ciliated. The ductus epididymis is pseudostratified and non-ciliated. Unlike lizards, no regionalization of the ductus epididymis is apparent.

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374 Poster Session I, Exhibit Hall, Friday 24 July 2009

Fletcher Sewall, Cara Rodgveller

NOAA-NMFS, Alaska Fisheries Science Center, Auke Bay Labs, Juneau, AK, United States

Changes in Body Composition and Fatty Acid Profile During Quillback Rockfish (*Sebastes maliger*) Embryogenesis

Survival during the larval phase can be vital in determining the eventual strength of year classes that recruit to fished stocks; larval survival, in turn, is often dependent on larvae having energy stores sufficient to ensure survival to first feeding. Differences in the amounts and use of endogenous protein and lipid sources during embryonic development may influence the survival rates of early planktonic rockfish larvae. Little is known regarding biochemical and energetic changes during the early development of Quillback rockfish (*Sebastes maliger*), a commercially important species that has internal development of embryos and gives birth to free-swimming larvae. We investigated

developmental changes in the body compositions and fatty acid (FA) profiles of embryos and pre-parturition larvae of the quillback rockfish for an assessment of their potential use as indicators of condition. Lipid was used more rapidly than protein and contributed a larger portion (60%) of total energy expended during development, indicating a protein-sparing effect. Oil globule volume was strongly correlated with lipid levels, affirming its utility as an indicator of condition. FA profiles of embryos differed distinctly from those of hatched larvae, indicating FAs are depleted at different rates during development. The conservation of 20:4n-6, the most abundant n-6 polyunsaturated FA, indicates that this essential FA may reflect the quality of maternal nutrient provisioning. Embryos and larvae of quillback rockfish, like other marine fishes, are likely incapable of synthesizing this metabolically important FA, either entirely or at a rate which will meet their needs for growth and survival.

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988 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

H. Bradley Shaffer, Robert C. Thomson, Amber N. Wright

University of California Davis, Davis, CA, United States

The California Amphibian and Reptile Species of Special Concern Update: Progress, Future Work, and Involvement by the Herpetological Community

The first edition of Amphibian and Reptile Species of Special Concern (ARSSC) in California was authored by Mark Jennings and Marc Hayes and released in 1994. This California Department of Fish and Game (CDFG) document plays an important role in management and conservation planning for California's native reptiles and amphibians. In the 15 years since this document's publication, our understanding of the conservation status, management needs, and systematics of California's native reptiles and amphibians has changed dramatically. A revision that updates this document with current knowledge is essential, because SSCs are central to California's Wildlife Action Plan, and the SSC designation is used with laws, regulations, state policies, and various state and national conservation initiatives to help conserve species at risk. In collaboration with the CDFG, we are producing an update of this important document. Our first goal was to produce a current list of amphibian and reptile "taxa" in California (~230 taxa), and a set of quantitative metrics to evaluate each taxon for SSC status. Our next goal is to evaluate each taxon, produce a list of SSC taxa, and create species accounts and maps that can be vetted by the community of experts on California amphibians and reptiles. Our goal is to make the SSC process a community effort that best reflects the collective knowledge of experts on California taxa and constitutes an active, ongoing effort to protect species at risk in the face of challenges ranging from habitat destruction to global climate change.

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730 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Alan Shanks

University of Oregon, Oregon Institute of Marine Biology, Charleston, OR, United States

Pelagic Larval Duration and Dispersal Distance

I present dispersal distances for 44 species (fish and invertebrates) with PD data for 40 of these. Data were combined with that in Shanks et al. (2003), providing information on 67 fish and invertebrate species. PD and dispersal distance are correlated, but with many exceptions. The distribution of dispersal distances was bimodal. Many species with PD's > 1 day dispersed < 1 km while others dispersed 10's to 100's of kilometers. Organisms with short dispersal distances were pelagic briefly or remained close to the bottom while pelagic. Null models of passively dispersing propagules predict dispersal distance for short PD's organisms (< 1 day), but over estimate dispersal distances for those with longer PD's. These models predict propagules are transported 10's of kilometers offshore, however, many larval types remain within the coastal boundary layer where currents are slower and more variable leadings to shorter than predicted dispersal distances. At short PD's, dispersal distances estimated from genetic data are similar to observed. At long PD's, genetic data generally over estimates dispersal distance. This discrepancy is probably due to the effect of rare individuals that disperse long distances smoothing genetic differences between populations. Larval behavior and species life history traits can play a critical role in determining dispersal distance.

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732 ELHS/LFC Ecology I, Galleria South, Broadway 1&2 25 July 2009

Alan Shanks[1], Catherine Pfister[1]

[1]*University of Oregon, Oregon Institute of Marine Biology, Charleston, OR, United States,* [2]*University of Chicago, Chicago, IL, United States*

Annual Recruitment of Three Species of Tidepool Fishes is Driven by Variation in Springtime Coastal Hydrodynamics

Using an 18-year time series of annual recruitment of *Clinocottus globiceps*, *C. embryum*, and *Oligocottus maculosus*, we investigated the relationship between recruitment and upwelling and downwelling, date of the spring transition, and spring wave climate. There were no significant regressions between springtime upwelling and recruitment in any species. The timing of the spring transition, however, was related to the recruitment of *C. globiceps* and *C. embryum*: the later the spring transition the larger their annual recruitment. We found a negative exponential relationship between timing of the spring

transition and *O. maculosus* recruitment, though only after removing one outlying data point (the strong 1997 El Niño year). Significant negative exponential regressions were also found between *O. maculosus* recruitment and hours in April and May when waves were > 2 and > 3 m in amplitude. In these regressions, 1997 was no longer an outlier. *O. maculosus* recruitment also varied positively with seawater temperature on the shore. The different hydrodynamic correlates of recruitment in this assemblage of species, as well as published observations, suggest that the larvae of these species are occupying different nearshore areas. *Clinocottus* species likely develop in coastal waters, while *O. maculosus* develops very close to shore, essentially in the surf zone, where its larvae may be swept offshore by rip currents generated during large wave events. Abiotic factors driving larval success can explain persistent differences in recruitment among these species over 18 years.

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806 Poster Session I, Exhibit Hall, Friday 24 July 2009

Akemi Shibuya[1], Sho Tanaka[2], Marcelo Rodrigues de Carvalho[3], Jansen Zuanon[1]

[1]Instituto Nacional de Pesquisas da Amazonia, Manaus/Amazonas, Brazil, [2]Tokai University, Shimizu/Shizuoka, Japan, [3]Universidade de Sao Paulo, Sao Paulo/Sao Paulo, Brazil

The Role of Pelvic Fins in Locomotion and Foraging in the Freshwater Stingray *Potamotrygon motoro* (Chondrichthyes: Potamotrygonidae)

Locomotion in batoids has been related to the propulsion generated predominantly by undulatory or oscillatory movements of the pectoral fins; however knowledge on the role of pelvic fins for locomotion still remains scarce. The aim of this study was to describe the use of pelvic fins in locomotion and body re-orientation during foraging in the freshwater stingray *Potamotrygon motoro*. Juvenile individuals of *P. motoro* (n=2, 14.7 and 15.0 cm LD, males) were maintained in a 120x60x60 cm acrylic aquarium. Pelvic fin movements of stingrays were recorded during feeding performances using a high speed camera at 250 fields $s^{-1,}$ in ventral view. *Potamotrygon motoro* presented independent, synchronic, and alternate movements of pelvic fins. Independent movements were used to maneuver the body to the right or left side during both locomotion and prey capture, whereas synchronic movements were employed during straight displacements for pushing off the body on the substrate and for ram feeding. Alternate movements of pelvic fins are similar to bipedalism of terrestrial and semi-aquatic tetrapods. Pelvic fins showed movements during feeding even when stationary, indicating an important function in maintaining the body's spatial position during prey capture and processing. The use of pelvic fins during prey capture may be advantageous since it results in less substrate disturbance when compared to the movements generated by pectoral fin undulation. Anatomical investigations of the pelvic fin musculature and skeleton may help understand their role in locomotion and foraging behavior on different types of substrates present in freshwater environments.

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198 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD I, Galleria North, Sunday 26 July 2009

George Shillinger, Alan Swithenbank, Steven Bograd, Helen Bailey, Michael Castleton, James Spotila, Frank Paladino, Barbara Block

Hopkins Marine Station of Stanford University, Pacific Grove, CA, United States

Satellite Tracking and Remote Sensing Describe Leatherback Movements and Distribution within the Equatorial and South Eastern Pacific

We describe the distribution, movements, and behaviours of 46 critically endangered female leatherback turtles (*Dermochelys coriacea*) satellite-tagged during 2004-2007 at Playa Grande, Costa Rica. The region used by the turtles over the tracking period spanned the eastern tropical and South Pacific between latitudes 12°N and 40°S, and between longitude 130°W and the coast of Central and South America. Turtle movements during internesting were restricted to nearshore habitats along Costa Rica's Nicoya Peninsula. Turtle internesting habitats were subject to interannual environmental variation, including temperature changes, which influenced turtle dispersal and vertical behavior during internesting. The tracking data suggested that relatively small expansions of existing marine reserves within the internesting region could significantly enhance turtle protection. During migration, turtles moved rapidly (majority>45km/d) southwest through an open-ocean corridor spanning from Costa Rica past the Galápagos Islands. South of 10S, the turtles moved into areas of low MKE and chlorophyll. Turtle swimming speeds decreased (~<25km/d) and they dispersed widely, taking meandering paths at low speeds into a region characterized by very weak current variations, very low phytoplankton standing stocks, and the absence of dynamic oceanographic features.

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283 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009

Jeffrey Shima[1], Stephen Swearer[2]

[1]Victoria University of Wellington, Wellington, New Zealand, [2]University of Melbourne, Melbourne, Australia

Demographic Connectivity in a Temperate Reef Fish Metapopulation: The Critical Role of the Dispersal Matrix

In temperate reef systems, larval dispersal typically connects fragmented populations, and larval quality may be shaped by developmental history at the natal reef (e.g., parental effects) and/or by conditions in the pelagic environment (e.g., food,

temperature, hydrodynamics, predator regime). We use otoliths of the common New Zealand triplefin (*Forsterygion lapillum*) to reconstruct the early life histories and evaluate whether larval quality is a function of natal populations, dispersal histories, or both. We used image analysis to quantify otolith traits and to reconstruct 5 larval phenotypes (pelagic larval duration, size-at-hatch, early larval growth, late larval growth, and an instantaneous larval growth rate), followed by a principal components analysis to derive a composite measure of larval quality. We used LA-ICPMS to quantify otolith microchemistry, followed by a set of cluster analyses (based upon 13 statistical descriptors of time series for each of 11 trace elemental ratios) to identify and characterize two putative natal "source populations" and two putative "larval dispersal histories". We evaluated the relationship between larval quality, source populations and dispersal histories using 2-way ANOVA and determined that larval quality of *F. lapillum* is a function of larval dispersal history and not source population identity. Overall, our results suggest that conditions in the pelagic larval environment shape larval quality and potentially mediate metapopulation connectivity for a temperate reef fish.

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368 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Akihiro Shiroza[2], Barbara Muhling[1], Faiza Al-Yamani[3], John Lamkin[1]

[1]NOAA/NMFS SEFCS, Miami, FL, United States, [2]University of Miami, Miami, FL, United States, [3]Kuwait Institute for Scientific Research, Safat, Kuwait

Seasonal and Spatial Abundance and Assemblages of Ichthyoplankton, Kuwait Waters 2003~2005

As part of a post Gulf War ecological survey, ichthyoplankton samples were collected from the Gulf of Kuwait from 2003 to 2005. This sampling program was part of an U.N sponsored effort to access the ecological damage resulting from an estimated 240 million gallons of crude oil spilled into the offshore waters in 1991. Larvae are very sensitive to the environmental changes and crude oil can be toxic to the larvae itself or indirectly affect the food web by altering plankton abundance. Current results are based on samples from 15 survey cruises carried out between June 2003 and June 2005 at 24 locations off the Kuwait coast. A total of 68,821 larvae were collected. Within this collection, 41 families were identified. A total of 49,392 larvae were collected with neuston net (406 samples) and 19,429 larvae were collected with bongo net tows (136 samples). Clupeidae was the most abundant family collected in the bongo samples with 5,387 larvae and 30.06% of the total. Gobiids were second most abundant with 2,660 larvae contributing 14.84% followed by Mugilidae, Engraulidae, Terapontidae, and Soleidae. Gobiidae was the most abundant family in the neuston collections, followed by Clupeids, Sciaenidae, Terapontidae, and Hemiramphidae. Multivariate analyses were used on a selected data set to determine the similarities of species assemblages between stations and Day/night differences in neuston tows.

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912 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Mahmood Shivji[1], Veljko Dragojlovic[2]

[1]Save Our Seas Shark Center, Nova Southeastern University, Dania Beach, FL, United States, [2]Harriet L. Wilkes Honors College, Florida Atlantic University, Jupiter, FL, United States

Heavy Metals in Market-Destined, Dried Shark Fins

Exploitation of sharks to supply the market demand for shark fins is arguably the largest driver of shark mortality worldwide. Combating shark overexploitation and achieving sustained conservation outcomes may best be accomplished not only by effective fishery management practices but also by also reducing market demand for fins. As with all commercial products, influencing market demand is fundamentally based on altering consumer awareness and purchase behavior. As apex predators, sharks are known to bioaccumulate heavy metals of concern to human health (e.g., mercury) in their flesh, leading to widely issued government warnings about limiting consumption of shark meat. Given that shark fins have a large consumer market and do not typically contain shark meat, we have investigated the prevalence of heavy metals known to be toxic to humans in low concentrations (total Mercury, Lead, Arsenic, Cadmium) in dried fins confiscated by NOAA's Office for Law Enforcement. An initial assessment of these metals in 75 market-destined fins showed that ~ 20% of the fins contained Lead levels exceeding US Food and Drug Administration (US FDA) limits for safe consumption. Approximately 7% of the fins contained total Mercury close to or above US FDA levels. We report on these and ongoing analyses of heavy metals in more market fins in the context of various international government food safety guidelines.

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86 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Brian Sidlauskas

[1]National Evolutionary Synthesis Center (NESCent), Durham, NC, United States and National Museum of Natural History, Washington, DC, United States

Understanding the Ecomorphological Diversification of African Distichodontid and Citharinid Fishes through Phylomorphospace Analysis

The African characiform fishes in family Distichodontidae vary widely in ecology and morphology, including herbivores, piscivores, invertivores and even fin-eaters, while species in their sister group (Citharinidae) are all detritivores with little morphological variation. This difference in variation between the two groups suggests that some factor

has constrained the ecomorphological evolution of the citharinids or has actively promoted the diversification of the distichodontids. Projecting a phylogeny into a multivariate morphospace (a phylomorphospace) reveals that the majority of skull shape and diet variation within Distichodontidae is contained within a clade defined by the possession of a novel joint within the lower jaw. This highly diverse clade has a very low lineage density (a measure of the packing of phylogenetic branches in morphospace) compared to the citharinids and the remaining distichodontids, all of which lack the novel joint and have similar skull shapes. Comparison of the real distichodontid dataset with simulated phylomorphospaces suggests that such a large difference in lineage densities cannot be reasonably generated by a null model of Brownian evolution, in which a single rate and mode of morphological evolution applies across the whole phylogeny. Instead, the innovative jaw joint possessed by some, but not all distichodontids appears to have sparked a shift in their mode of evolution by releasing anatomical constraints and allowing the exploration of new ecological niches.

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87 Fish Systematics, Pavilion East, Monday 27 July 2009

Brian Sidlauskas[1], Jan Mol[3], Richard Vari[2]

[1]National Evolutionary Synthesis Center (NESCent), Durham, NC, United States, [2]National Museum of Natural History, Washington, DC, United States, [3]Anton de Kom University, Paramaribo, Suriname

Allometrically Informed Approaches to Species Discrimination and Discovery in the *Leporinus cylindriformis* group (Characiformes: Anostomidae)

We investigated the ability of traditional linear and geometric morphometrics to delimit species within the Neotropical fishes in the *Leporinus cylindriformis* group. Once regressions were used to account for marked allometric variation, most of the recognized species in this group could be distinguished with either method, particularly using variation in the depth of the body. Both approaches returned congruent patterns of separation among putative species, but the geometric approach distinguished four more species pairs than could the linear approach and provided more statistical power. Based on distinctive morphometrics, meristics and coloration, we recognize a highly elongate species from Suriname as new. The unique *Leporinus cylindriformis* holotype from Porto de Moz, Brazil differs in morphology, meristics and pigmentation from specimens commonly referred to that species from the main basin of the Amazon; the latter specimens may represent an additional undescribed species. The *L. cylindriformis* holotype itself may represent a rare species or a specimen collected at the edge of its native range. Measurements of the holotype and paratype of *Leporinus niceforoi*, which were collected in the Amazonian slope of Colombia, differ substantially from similarly pigmented and putatively conspecific specimens from Amazonian portions of Ecuador and Peru. Recently collected specimens from Colombia are needed to determine whether the observed morphometric variation encompassed by the current concept of *Leporinus niceforoi* indicates a morphocline within a single species, suggests the presence

of multiple cryptic species, or results from shrinkage of the types. In all these cases, reliable morphometric differentiation requires attention to allometry.

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73 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Dustin Siegel[1], Aurélien Miralles[2], Robert Aldridge[1]

[1]Saint Louis University, St. Louis, MO, United States, [2]Centre National de la Recherche Scientifique, Gif-sur-Yvette Cedex, France

Comparative Female Cloacal Morphology of the Caenophidia

In 1965 Manfred Gabe and Hubert Saint-Girons published the most comprehensive account of the lepidosaurian cloaca. This included cloacal descriptions of 41 saurian species, 13 ophidian species, two amphisbaenian species, and one Sphenodon. Since this time the data presented by Gabe and Saint-Girons have been used in many contexts including, elucidating higher-level evolutionary relationships of the Squamata using both phenetic and phylogenetic methods. One such study traces the evolution of the female cloaca onto a phylogeny to identify synapomorphies for different squamate families; however, this analysis included only the Colubridae as an ophidian representative. Here we investigate the evolution of the female ophidian cloaca in the Caenophidia (Colubroidea + Acrochordidae) from a histological perspective. Histological characters of cloacae were traced onto current molecular phylogenies of the Caenophidia to examine the possible evolutionary trajectories of the caenophidian cloaca. Twelve species from Colubridae (representing Psammophiinae, Calamariinae, Colubrinae, Natricinae, Pareatinae, Homalopsinae, Xenodontinae, Boodontinae, and Dipsadinae), four from Viperidae (representing Crotalinae and Viperinae), two from Atracaspididae, two from Elapidae, one from Hydrophiidae, and one from Acrochordidae were utilized in this analysis. Two boids (representing Pythoninae and Erycinae) and a cylindrophiid were used as outgroups to assess cloacal character polarity. Our investigation uncovered numerous derived characters of the caenophidian cloaca, including features of the urodaeal epithelium, association between ureteric and vestigial Wolffian ducts, association of the proctodaeum and intestine, and junction of the urodaeum and oviducts, which appear to represent synapomorphies in support of different levels of the caenophidian phylogeny.

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836 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Andrew Simons[1], Vinnie Hirt[1], Kevin Tang[2], Hank Bart[3], Rob Wood[2], Rick Mayden[2]

[1]University of Minnesota, St. Paul, MN, United States, [2]Saint Louis University, St. Louis, MO, United States, [3]Tulane University, New Orleans, LA, United States

Cypriniformes Tree of Life: Timing the Dispersal of Cyprinid Fishes into Africa

The cyprinid fauna of Africa comprises at least 500 described species in 26 genera representing two major cyprinid clades, the Cyprininae and the Danioninae. This fauna is not as morphologically diverse as other continental cyprinid faunas suggesting a recent origin, presumably due to dispersal from Eurasia subsequent to the northward movement of Africa and the closure of the Tethys Sea 14-18 MYA. The Cypriniformes likely arose in Laurasia in the early Cretaceous, and the Cyprinidae in the late Cretaceous, both well before the collision of the African and Indian plates with Eurasia. In this study we use a phylogenetic analysis of nuclear and mitochondrial genes to determine the origin of the African fauna and fossil calibrations to infer divergence times and estimate the timing and number of dispersals into Africa.

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251 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Colin Simpfendorfer[1], Andrew Tobin[1], David Welch[2]

[1]Fishing and Fisheries Research Centre, James Cook University, Townsville, Queensland, Australia, [2]Queensland Department of Pdustries and Primary Industries and Fisheries, Townsville, Queensland, Australia

Shark Catches in the Inshore Waters of the Great Barrier Reef World Heritage Area

The take of sharks in fisheries in the Great Barrier Reef World Heritage Area have become increasingly controversial in recent times. To provide scientific information to inform the consideration of this issue, fishery-dependent surveys have been conducted throughout the area to document species and size composition of various sectors that take sharks. These data show that commercial net fishers catch over 25 species of sharks and ray, with the main species being Australian blacktip, spottail, scalloped hammerhead, milk, whitecheek and spinner sharks. Species composition, importance and size varies between different sectors of the commercial fishery. Discarding practices were also examined and varied by operator and sector, with some species (e.g. milk sharks) more likely to be discarded than others. Post-release survival of discards is

unknown, but may be an important consideration in relation to the impact of the fishery. The majority of sharks taken were less than 150 cm in length. Data from recreational fishers was not able to provide detailed species composition data, but did demonstrate release rates >90%. The use of these data in an ecological risk assessment will be discussed.

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244 SSAR SEIBERT PHYSIOLOGY AWARD, Galleria North, Friday 24 July 2009

Navasha Singh, Robert E. Espinoza

California State University, Northridge, Northridge, CA, United States

Going Green Takes Guts: Comparative Gross Morphology of Lizard Digestive Tracts as a Function of Diet

Plant tissues are harder to digest and less nutrient and energy rich than are animal tissues. As a consequence, herbivorous vertebrates have evolved specializations in their morphology, physiology, and behavior that compensate for the challenges imposed by eating plants. For example, herbivorous lizards are widely considered to have specialized guts to facilitate the digestion of plant matter. But the gut morphology has been characterized in a relatively small number of lizard species (primarily herbivorous species) precluding broad generalizations linking form to function. We examined the gross morphology of the guts of more than 25 species of herbivorous and 55 species of non-herbivorous lizards spanning the breadth of lizard diversity and representing multiple, independent origins of herbivory. The area of each gut segment was estimated using ImageJ software. We tested the ways in which the gross gut morphology of herbivores has diverged from the ancestral carnivore condition and whether the guts of omnivores are intermediate using conventional statistics (ANCOVA) and phylogenetically based analyses. Our hypotheses that herbivores would have larger guts and that omnivores would be intermediate were generally supported. Stomach area: herbivores > omnivores = carnivores; small intestine area: herbivores > omnivores > carnivores; and large intestine area: herbivores > omnivores = carnivores. Our study supports the general hypothesis that as lizards evolutionarily increase the proportion of plant matter in their diets, the size and capacity of their guts increase to facilitate the digestion of plant tissues.

1018 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Justin Sipiorski, Erik Wild

Universtiy of Wisconsin, Stevens Point, WI, United States

Herpetology & Ichthyology at the University of Wisconsin-Stevens Point

The University of Wisconsin-Stevens Point is one of 13 comprehensive universities in the UW System. The Department of Biology is comprised of 23 faculty and serves over 600 undergraduate biology majors, with a strong emphasis on undergraduate involvement in research. Several of the department's faculty serve as curators of the collections of the UWSP Museum of Natural History. These collections serve both research and teaching purposes and provide excellent opportunities for preparing undergraduates for graduate study and careers in ichthyology and herpetology. The George Becker Memorial Ichthyology Collection (8,000 lots) has recently acquired, through a partnership with the Milwaukee Public Museum 10,000 curated and approximately 20,000 unprocessed lots of Wisconsin fishes. This new acquisition places more than half (50,000 lots) of the specimens collected for Wisconsin fish distribution studies in the state's history under one roof, and makes the Becker collection the largest in the state. The UWSP Herpetology Collection houses over 4,000 preserved specimens of reptiles and amphibians. Historically, the most significant contributions to the collection were during the 1960-70's, yet now renewed efforts to document the state's reptiles and amphibians has resulted in a new period of growth. The catalogued collection is largely regional with 45% coming from Wisconsin and another 14% from Illinois, although there is material from 35 other states are 7 countries. The history of these collections, details of the holdings, and future projects such as electronic data basing and web-based access will be discussed and the undergraduate programs in ichthyology and herpetology presented.

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158 AES Ecology I, Pavilion West, Saturday 25 July 2009

Gregory Skomal[1], Stephen Zeeman[2], John Chisholm[3], Erin Summers[4], Harvey Walsh[5], Kelton McMahon[5], Simon Thorrold[5]

[1]MA Marine Fisheries, Vineyard Haven, MA, United States, [2]University of New England, Biddeford, ME, United States, [3]MA Marine Fisheries, New Bedford, MA, United States, [4]ME Dept. Marine Resources, Boothbay Harbor, ME, United States, [5]Woods Hole Oceanographic Institution, Woods Hole, MA, United States

Mesopelagic Trans-equatorial Migrations by Basking Sharks in the Western Atlantic Ocean

The world's second largest fish, the basking shark (*Cetorhinus maximus*), is broadly distributed in boreal to warm temperate latitudes of the Atlantic and Pacific oceans from

shallow coastal waters to the open ocean. Satellite archival tagging in the North Atlantic has shown that basking sharks move seasonally, are often associated with productive frontal zones, and may make occasional dives to mesopelagic depths. However, basking sharks are thought to be restricted to temperate latitudes and the extent to which they exploit deeper water habitat remains a mystery. Using satellite archival tags and a novel geolocation technique, we demonstrate that basking sharks are seasonal migrants to mesopelagic tropical waters. We deployed 25 pop-up satellite transmitting (PSAT) tags on basking sharks in the western North Atlantic off the coast of Cape Cod, MA during the summer and autumn months. In total, 18 (72%) tags transmitted data after deployment periods of 12-423 days (mean = 203 days). Tagged sharks moved from temperate feeding areas off the coast of southern New England to the Bahamas, the Caribbean Sea, and onward to the coast of South America and into the Southern Hemisphere. When in these areas, basking sharks descended to and, in some cases, remained at mesopelagic depths for weeks to months at a time. Our results demonstrate that tropical waters are not a barrier to migratory connectivity for basking shark populations and highlight the need for global conservation efforts throughout the species range.

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594 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Anna Smith, Jeff Shima

Victoria University, Wellington, New Zealand

Variation in the Impact of Larval History on Survival

Populations of many coastal marine species are connected by dispersal during a pelagic larval phase, because most species have limited adult movement. Dispersal can be physiologically demanding, and mortality following dispersal events may be selective upon individuals with particular dispersal histories. Understanding the influence of larval history on performance and fate of settlers is critical, as the fitness of surviving individuals from different larval sources will determine 'realised connectivity'. This study considers how spatial and temporal variation in a metapopulation interacts with larval history to determine juvenile growth, condition and survival in the reef fish *Forsterygion lapillum* (common triplefin). We sampled sagittal otoliths from 170 *F. lapillum* and used image analysis of otolith traits to reconstruct larval history and post-settlement growth. Fish were collected at intervals through Jan – March 2008 and at two scales of spatial variation. Fine-scale variation in habitat was defined by macroalgae composition of patches. Habitat variation was nested within large-scale variation identified by regional location; open coast or harbour. Selective intensity was higher on the open coast compared to the harbour. However, within each region, selective intensity varied through time, as did the correlation between larval history and juvenile growth. Additionally, on the South Coast macroalgae habitat was found to mediate the

strength of selective intensity. This study highlights the role of variation in the benthic environment in determining the probability of settlers with different larval histories to reach reproductive maturity.

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16 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

David Smith, Inci Bowman

Smithsonian Institution, Washington, DC, United States

Darwin's Critics

Charles Darwin's theory of evolution by natural selection has been the most controversial scientific idea of all time. It has inspired furious and determined opposition since the day it was published. In this paper, we explore the contemporary arguments that Darwin faced during his lifetime. Today's antievolutionists come almost exclusively from the fundamentalist religious community, but in the mid-nineteenth century, the opposition was much broader and more respectable. Darwin himself did not have all the answers, and we can point out three conspicuous weaknesses in his argument. First, he knew nothing about the biological basis of heredity; second, his theory was not subject to direct experimental proof; third, he did not address the question of ultimate origin. Among his critics, although their arguments were quite different, were two prominent figures in ichthyology and herpetology: Louis Agassiz and Edward Drinker Cope. We try to assess the opposition to Darwin's theory within the context of the time, seeing the world as his critics saw it and knowing what they knew, and not judging them by what we know today.

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279 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Gerald Smith

University of Michigan, Ann Arbor, MI, United States

Cenozoic History of Western North American Freshwater Fishes

Western North American freshwater fish faunas are about one-tenth as diverse as faunas in equivalent sized-drainages in Eastern North America, despite having high speciation rates. Active-margin plate tectonics caused high mountains and crustal extension that created multiple basins surrounded by steep slopes and extreme barriers that limit immigration among populations. High origination rates and higher extinction rates in Pacific and Basin and Range drainages were driven by the same isolation. Cyprinids, catostomids, salmonids, goodeids, cyprinodontids, atherinopsids, and cottids diversified in the Miocene and Pliocene in Pacific coastal drainages such as the Lerma-Rio Grande

de Santiago, Yaqui, Colorado, Sacramento, Columbia, and Yukon. The Sacramento drainage and its primary Pliocene tributary, the upper Snake River, provided the richest habitats, in a large, deep rift lake on the western Snake River Plain. Scores of large and small lakes in Nevada, California, Oregon, Arizona, Utah, and Mexico supported small, relict faunas of the above families, enhanced by a few connections to the Colorado, Sacramento, and Snake drainages. Speciation rates exceeded extinction rates in some of these habitats in the Pliocene, but severe extinction dominated again in the Pleistocene to recent.

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994 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Leo Smith

The Field Museum, Chicago, IL, United States

Limits and Relationships of the So-Called Pseudochromoid Fishes

A handful of recent morphological studies have improved our understanding of the familial limits and intrarelationships of the so-called pseudochromoid fishes (Pseudochromidae, Plesiopidae, Grammatidae, and Opistognathidae). Despite progress on the intrarelationships of pseudochromoids, their placement within Percomorpha remains problematic. For more than a century, they have been allied with the seabasses (Serranidae) and groupers (Epinephelidae), but recent studies have not corroborated this placement. In this talk, I will present the results of ongoing work on the relationships of pharyngognathous percomorphs that sheds light on the monophyly and interrelationships of pseudochromoids.

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731 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Wade Smith[1], J. Fernando Márquez-Farías[2], Jessica Miller[1], Selina Heppell[1]

[1]Oregon State University, Corvallis, OR, United States, [2]Universidad Autonoma de Sinaloa and Instituto Nacional de la Pesca, Centro Regional de Investigación Pesquera de Mazatlán, Mazatlán, Sinaloa, Mexico

Distinguishing Natal Origins from Vertebral Chemical Composition: the Utility of Trace Elements as Natural Markers in Elasmobranch Populations

The identification of nursery areas and understanding of their importance provides insight into the structure and dynamics of populations. Knowledge of dispersal pathways and population connectivity provides valuable details for successful conservation. Elements are naturally assimilated into the tissues and calcified structures of many species as a byproduct of respiration and feeding. The resulting combinations

and ratios of these elements may reflect the physiochemical environment in which an organism lives or has previously occupied. The segregation of juvenile and adult habitats among many elasmobranchs through the use of nursery areas creates the potential for distinctive elemental markers to be incorporated into vertebrae as a result of the differing physical and chemical characteristics encountered as young-of-the-year. Trace elemental analyses have proven to be powerful markers in ecological studies, however, these tools have not previously been applied to investigations of shark and ray populations. To determine if differences in elemental composition can be detected in cartilaginous vertebrate and are geographically consistent, we are conducting a field study of young-of-the-year scalloped hammerhead sharks (*Sphyrna lewini*) from various pupping locations. Samples were collected from artisanal fishery landings along the Pacific coast of Mexico over four consecutive months in both 2007 and 2008. Vertebrae were cleaned, thin-sectioned, and analyzed using Laser Ablation Inductively Coupled Plasma Mass Spectrometry. Multivariate analysis of variance was used to examine intra-annual differences in vertebral chemistry within sample locations. The ability to successfully classify individual specimens to their site of natal origin was assessed through quadratic discriminant function analysis.

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383 Poster Session I, Exhibit Hall, Friday 24 July 2009

Darrel E. Snyder, C. Lynn Bjork, Sean C. Seal

Larval Fish Laboratory, Colorado State University, Fort Collins, CO, United States

Larvae and Early Juveniles of Three Small, Non-native Cyprinids Common to the Upper Colorado River Basin: *Cyprinella lutrensis*, *Notropis stramineus*, and *Pimephales promelas*

Red shiner *Cyprinella lutrensis*, sand shiner *Notropis stramineus*, and fathead *Pimephales promelas* are small-bodied, non-native cyprinids common to the middle and lower reaches of Upper Colorado River Basin streams and rivers. To better facilitate morphological identification of captured larvae and early juveniles, especially recently hatched protolarvae, prior descriptions and illustrations are being supplemented and assembled into more complete and comparable species accounts. This poster highlights some of the drawings and information being prepared for a comprehensive guide to cyprinid larvae and early juveniles of the basin.

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944 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Mateus Soares, Marcelo Carvalho

Universidade de Sao Paulo, Sao Paulo, SP, Brazil

Evolutionary Implications of the Mandibular and Hyoid Arch Musculature in Neotropical Freshwater Stingrays, Family Potamotrygonidae (Chondrichthyes)

Anatomical studies concerning the musculature of Neotropical potamotrygonid freshwater stingrays are scarce and usually restricted to single species. With the objectives to better understand variations among the mandibular and hyoid muscles of chondrichthyans, we undertook dissections of ten of the 20+ currently valid species of potamotrygonids, representing all three valid genera (as well as a fourth undescribed genus). Our results indicate that the hyoid muscles varied uninformatively, even among genera. Among the mandibular muscle group, however, more significant differences were encountered. For example, the medial component of the spiracularis muscle is similar in *Potamotrygon* and *Plesiotrygon*, where it originates in the neurocranial otic region and projects ventromedially to mix with the depressor hyomandibulae. This ventromedial projection is different in *Paratrygon*, as the spiracularis has fibres that also insert onto Meckel`s cartilage, with only few components projecting to insert between the depressor hyomandibulae and coracohyomandibularis. Among species of *Potamotrygon*, significant differences were encountered in size and composition of the adductor mandibulae complex. These muscles extend to the propterygium, and run dorsal to it, in *P. motoro*, *P. leopoldi*, *P. falkneri*, *P. scobina* and *P.* sp. nov. (Tapajós River), but fail to do so in *P. humerosa* and *P. orbignyi.* Furthermore, in *P. motoro*, *P. leopoldi* and *P.* sp. nov., a muscle bundle from the adductor mandibulae lateralis 2 extends to the antorbital cartilage. Muscle characters investigated did not reveal significant differences between *Plesiotrygon* and *Potamotrygon*, corroborating recent studies in which both genera are regarded as sister-groups or even synonymous.

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958 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Mateus Soares, Marcelo Carvalho

Universidade de Sao Paulo, Sao Paulo, SP, Brazil

Morphological and Evolutionary Patterns of the Spiracularis Muscle in Batoids (Chondrichthyes)

The present study was conducted to reveal evolutionary implications of the different patterns of the spiracularis muscle in batoids. The spiracularis originates on the neurocranial otic region and generally inserts on the distal aspect of hyomandibula. In *Torpedo*, *Rhinobatos* and *Pristis* the muscle is simple, composed of a single bundle. In other genera it is subdivided into two portions, one lateral, which usually does not vary

significantly, and one medial, which varies considerably. In *Narcine*, the medial spiracularis extends over the lateral portion and inserts on Meckel's cartilage. In *Zapteryx*, the insertion occurs between the hyomandibula and the palatoquadrate. Within rajiforms, the medial spiracularis extends directly to the palatoquadrate either in a simple manner as in *Leucoraja*, or overlying the lateral spiracularis as in *Rajella* and *Gurgesiella*, or it may present a tendinous connection with the hyomandibula as in *Atlantoraja* and *Rioraja*. In pelagic myliobatiforms the spiracularis components are more indistinguishable, and insert onto the palatoquadrate. In dasyatids the muscle remains closely associated with the mandibular joint, slightly projecting towards Meckel's cartilage, whereas in urolophids the insertion is entirely on Meckel's cartilage. In *Taeniura*, the muscle projects ventromedially to insert on its antimere, which also occurs in *Potamotrygon* and *Plesiotrygon*, but not in *Paratrygon*, in which there is only a slight ventromedial projection. Additionally, in *Potamotrygon* and *Plesiotrygon*, the spiracularis merges ventrally with the depressor hyomandibulae. The spiracularis is employed for branquial ventilation in batoids, but the different patterns found may support its use for more varied functions.

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633 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Susan Sogard

National Marine Fisheries Service, Santa Cruz, CA, United States

Temperature Effects on Early Pelagic Stages of Warm Temperate Fish Species and Consequences for Connectivity Patterns

Early stages of warm temperate species can experience a broad range of temperatures during their development, with potential impacts on most physiological processes as well as behaviors such as thermoregulation and motor activity. For example, selection of a preferred temperature in the water column can influence the degree and extent of transport by alongshore currents. Likewise, maximum swimming speeds vary with temperature and can affect both the dispersal and retention capabilities of larvae. Motor activity and vertical distribution can also vary with time of day, influencing transport patterns by day vs. night. In this review I examine temperature effects on factors that likely influence connectivity in pelagic stages, with a focus on growth, stage duration, swimming capabilities, and vertical migration behavior. Although examples for warm temperate species are limited, I will assess patterns of generality and the roles of ontogeny and phylogeny in explaining differences in temperature responses and dispersal potential.

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894 Poster Session I, Exhibit Hall, Friday 24 July 2009; ELHS BLAXTER AWARD

Dongwha Sohn[1], Lorenzo Ciannelli[1], Deborah Blood[2], Janet Duffy-Anderson[2], Ann Matarese[2]

[1]Oregon State University, Corvallis, OR, United States, [2]Alaska Fisheries Science Center, Seattle, WA, United States

Vertical Distribution Egg Model for Greenland Halibut (*Reinhardtius hippoglossoides*) in the Eastern Bering Sea

Our purpose is to examine the vertical distribution of Greenland halibut (*Reinhardtius hippoglossoides*) eggs in the eastern Bering Sea. We modify existing one-dimensional egg models according to the buoyancy and dimension of Greenland halibut eggs for the eastern Bering Sea. In February 2008 and 2009, Greenland halibut eggs were collected in the eastern Bering Sea from bongo tows during ichthyoplankton surveys. The identified stage of development and diameters of Greenland halibut eggs were measured at sea. Also, we measured instantaneous densities of Greenland halibut eggs aboard ship using an Egg Density Gradient Apparatus (EDGAR). Densities were measured for 79 eggs in 2008 and 6 eggs in 2009. Density values ranged from 1.02429 to 1.02889 g/cm^3 in 2008 and from 1.02521 to 1.02603 g/cm^3 in 2009. Results indicate that density of Greenland halibut eggs may change with their development; older eggs have a greater density than younger eggs. Results from the parameterized egg model will describe how the vertical distribution of Greenland halibut eggs changes in relation to external (temperature and salinity) and internal (maturity) conditions. Modeled egg vertical distributions will be compared with field observations and Greenland halibut egg catches from depth-discrete samples derived from MOCNESS tows for model validation.

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837 Fish Conservation II, Pavilion West, Sunday 26 July 2009; ASIH STOYE AWARD CONSERVATION

Laurie Sorenson

Virginia Institute of Marine Science, Gloucester Point, VA, United States

Development of Molecular Markers for the Discrimination of Atlantic and Indo-Pacific Populations of Istiophorid Billfishes

Blue marlin and sailfish were previously described as comprising two species: one in the Atlantic Ocean and one in the Indo-Pacific. However, recent genetic studies have demonstrated that both blue marlin and sailfish represent single, circumtropical species. Commercial possession, importation, and sale of Atlantic blue marlin and sailfish is prohibited under the Fishery Management Plan (FMP) for Atlantic Billfishes, but

without characters that unambiguously discriminate Atlantic and Indo-Pacific individuals, it is possible to illegally market Atlantic istiophorids as Indo-Pacific. Previous genetic work has demonstrated two distinct mitochondrial DNA (mtDNA) lineages exist within blue marlin and sailfish: a ubiquitous clade including individuals from the Atlantic and Pacific oceans, and one restricted to the Atlantic. The application of five nuclear microsatellite markers to blue marlin and sailfish revealed allelic frequency differences between individuals from the Atlantic and the Pacific for both species. Despite this genetic differentiation between ocean basins, not all individuals can be unambiguously assigned to ocean of origin based on the available genetic markers. To increase our power in assigning individuals to the Atlantic or the Indo-Pacific, additional molecular markers have been generated. Currently, 15 primer pairs are being tested for their utility in distinguishing conspecifics of blue marlin and sailfish, and discriminatory markers will be selected and screened against individuals of known geographic origin to document the accuracy of assignments. My goal is to develop a database that will provide unambiguous assignment of samples to the ocean basin of origin, providing a tool for the enforcement of the FMP.

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509 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Alan Sosa, Gad Perry

Texas Tech University, Lubbock, TX, United States

Effects of Urbanization on Ornate Box Turtle Movements and Activity

Box turtles, once considered common, are declining across their native range as habitat destruction has increased along with direct mortality through collisions with automobiles. Populations persist along a gradient of habitats from native to urban. This study was conducted to determine the effects of urbanization on ornate box turtle (*Terrapene ornata ornata*) movements and activity patterns. We radio tagged and tracked turtles that are constrained in urban areas, free-range in urban areas, and free-range in native habitats. In addition, we translocated and radio tagged turtles to either urban or native habitats after their rehabilitation at a wildlife rehabilitation center. We re-located each turtle two to four times per week and recorded location, activity, and weather data. Home ranges of "native" box turtles were significantly larger than both free-ranging and constrained urban box turtles. Most translocated turtles were lost to collection as we found no signs of road mortality. Native and translocated turtles were crepuscular, whereas urban turtles showed no activity peak. The smaller home ranges of free-ranging urban turtles may result from restricted movements, and the microclimates of urban habitats may allow activity throughout the day. Translocated box turtles have been shown to home to their original location and move more than resident turtles. These behaviors are likely responsible for our inability to monitor turtles in areas where collection is high.

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53 Herp Physiology, Galleria North, Monday 27 July 2009

Amanda Southwood, Leigh Anne Harden

University of North Carolina Wilmington, Wilmington, NC, United States

Temperature Effects on Metabolic Enzyme Activity in Muscle Tissue of Diamondback Terrapins (*Malaclemys terrapin*)

The diamondback terrapin (*Malaclemys terrapin*) spans a geographic range that stretches along the East and Gulf coasts of the United States from Massachusetts to Texas. It is the only estuarine species of turtle, and inhabits shallow brackish waters of coastal marshes and creeks. In North Carolina, terrapins are most active from March through October and spend the winter months buried shallowly in the muddy substrate of the intertidal zone. Terrapins experience mean air temperatures of 26.9°C (range 19.1 - 36.2°C) during the summer and 10.7°C (range -5.5 - 24.6°C) during the winter. Mean water temperature during the summer is 28.7°C (range 24.6 - 32.6°C), and mean water temperature during the winter is 12.4°C (range 8.7 - 17.2°C). Temperature has profound effects on metabolism and physiology of reptiles, and thermal conditions likely play an important role in the timing of seasonal behaviors for terrapins. We investigated the effects of temperature on metabolic enzyme activity in muscle tissue collected from terrapins during Summer 2008 and Winter 2009. Activity of lactate dehydrogenase, pyruvate kinase, citrate synthase, and cytochrome c oxidase were assessed at 10, 20, 30, and 40°C to assess thermal dependence over the range of temperatures typically experienced by terrapins. Metabolic enzyme activities of tissue collected during summer and winter were compared to assess the degree to which seasonal acclimatization occurred. Results are interpreted in light of terrapin ecology and habitat utilization.

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341 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Cecilia Spath[1], Santiago Barbini[1], Jorge Colonello[2], Daniel Figueroa[3]

[1]Laboratorio de Ictiología, Departamento de Ciencias Marinas, Universidad Nacional de Mar del Plata. CIC, Buenos Aires, Argentina, [2]Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP). CONICET, Buenos Aires, Argentina, [3]Laboratorio de Ictiología, Departamento de Ciencias Marinas, Universidad Nacional de Mar del Plata, Buenos Aires, Argentina

Food Habits of *Discopyge tschuddi* (Chondrichyes, Narcinidae) off North Argentina and Uruguay

The apron ray, *Discopyge tschudii*, is abundant and common species from the coast of southern South America. Diet composition and feeding strategy of this species were investigated through stomach content analysis. The specimens were collected from

research cruises carried out by Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP) and commercial landing between 2005-2008 off north Argentina and Uruguay (34°S - 41°S). Stomachs were frozen to -20ºC. Prey were counted, weighted, and identified to the lowest possible taxonomic level. Of a total of 342 stomachs examined, 88.3% contained food. According to the Index of Relative Importance expressed as a percentage, polychaetes (96.36%) were the most important prey group in the diet of *D. tschudii*. Minor importance had siphons of *Amiantis purpurata* (2.61%) and amphipods (1.03%). The graphical method of prey-specific abundance against frequency of occurrence suggested that *D. tschudii* displayed a clear specialisation toward polychaetes. However, when the polychaetes are grouped by their life style (sedentary: %IRI = 21.92; errant: %IRI = 31) a mixed feeding strategy is observed. Our results show that *D. tschudii* feeds exclusively on benthic invertebrates.

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895 HERPETOLOGISTS' LEAGUE GRADUATE RESEARCH AWARD II, Galleria North, Sunday 26 July 2009

Stephen Spear, Andrew Storfer

Washington State University, Pullman, WA, United States

Colonization and Gene Flow of Coastal Tailed Frogs (*Ascaphus truei*) at Mount St. Helens: Population Response across Disturbance Gradients

Large, infrequent disturbances provide "natural laboratories" to test how organisms respond to environmental change. Mount St. Helens erupted in 1980 and immediately altered 600 km²of surrounding forest. Currently the blast zone is divided into an unmanaged national monument and a managed portion that was salvage logged and replanted. Coastal tailed frogs (*Ascaphus truei*) have recolonized much of the blast zone, but given their susceptibility to desiccation and thermal stress, it is unlikely frogs could successfully cross the open blast zone. One hypothesis is that populations within the blast zone were founded by a limited number of residual adults that survived the eruption without current dispersal. Alternatively, tailed frogs colonized the blast zone from a limited number of surrounding sites following stream corridors. Our results do not fully support either hypothesis. Gene flow was high among all sampled sites. Furthermore, there was no evidence of population bottlenecks. Hierarchical landscape models demonstrated that environmental processes affected gene flow differently dependent on management. Specifically, gene flow through the unmanaged national monument followed a straight line route through open areas with little landscape influence, with movement likely facilitated by coarse woody debris. In contrast, sites within the managed blast zone followed a route restricted to forest and stream corridors, and were influenced by precipitation and solar radiation, suggesting the reduction of understory cover may leave frogs more susceptible to changing environmental conditions.

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199 Poster Session I, Exhibit Hall, Friday 24 July 2009

Su Sponaugle[1], Robert Cowen[1], Claire Paris[3], Villy Kourafalou[2], Katie Shulzitski[1], Martha Hauff[1], Kristen Walter[1], Cedric Guigand[1]

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Linkages Between Larvae and Recruitment of Coral Reef Fishes Along the Florida Keys Shelf: An Integrated Field and Modeling Analysis of Population Connectivity in a Complex System

Quantifying population connectivity among benthic marine populations remains an important yet challenging goal in marine ecology. Our interdisciplinary study was designed to integrate intensive empirical data into coupled Lagrangian particle-tracking and high-resolution hydrodynamic models to quantify the relative contributions of upstream versus local sources of reef fish larvae to the oceanographically dynamic Florida Keys. During three summer cruises, we sampled ichthyoplankton on multiple cross-shelf transects distributed along and upstream of the Keys. These transects extended from inside of the reef tract into the Florida Current front and intercepted ephemeral mesoscale frontal eddies. Settling larvae and recruited juveniles were sampled simultaneously during and following each cruise at two locations in the upper and lower Keys. Preliminary results from the first cruise indicate that reef fish larvae were most abundant in the mid-shelf and offshore regions compared to the near-reef region. Larval settlement to the lower Keys consistently exceeded that to the upper Keys, reflecting more recirculation of shelf water in the lower Keys as captured by the hydrodynamic model and predicted by preliminary runs of the biophysical model. Future analysis of otoliths and condition indices of pelagic and settlement-stage larvae and settled juveniles will be used to test whether growth and condition varies among larvae in different water masses, and to identify characteristics of survivors. These data will be incorporated into the transport history of the larvae from the biophysical model to hindcast and forecast the probabilities of spawning sources and successful settlement areas.

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197 ELHS/LFC Connectivity II, Galleria South, Friday 24 July 2009

Su Sponaugle[1], Joel Llopiz[1], Lisa Havel[2], Tauna Rankin[1]

[1]*Marine Biology & Fisheries, RSMAS, Univ. of Miami, Miami, FL, United States,*
[2]*Univ. of Texas Marine Science Institute, Port Aransas, TX, United States*

Spatial Variation in Larval Growth and Gut Fullness in a Coral Reef Fish: Implications for Population Connectivity

Successful feeding and fast growth is thought to be critical to surviving the pelagic larval stage of benthic marine fishes, yet few measures of these processes are available for tropical reef fishes. We tested the hypothesis that larvae experience faster growth in more productive coastal waters due to increased prey availability. We examined spatial patterns in larval growth and gut fullness for a common coral reef fish, the bluehead wrasse *Thalassoma bifasciatum*. During two ichthyoplankton cruises (September 2003, October 2004), larvae were collected using a coupled MOCNESS at 17 stations along an 80-km East-West transect across the Straits of Florida between Florida and the Bahamas. For a subsample of larvae collected at different distances along the transect, we examined sagittal otoliths to estimate growth rates and we inspected gut contents and estimated gut fullness for the same individuals. We also identified and enumerated the prey of *T. bifasciatum* from a subsample of zooplankton samples collected simultaneously with the larvae. Larvae collected at western stations grew significantly faster, were larger-at-age, and had fuller guts than those collected at central and eastern stations. Further, gut fullness of larvae was directly related to cross-straits prey abundance. Despite these repeatable patterns of growth and gut fullness, larval *T. bifasciatum* were more abundant at the central and eastern stations, possibly reflecting particular transport processes or differential predation mortality. These results begin to bridge our understanding of the pelagic processes influencing connectivity of nearshore populations.

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535 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009

Ashwin Sreenivasan[1], Ron Heintz[2], Thomas Hurst[3]

[1]University of Alaska Fairbanks, Fairbanks, AK, United States, [2]NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories, Juneau, AK, United States, [3]NOAA Fisheries, Alaska Fisheries Science Center, Hatfield Marine Science Center, Newport, OR, United States

Differences between Observed Growth and a Physiological Growth Index (RNA/DNA Ratio) in Larval Pacific Cod (*Gadus macrocephalus*) and Walleye Pollock (*Theragra chalcogramma*) at Different Temperatures

The ratio of RNA/DNA (R/D) has applications as a growth index in larval fish because it is sensitive to recent changes in nutrition and protein synthesis. Because RNA activity is temperature-dependent, development of an R/D index requires temperature calibration. We used a fluorometry protocol to obtain nucleic acid concentrations in whole-body individual larvae cultured at different temperatures. Growth was compared between groups of larval Pacific cod (*Gadus macrocephalus*) and walleye pollock (*Theragra chalcogramma*) cultured at 5°C and 8°C from hatch for 36-40 days. In both species, fish at 5°C grew more slowly. However, fish at 5°C exhibited higher R/D ratios. Elevated R/D ratios did not indicate faster growth. This suggests that these gadid larvae compensate for reduced RNA activity at colder temperatures with greater RNA production. An extended sampling period will be useful in elucidating long-term physiological effects on growth of cod and pollock of cold temperatures.

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179 Fish Morphology & Physiology, Galleria South, Monday 27 July 2009

Katie Staab[1], Lara Ferry-Graham[2], L. Patricia Hernandez[1]

[1]The George Washington University, Washington, DC, United States, [2]Moss Landing Marine Labs, Moss Landing, CA, United States

Morphological and Kinematic Variation in Upper Jaw Protrusion in Cypriniform Fishes

Cypriniformes is a diverse order of freshwater fishes that likely owes some of its success to the novel feeding mechanism employed by members of the group. Cypriniform fishes effect premaxillary protrusion via a kinethmoid, a novel sesamoid ossification that is a synapomorphy for the order. The kinethmoid is entirely suspended by ligaments to the premaxillae, maxillae, palatines, and neurocranium. While the ligamentous attachments are relatively conserved among species, there is great variation in kinethmoid shape. Cypriniform fishes are trophically diverse with most species feeding on secondary producers such as macrocrustaceans and insects. Many members are benthic feeders,

while others can switch between pelagic and benthic modes depending on food availability. Our previous work has suggested that morphological variation of the kinethmoid is likely to be correlated with ecological niche. Here we performed kinematic analyses on five cypriniform species with widely varying kinethmoid shape. Our initial hypothesis was that *Carassius auratus* and *Catostomus insignis*, species with elongate kinethmoids that feed on benthos would have slower protrusion speeds than species that feed on insects and possess shorter kinethmoids. We found the opposite to be true. *C. auratus* and *C. insignis* protrude their upper jaws faster than *Gila robusta*, *Danio rerio*, and *Devario aequipinnatus*. Additionally, species with elongate kinethmoids tend to produce strikes dominated by suction rather than ram modes of feeding. These data suggest that kinethmoid-mediated premaxillary protrusion in benthic cypriniforms is a versatile mechanism, allowing for searching through benthos as well as effective capture of elusive prey.

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982 Poster Session I, Exhibit Hall, Friday 24 July 2009; ASIH STORER HERPETOLOGY AWARD

Aaron Stahl

University of Northern Iowa, Cedar Falls, IA, United States

A Timecourse Study in Embryonic Development of African Dwarf Frogs (*Hymenochirus boettgeri*) Exposed to Atrazine

Atrazine is one of the most commonly used broad-leaf herbicides in the world. It functions by binding to a protein in photosystem II and inhibits electron transport. Previous studies have indicated that vertebrates exposed to atrazine display consequences such as behavioral changes, endocrine disruption, and delayed development. The focus of this study is the embryonic developmental rate of the African dwarf frog. It has been proposed that development can be slowed due to decreased cyclin levels. Cyclin levels must reach a threshold in order to progress the cell through mitosis. The eggs were collected immediately after fertilization. Half of the eggs were exposed to five different quantities of atrazine: 5 ppb, 10 ppb, 20 ppb, 100 ppb, and 200 ppb. Eggs not exposed to atrazine were used as a control. Four days after fertilization, the eggs were used for protein analysis in western blot assays. To determine the origin of these side-effects, a timecourse study of embryonic stages was crucial. Preservation will allow for further investigation of abnormalities and indication of developmental rate. Preliminary data results will be presented.

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88 Poster Session I, Exhibit Hall, Friday 24 July 2009

Zachary Stahlschmidt, Dale DeNardo

Arizona State University, Tempe, AZ, United States

Effect of Nest Temperature on Egg-brooding Behavior, Metabolism, and Clutch-Nest Thermal Relations in Children's Pythons (*Antaresia childreni*)

Parental care meets several critical needs of developing offspring, and python egg brooding is an exceptional model for examining environmental influences on parental behaviors because python egg brooding is simple, dynamic, and significantly affects embryonic temperature, respiration, and water balance. We used captive Children's pythons (*Antaresia childreni*) to assess facultative endothermic capability, the influence on egg-brooding behaviors of the gradient between the nest temperature (T_{nest}) and clutch temperature (T_{clutch}), and the effect of these behaviors on the developmental micro-environment. We monitored maternal egg-brooding behavior, rates of brooding unit (i.e., female and associated clutch) respiratory gas exchange, T_{nest}, T_{clutch}, and intra-clutch oxygen tension (PO_2clutch) during acute changes among four incubation temperature conditions: constant preferred temperature (31.5°C); 'cooling'; constant cool temperature (25.6°C); and 'warming'. A. childreni were not facultatively endothermic because brooding unit Q_{10} for VO_2 and VCO_2 were similar to other ectothermic boid snakes (1.9 - 5.7) and T_{clutch} conformed to T_{nest} at the constant, cool temperature treatment. Females coiled tightly around eggs more often during cooling to conserve clutch heat and less often during warming to expedite an increase in T_{clutch}. Additionally, the amount of time that females spent tightly coiled during warming significantly affected the T_{nest}-T_{clutch} gradient. Together these results indicate that non-endothermic female A. childreni are capable of assessing the T_{nest}-T_{clutch} gradient and making behavioral adjustments to enhance the thermal micro-environment of their developing offspring.

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280 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Zachary Stahlschmidt, Dale DeNardo

Arizona State University, Tempe, AZ, United States

Parental Care: Implications and Motivations of Python Egg-Brooding Behavior

Parental care meets several critical needs of developing offspring and is a reproductive adaptation employed by many vertebrates. Although less studied, intra-offspring tradeoffs (e.g., parental foraging in birds benefits hatchling energy balance at the expense of hatchling thermoregulation) likely play a critical role in the timing of different parental behaviors. We studied python egg-brooding behavior in Children's

pythons (*Antaresia childreni*) to examine several dynamic intra-offspring tradeoffs. After oviposition, female pythons generally coil around their eggs until hatchlings emerge (45 – 60 days). Females spend the majority of brooding tightly coiled around their eggs which reduces costly water loss through their parchment-shelled eggs but creates a hypoxic developmental environment that reduces embryonic metabolism. Periodic postural adjustments beneficially ventilate the clutch at the cost of increased egg water loss. Yet, these ventilating behaviors do not increase with embryonic metabolism as development progresses, and we provide evidence that A. childreni eggshells mediate this dynamic respiration-hydration tradeoff. Despite the changes in posture and eggshell characteristics, the brooding-induced hypoxia creates smaller, weaker, and slower offspring. We further show that, although female A. childreni are not facultatively thermogenic, they are capable of assessing the clutch-nest temperature gradient and making behavioral adjustments to enhance the thermal developmental environment. Overall, while python parental care is relatively simple, it is dynamic, sensitive to extrinsic cues, and significantly affects embryonic temperature, respiration, water balance, and ultimately hatching success and hatchling quality. Broadly, it may serve as a useful model to study the evolution of parental care, endothermy, and viviparity.

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539 Snake Conservation, Pavilion West, Monday 27 July 2009

Kristin Stanford, Richard King

Northern Illinois University, DeKalb, IL, United States

10,000 Watersnakes Can't be Wrong: Demographic Analysis of Population Recovery

The Lake Erie watersnake (*Nerodia sipedon insularum*) is a state endangered, federally threatened species limited to islands in the western basin of Lake Erie. Capture-mark-recapture population monitoring of this snake now spans nearly 30 years, with more intensive monitoring (more than 10,000 captures) since federal listing in 1999. We used Cormack-Jolly-Seber models in Program MARK to assess variation in annual adult survival over time, between sexes, and among study sites. In recent years (2001-2008), adult survival has been high, averaging about 70% and exceeding that of watersnake populations elsewhere. Survival varied between the sexes and among sites, ranging from 0.40-0.93 in males and 0.56-0.87 in females. Estimates of survival were often quite precise, with 95% confidence intervals frequently narrower than 0.20 and sometimes narrower that 0.10 Recapture probability varied among sites and years, averaging 0.20 (range = 0.03-0.82). We used Pradel models within Program MARK to estimate realized adult population growth over this same period. Population growth was similar across sexes, sites, and years with $\lambda = 1.06$ (95% confidence limits = 1.02-1.10), corresponding to a 6% annual increase in the numbers of adult watersnakes. Available data from 1980-1983 and 1996-1998 indicate that Lake Erie watersnake survival has increased since federal listing in 1999, providing further evidence of population recovery.

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724 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Bethany Stanhope

University of Northern Iowa, Cedar Falls, IA, United States

Evolution of Genome Size in Suckers (Catostomidae: Cypriniformes)

Genome size is exhibited in varying degrees among vertebrates, and the amount of DNA content is often correlated with developmental rate and morphology. It has long been observed that a larger genome size will positively correlate with elongated development periods and larger body size, whereas smaller genomes will be paired with shortened lifespan and specialization of physical features. Catostomidae are thought to have descended from a single tetraploid ancestor and its members represent a wide variety of body types and maturation periods. Previous studies of the catostomids have indicated loss of duplicate gene expression across the phylogeny. The objective this study is to determine if a correlation exists between genome content and phylogeny. Feulgen image densiometry to determine DNA content from red blood cells. Genome size data will be mapped on a published hypothesis of relationships within the group to test for evolutionary trends. Preliminary results will be presented.

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883 Herp Systematics, Pavilion West, Thursday 23 July 2009; ASIH STOYE AWARD GENERAL HERPETOLOGY

Edward Stanley

Villanova University, Villanova, PA, United States

A Species Level Phylogeny of the Cordylidae (Squamata) as Inferred from Five Nuclear and Three Mitochondrial Genes

Evolutionary relationships among members of the African Lizard family Cordylidae are poorly known. In a prior study based on 12s and 16s mitochondrial genes and including 16 species, Frost et al. (2001) identified *Cordylus* as paraphyletic and *Pseudocordylus* as polyphyletic, and sank both *Pseudocordylus* and the attenuate, reduced-limbed *Chamaesaura* into the synonymy of I. I reinvestigated cordylid relationships in a more comprehensive study, sampling 46 of the 60 species in the family, using five nuclear (Phosducin, Kif24, PRLR MYH2 and RAG1) and three mitochondrial (ND2, 16s and 12s) genes. Eleven major clades were recovered, but patterns of relationship among these are only partly resolved. *Cordylus* sensu stricto and *Pseudocordylus* are again shown to be paraphyletic and polyphyletic, respectively, and retention of the widely recognised genera, *Chamaesaura* and *Pseudocordylus* necessitates the recognition of seven new genera: *Platysaurus* is monophyletic and receives good support as the basal member of

the clade. A *Cordylus warreni* complex comprises seven, large-bodied species found in mountainous regions of the Transvaal, Mozambique and Zimbabwe. A *Cordylus namaquensis* clade contains five species found in xeric environments in the Northern Cape and Namibia. A complex of eight robust *Pseudocordylus* species is evolutionarily distinct from the two species of gracile *Pseudocordylus*, for which the name *Hemicordylus* is available from Smith. *Chamaesaura* forms a clade with *Cordylus coeruleopunctatus*. *Cordylus giganteus*, *C. polyzonus* and *C. cataphractus* form monotypic clades. The type species, *Cordylus cordylus*, is included in a clade of 20 species that range from South Africa to Angola and Ethiopia.

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430 Fish Systematics, Pavilion East, Monday 27 July 2009

Jay Stauffer[1], Rachel Cleaver[1], Adrianus Konings[2]

[1]Penn State University, University Park, PA, United States, [2]Cichlid Press, El Paso, TX, United States

A New Cichlid in the Genus *Stigmatochromis* (Teleostei: Cichlidae) from Lake Malawi, Africa

Stigmatochromis is a wide spread genus of cichlid fishes endemic to Lake Malawi. It is diagnosed by two main characteristics: a long snout equal in length or longer than the post-orbital head length and numerous, relatively small, unicuspid teeth in the outer series of the oral jaws. *Stigmatochromis woodi* is a widely distributed sand-dwelling species that feeds on small fishes. *Stigmatochromis woodi* construct large bowers that are shallow spawning pits in the sand. It shares its habitat with a morphologically and ecologically similar form which is recognized by ornamental fish breeders as "Stigmatochromis Tolae," but which does not appear to build bowers in the sand. Morphometric and meristic data were collected and compared to *S. woodi* to determine if these two forms represented distinct species. The two forms indeed appear to be heterospecific and *Stigmatochromis* 'tolae' can be distinguished from *S. woodi* by a smaller mouth that is not in line with the horizontal body axis, as is the case in *S. woodi*.

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328 Herp Development & Morphology, Galleria North, Sunday 26 July 2009

C. Tristan Stayton

Bucknell University, Lewisburg, PA, United States

The Morphological and Biomechanical Evolution of Emydid Turtle Shells

Turtle shells exhibit great morphological diversity in terms of both shape and size. This diversity undoubtedly influences how well these shells function in a number of different

roles (force resistance, moving through fluids, heat exchange, etc...), but few studies exist that quantify how differences in shell shape influence performance. Here I use geometric morphometrics to quantify shell shape and Finite Element (FE) methods to model the mechanical response of emydid turtle shells to physical loads. FE models of turtle shells were loaded at points on both the carapace and plastron, and stresses that developed as a result of that loading were quantified. As previous studies have found, aquatic turtles generally possessed flatter shells that those found in terrestrial species. These flatter shells usually developed higher stresses for a given load, although in many aquatic species stresses were not exceptionally high. Turtles possessing high-stress shell shapes tended to be larger than other species, helping to mitigate the relative weakness of the shape. Although previous researchers have hypothesized a trade-off between tall, rounded shells that develop very low stresses for a given shape and flat or elongate shells that minimize drag during swimming, many aquatic turtles possess surprisingly strong shells for their height. Additional compromises in shell strength may be offset by evolutionary changes in turtle shell size.

1002 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Mark Steele, David Wang

California State University, Northridge, CA, United States

A Test for Equivalence of Reproduction of Temperate Reef Fishes on Artificial versus Natural Reefs

Artificial reefs are commonly used to mitigate damage to or loss of natural reefs, yet how well these artificial reefs function is still widely debated. One major question is whether artificial reefs produce fishes at rates equivalent to those on natural reefs. We tested whether rates of reproduction of five of the most common rocky reef fishes in the Southern California Bight were equivalent on a large artificial reef (Wheeler North Reef) to those on nearby natural reefs. Fishes (California sheephead, kelp bass, barred sand bass, señorita, and blacksmith) were collected during the spawning season in two years (summer 2007 and 2008) and batch fecundity was estimated by the gravimetric method. Preliminary analysis indicates that batch fecundity on the artificial reef was similar to that on natural reefs for some species (e.g., California sheephead) and lower on the artificial reef for others (e.g., kelp bass). This finding implies that artificial reefs may be able to enhance local production of some fishes. The artificial reef was relatively young (8-9 years) during this study, and as the reef and the biotic community on it develops more fully, reproductive output of all study species may become more similar to that on nearby natural reefs.

743 Fish Genetics II, Parlor ABC, Monday 27 July 2009

Carol Stepien, Joshua Brown, Douglas Murphy

University of Toledo, Toledo, OH, United States

Invasion Genetics of the Round Goby (*Neogobius melanostomus*): Founding Sources, Spatial Patterns, and Temporal Changes

Genetic composition is believed to be important in aiding success of an exotic species introduction, which is evaluated across the North American invasion of the Eurasian round goby *Neogobius melanostomus*, dating from its 1990 appearance to the present. We test the central hypothesis of whether its population genetic composition has changed over the invasion's time course, analyze spatial structure, and identify likely founding source(s). We analyze mtDNA cytochrome b gene sequences and 8 nuclear microsatellite loci for 1300+ round gobies from 25 North American and 22 Eurasian locations, and test temporal patterns from 2-3 time periods at 5 locations; using F_{ST} analogs, neighbor-joining trees, haplotype networks, Bayesian assignment tests, Monmonier barrier analysis, and 3-dimensional factorial correspondence analysis. Results show: (1) the southern Dnieper River at the port of Kherson in Ukraine was the primary donor population, supplemented by others, (2) the invasion has high genetic diversity and no founder effect, (3) significant spatial genetic structuring, (4) some fringe areas fit a "leading edge" model with less genetic variability, whereas others have high diversity with unique alleles from other donor sources, and (5) peripheral sites changed significantly over time, towards net gain of alleles, whereas original sites remained stable. High genetic diversity and divergence across its invasive range likely enhanced the round goby's ecological success. Spatial genetic structure among the different locations likely reflects both differential introduction histories and local genetic predominance of established colonists.

1048 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Sean C. Sterrett[1], Adam J. Kaeser[2], Lora L. Smith[3], Jean C. Brock[3]

[1]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA, United States, [2]Georgia Department of Natural Resources, Albany, GA, United States, [3]Joseph W. Jones Ecological Research Center, Newton, GA, United States

Spatial Ecology and Instream Habitat Selection of Female Barbour's Map Turtle (*Graptemys barbouri*) in Ichawaynochaway Creek, Baker County, Georgia

The major goal of the Georgia Wildlife Action Plan explicitly is to "develop a conservation strategy based upon the best available data on the distribution and

abundance of wildlife species, particularly rare and declining species." However, conservation strategies also require information about spatial ecology of species. Very little is known about the basic ecology of one of Georgia's protected species, Barbour's map turtle (*Graptemys barbouri*). Barbour's map turtles are typically associated with streams with limestone substrate, which is common throughout the Apalachicola-Chattahoochee-Flint River Basin in the southeastern U.S., where this turtle is endemic. The objective of this study was to examine the spatial ecology and instream habitat selection of female Barbour's map turtles using sonar interpreted habitat maps. We used logistic regression and an AIC approach to develop predictive habitat models. We radiotracked 14 female Barbour's map turtles (10 adults and 4 subadults) on Ichawaynochaway Creek, a tributary of the Flint River in Baker County, Georgia from 2007-2009. On average, turtles used 839 ± 199 m of creek length and the mean 50% kernel density estimate was 0.23 ± 0.05 ha. There was no difference in home range size between adults and subadults, although adults used significantly deeper areas of the creek. The global model, which included substrate type, large woody debris and depth, was the best supported candidate model to predict female *G. barbouri* instream habitat use. This study determined the extent of stream length and specific habitat features used by female Barbour's map turtle in Ichawaynochaway Creek.

1041 Clark Hubbs Symposium, Galleria South, Saturday 25 July 2009

Steve Stevenson

University of New Orleans, New Orleans, LA, United States

Travels with Clark: Perspectives on the Origin of Lore

Clark Hubbs, like all mentors, frequently performed habits and tendencies of behavior of unusual interest to his graduate students and these are ultimately accumulated into a body of lore by those students. These tales, in the oral tradition, have become repeated and enhanced primarily while at social gatherings of those students at professional meetings and/or while collectively driving into the night to or from those said occasions. It is my perspective that this represents a kind of social facilitation behavior found in all graduate students.

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482 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

James R. Stewart, Tom W. Ecay

East Tennessee State University, Johnson City, TN, United States

Consequences of Interpopulational Variation in Oviductal Egg Retention to Embryonic Calcium Nutrition

Patterns of maternal provision and embryonic mobilization of calcium are thought to contribute importantly to plasticity in the evolution of reproductive mode among Reptilia. A prominent scenario predicts that evolution of viviparity is the culmination of progressive extension of oviductal egg retention accompanied by progressive reduction of eggshell thickness and that calcium placentotrophy evolves subsequent to viviparity. Thus, if embryos are dependent on calcium from the eggshell, evolution of viviparity will result in embryonic nutritional deficiencies. We studied embryonic calcium mobilization in two lizards with intraspecific variation in the pattern of oviductal egg retention to address two questions. Are embryos dependent on eggshell calcium? Is the calcium content of hatchlings correlated inversely with length of egg retention? Populations of *Lacerta vivipara* either oviposit eggs containing embryos in the limb bud stage or give birth to free living young. *Saiphos equalis* has prolonged egg retention with interpopulational variation in the timing of oviposition relative to hatching. Maternal provision of calcium differs between species but embryos from oviparous eggs of each species extract a significant amount of calcium from the eggshell. Viviparous eggshells lack a calcareous layer and embryos obtain calcium from placental transfer. Concentration of calcium in viviparous neonates is less than in oviparous hatchlings in both species. These comparisons suggest that there is a nutritional cost to neonates associated with evolution of viviparity, but the broad distribution of this reproductive mode among Squamata indicates that this cost does not preclude the transition. (Supported by a grant from NSF - IOB 0615695)

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84 Fish Systematics, Pavilion East, Monday 27 July 2009

Melanie Stiassny

American Museum of Natural History, New York NY, United States

Extreme Hydrological Conditions and Complex Channel Topology Drives Population Divergence and Speciation in the Lower Congo River

Unlike most of the rest of the Congo River, the lower Congo downstream of Pool Malebo to the port town of Matadi is highly channel-constrained with a peculiarly complex hydrology that appears to have isolated it from the remainder of the basin. Channel topology itself is highly heterogeneous, punctuated by underwater canyons of extreme depth. Water velocities are also extreme, even in areas without surface rapids,

and recent measurements taken with pirogue-deployed Acoustic Doppler Current Profilers (ADCP) have revealed complex flow patterns within the water column including shifting counter directional flows and descending and ascending "walls" of fast moving water. Analysis of remotely sensed data provides an additional view of the numerous macrohabitats and channel features that characterize this hydrologically complex stretch of river. Using the latest remote sensing technologies, and with much on-the-ground sampling and systematic analysis, we are beginning to get a much clearer picture of just how the geomorphological template of the river has played a major role in isolating populations and generating high levels of divergence among diverse clades of fishes. To date we have documented well over 300 fish species and of these upward of 80 appear to be endemic to the lower Congo region. With such unexpectedly high levels of species richness and endemism associated with a unique hydrological regime, this short stretch represents a model system for exploring the interplay of complex hydraulic conditions, channel features of extreme depth, and diversity generation cast within a broad systematic framework.

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217 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Amber Stokes

Utah State University, Logan, UT, United States

Sex-biased predation on *Taricha* by a novel predator in Annadel State Park

Newts of the genus *Taricha* have long been studied due to the powerful neurotoxin found in their skin. Tetrodotoxin (TTX) acts by blocking receptors in sodium channels, ultimately resulting in death via asphyxiation. The only documented predators of species in this genus have been snakes of the genus *Thamnophis*. Recently, predation on *Taricha* in Ledson Marsh in Annadel State Park, Santa Rosa, CA was discovered. Two species of *Taricha* were found living sympatrically at this location, the California newt (*T. torosa*) and the rough-skinned newt (*T. granulosa*), and tracking of predation on both species from 1998-2008 showed that it was male-biased. Fluorometric High Phase Liquid Chromatography (HPLC) analysis was used in order to quantify TTX levels in the skin of ten male and ten female newts of each species. Quantification of TTX was done to determine the influence that TTX levels may have on sex-biased predation in this population. We found that females are significantly more toxic than males, and that *T. torosa* were significantly more toxic than *T. granulosa*. An in-depth ecological study of relative abundances of both species and identification of the predator are needed at this site to obtain a clear picture of the predator-prey dynamics at Ledson Marsh.

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477 ELHS/LFC Ecology II/Condition, Broadway 1&2, Sunday 26 July 2009; ELHS SALLY RICHARDSON AWARD

David Stormer, Francis Juanes

University of Massachusetts, Amherst, MA, United States

Cohort Structure, Growth, and Condition of Juvenile Bluefish *Pomatomus saltatrix* in the Hudson River Estuary, New York

The mechanisms of recruitment from the juvenile to the adult life stage in marine fishes are topics of much interest in fisheries science. Estuaries may aid in dampening recruitment variability by providing abundant resources and by reducing predation risk. In this study, the cohort structure of juvenile bluefish *Pomatomus saltatrix* was investigated during summer residency in the Hudson River estuary, N.Y. Otolith microstructure was used to determine hatch-dates, and estimate growth rates. Condition was measured by calculating lipid content of white muscle. Growth rates and lipid content were compared between the spring- and summer-spawned cohorts of juvenile bluefish through the summer of 2008. Peak hatch-dates for the spring and summer cohorts occurred in mid-April and late June respectively. Spring-spawned juvenile bluefish comprised the entire catch until late July when the first summer-spawned fish was captured in the estuary. The summer cohort recruited to the estuary by mid-August, making up approximately half of the juvenile abundance (61% by the end August). The spring and summer cohorts exhibited similar growth rates. Lipid content was similar between cohorts when all time periods were combined. However, spring-spawned fish entered summer with higher lipid content and depleted energy reserves through the summer, whereas the summer cohort accumulated lipids content over time. Results of this study indicated that energy acquisition was selected over growth by the summer cohort in preparation for the fall migration. Consequently, size-specific predation mortality rather than starvation during migration may explain the recruitment failure exhibited by the summer cohort of juvenile bluefish to the adult population.

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115 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Adam Stow, Heidi Ahonen

Macquarie University, Sydney, Australia, Australia

Patterns of Dispersal and Genetic Variation in the Sand Tiger Shark (*Carcharias taurus*)

Population sizes of sand tiger sharks (*Carcharias taurus*) are considered to be in decline throughout their distribution. Anthropogenic impacts are believed to be the primary

threats to the eastern Australian population of sandtiger sharks, which is listed as Critically Endangered, and the most threatened population globally. We have shown that sand tiger sharks sampled off eastern Australian are isolated and have relatively low levels of genetic diversity. However the degree of isolation between all extant populations is still uncertain. In this study mitochondrial DNA (mtDNA) and nuclear loci (AFLP's and microsatellites) are being used to estimate genetic partitioning among grey nurse shark populations throughout their global distribution. We have also increased our sampling density of the critically endangered east Australian sand tigers allowing us to comment on fine scale dispersal patterns within this population.

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166 Poster Session I, Exhibit Hall, Friday 24 July 2009

Adam Stow, Paul Duckett

Macquarie University, Sydney, Australia

Climate Change and the Conservation of Australian Arid Zone Ecosystems

Our understanding of the impact past climates had on the population structure of southern hemisphere species lags behind that of northern hemisphere biota. During glacial maxima it is likely that the distributions of many species contracted to refugia. In Australia, the Pleistocene epoch was punctuated by hyper-aridity events during periods of glaciation. These hyper-aridity events caused the expansion of inland deserts, and contraction of woody vegetation, and are potentially analogous to the glaciation experienced in many northern hemisphere biomes. Preliminary investigations on the genetic structure of the gecko *Gehyra variegata* from the eastern arid zone of Australia indicated the sampled population has significant geographical structuring consistent with allopatric fragmentation and a subsequent range expansion. The timing of these events, inferred from molecular data, is congruent with a peak in amplitude for Pleistocene climatic oscillations around 400,000 years ago. The genetic partitioning suggests past refugia are associated with catchment areas, where species coalesced during dry phases. Furthermore, these data highlight the conservation significance of particular catchments in arid Australia. Ongoing work investigates genetic structuring in multiple arid zone lizard species and flora to ascertain whether the patterns we have observed with *Gehyra variegata* are generally consistent for woodland species.

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503 Poster Session I, Exhibit Hall, Friday 24 July 2009

Nicolas Straube[1], Samuel P. Iglesias[3], Daniel Y. Sellos[3], Juergen Kriwet[1], Ulrich Schliewen[2]

[1]Museum fuer Naturkunde, Stuttgart, Germany, [2]Zoologische Staatssammlung, Munich, Germany, [3]Muséum national d'Histoire naturelle, Station de Biologie Marine de Concarneau, France

Molecular Phylogeny and Node Age Estimation of Lantern Sharks (Elasmobranchii: Etmopteridae)

Etmopteridae is the most speciose family within Squaliformes comprising several species showing low morphological character diversity useful for phylogenetic analyses. Therefore, molecular data are expected to attain a better resolution of species interrelationships. Here, we compiled an extensive DNA dataset to (1) critically test for the monophyly of Etmopteridae, to (2) identify the sister-group of Etmopteridae among Squaliformes, to (3) test the monophyly of each of the five single genera included in Etmopteridae, to (4) compare molecular and morphological characters for their phylogenetic signal, and to (5) test for a Lower Eocene origin of Etmopteridae as indicated by the fossil record. Preliminary results attained from MP, ML, and Bayesian analyses revealed a stable tree topology based on 4715 basepairs of both nuclear and mitochondrial genes (mtDNA: 12S rRNA, full valine tRNA, 16S rRNA, COI; nuclear: portion of RAG1). Higher level interrelationships tentatively suggest (1) the genus *Somniosus* of paraphyletic Somniosidae to be sister of monophyletic Etmopteridae; (2) *Trigonognathus* is the sister-taxon to *Etmopterus* and *Microscyllium*; (3) *Etmopterus* is paraphyletic with respect to *Microscyllium*; and (4) the *Centroscyllium* + *Aculeola* clade is sister of a clade comprising *Etmopterus*, *Microscyllium*, and *Trigonognathus*. Within *Etmopterus*, four clades are identified representing morphologically characterizable species groups. These are at least partially endemic to defined geographic areas. Preliminary efforts to date the origin of Etmopteridae using fossil calibration points suggest the family's origin to be around 65 to 61 mya ago at the beginning of the Paleocene.

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931 Herp Systematics, Pavilion West, Thursday 23 July 2009

Jeffrey W. Streicher, Jesse M. Meik, Jonathan A. Campbell, Eric N. Smith

Amphibian and Reptile Diversity Research Center, Department of Biology, The University of Texas at Arlington, Arlington, TX, United States

Phylogenetic Placement of Type and Rare Specimens Using A Priori Hypotheses from Molecular Data: A Case Study using Direct-developing Frogs (Anura: Craugastoridae) from Northern Central America

Contemporary studies that revise taxonomy using molecular phylogenies are prevalent across organismal disciplines. Many of these studies, however, are limited in their revision capabilities when DNA sequence data for type-specimens (or other material from type-localities) are absent. Ideally researchers could obtain fresh tissue samples from topotypic material or through use of specialized molecular techniques that yield DNA from formalin-preserved specimens; however, these options are often not logistically feasible. We examined our ability to identify the phylogenetic placement of type and rare specimens via multivariate morphological comparisons of groups of specimens corresponding to a multilocus molecular phylogeny derived from matched DNAs. Using direct-developing frogs in the subgenus *Hylactophryne* we generated a molecular phylogeny for 60 taxa from 1 mitochondrial and 4 nuclear gene regions for a concatenated total of ca. 2700 base pairs. We evaluated morphological cohesion and separation of groups by deriving discriminant functions using known clade members as a priori statistical populations, and included several type and rare specimens in this framework. Across molecular and morphological datasets, our final analysis includes 20 of the 21 currently recognized species in the subgenus. Additionally, we discuss the strengths and weaknesses of this methodology and the feasibility of its application to other taxonomic groups.

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925 Poster Session I, Exhibit Hall, Friday 24 July 2009

Jeffrey W. Streicher, Eric N. Smith

Amphibian and Reptile Diversity Research Center, Department of Biology, The University of Texas at Arlington, Arlington, TX, United States

Patterns of Diversification in Phenotypically Polymorphic Direct-developing Frogs (Anura: Craugastoridae) from Northern Central America

In Central America, direct-developing frogs inhabiting the leaf litter constitute a taxonomically diverse group. Among these taxa, several lineages exhibit high levels of color pattern polymorphism which has resulted in the reallocation of many species to widely distributed ‘species series' that display similar types of variation. In the present

study we investigated relationships among 2 series within the genus *Craugastor* that exhibit substantial amounts of intraspecific phenotypic polymorphism. The *C. mexicanus* and *C. rhodopis* series are distributed across an extensive elevational span from central México to northern Panamá. Focusing on taxa from México and Guatemala, we examined phylogeographic structure across several species of each series using ca. 400 base pairs of the mitochondrial small subunit (12S) ribosomal RNA gene from a total of 96 frogs. Our preliminary analyses reveal multiple mitochondrial lineages within each series and phylogenetic relationships that are incongruent with recent taxonomic revisions. We found several groups included in our study to be polyphyletic and evidence for the occurrence of several diversification patterns (some in parallel) between closely related lowland and montane clades. Based on our sampling we provide suggestions for future systematic revision and identify geographically distinct mitochondrial lineages to aid in conservation planning.

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602 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Stephen Struble, Eric Schultz, Kurt Schwenk

University of Connecticut, Storrs, CT, United States

Structure of the Pseudobranch in the Poeciliidae and Related Taxa

The pseudobranch is an organ of unclear function derived from hyoid arch gill remnants. Previous reviews of the teleost pseudobranch do not include reference to a 'lobular compact' form that we find in Poeciliids. To characterize this unique morphology and its phylogenetic occurrence, we examined the pseudobranch of 25 species of Poeciliids, two species within the Cyprinodontidae, and species in the Atheriniformes and Beloniformes. Features of gross morphology were scored upon dissection. Features of internal structure and circulatory pathways were scored using histological sections. Cyprinodontiform species share the derived lobular compact form, in which filaments are enclosed together in a membrane, and which is loosely affixed to the medial base of the operculum by a similar membrane. Membranes are composed of respiratory epithelial cells interspersed with melanocytes. Species vary in degree of melanization and prominence of lobes. Internally, lamellae are dotted with pseudobranchial cells that may be homologous to chloride cells. Small amoeboid cells are also common. Blood is supplied by the afferent pseudobranchial artery, which appears to originate from both the cephalic circle and the efferent branchial artery. Blood leaving the pseudobranch drains to the ophthalmic artery via the efferent pseudobranchial artery. An Atheriniform (*Menidia menidia*) possesses a 'covered' form of pseudobranch, and a Beloniform (*Strongylura marina*) possesses another previously undescribed compact form of pseudobranch.

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905 Herp Biogeography, Galleria North, Saturday 25 July 2009

Bryan Stuart[1], Guin Wogan[1]

[1]North Carolina Museum of Natural Sciences, Raleigh, NC, United States, [2]University of California, Berkeley, CA, United States

Phylogeography of the Asian Common Toad, *Bufo melanostictus*: Deep Genetic Structure in a Widespread Human Commensal

Recent molecular genetic analyses have inferred that numerous geographically widespread species of Southeast Asian amphibians actually represent complexes of cryptic species. We examined genetic variation in *Bufo melanostictus*, a common species that thrives in human-modified environments across much of tropical Asia and is expected to have relatively good dispersal ability. Analyses of mitochondrial and nuclear DNA sequence data from more than 130 individuals sampled from across its geographic range revealed unexpectedly deep genetic structure in *B. melanostictus*. These sequence data are used to infer the evolutionary history of this species, and the implications for Southeast Asian biogeography and estimates of amphibian species diversity are discussed.

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876 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Kristine Stump[1], John McManus[1], Samuel Gruber[2]

[1]University of Miami - RSMAS, Miami, FL, United States, [2]Bimini Biological Field Station, Bimini, Bahamas

Applying Individual-Based Modeling Techniques to Address Potential Impacts of Essential Habitat Loss in a Lemon Shark Nursery

Individual-Based Modeling (IBM) is a powerful heuristic tool used to understand complex ecological processes. "Agents" representing individuals are assigned rules that dictate their behavior and influence interactions with other agents and the environment. After multiple iterations of the model, population- and ecosystem-level patterns may emerge from interactions of independently-acting agents. The goal is to develop a model such that emergent patterns reflect patterns of interest observed in the field. In the present study at Bimini, Bahamas, the mangrove-fringed lagoon comprises several important nurseries for lemon sharks (*Negaprion brevirostris*). The study site is a critical nursery, as it affords ample prey and protection from larger predators. A significant volume of research exists concerning the life history, physiology, diet, bioenergetics, growth and behavioral ecology of lemon sharks in Bimini. This study will utilize a twenty-year database combined with ongoing field observations to create an IBM that combines the behavior and bioenergetics of juvenile lemon sharks with that of their prey

and predators as they interact within the nursery ecosystem. The field-validated model will be used to describe the functioning of the nursery ecosystem and address actual and potential ecological impacts of planned coastal development in the area, serving as a tool to assess management alternatives. The model will help elucidate the role of top predators in a mangrove-fringed lagoon ecosystem, as well as the potential consequences of a decline or loss of such predators.

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54 General Herpetology, Galleria South, Sunday 26 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Jennifer L. Stynoski

University of Miami, Coral Gables, FL, United States

Discrimination of Offspring by Indirect Recognition in an Egg-Feeding Dendrobatid Frog (*Oophaga pumilio*)

Offspring discrimination - the differential treatment of offspring and unrelated young during parental care - functions in numerous animal taxa to ensure that vital and costly parental care behaviors are appropriately directed. Discrimination can be facilitated either by direct recognition of offspring or by indirect recognition of offspring location. Offspring discrimination and recognition mechanisms have not been identified in an amphibian. In *Oophaga pumilio*, a dendrobatid frog with obligatory maternal provisioning behavior, I tested whether mothers discriminate between offspring and unrelated young, whether they use direct or indirect recognition cues, and whether prior parental investment plays a contextual role in the differential treatment of young. Mother frogs utilized tadpole-rearing cups attached to tree trunks in wet tropical forest. After manipulating the identity, location, and/or age of tadpoles in cups, I determined whether maternal provisioning behavior was maintained over time by measuring tadpole growth and development. Mothers provisioned young regardless of tadpole identity, but were sensitive to location and did not provision tadpoles moved two centimeters to an adjacent cup. When given a choice between related and unrelated tadpoles in originally-chosen or adjacent cups, mothers discriminated by location, but not relatedness. Maternal provisioning behavior persisted when a tadpole provisioned for 10 days was replaced with either an age-matched or newly-hatched unrelated tadpole, so direct offspring recognition does not appear to be dependent on prior parental investment. Together, these results provide strong evidence that mother *O. pumilio* utilize indirect recognition cues to discriminate between offspring and unrelated offspring.

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529 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Monserrat Suarez-Rodriguez[1], J. Jaime Zuniga-Vega[1], Fernanda R. Rodriguez-Reyes[1], Hector Espinosa-Perez[2], Jerald B. Johnson[3]

[1]Facultad de Ciencias, Universidad Nacional Autonoma de Mexico, Distrito Federal, Mexico, [2]Instituto de Biologia, Universidad Nacional Autonoma de Mexico, Distrito Federal, Mexico, [3]Department of Biology, Brigham Young University, Provo, UT, United States

Intraspecific Variation in Body Shape and Reproductive Traits of the Livebearing Fish *Poecilia butleri*

Widespread species are ideal models for the study of the factors that promote adaptive variation in phenotypic traits. The first obvious step is to quantify the level of variation among populations in particular species. We studied 14 populations of the poeciliid fish *Poecilia butleri* along most of its distributional range in México. We quantified interpopulational variation in brood size, individual embryo size, and reproductive allotment. We also estimated intraspecific differences in body shape by means of geometric morphometric techniques. Our results indicate drastic differences in most of the traits examined. Particularly, significant interpopulational differences were found in the number of embryos per brood and in individual embryo size. Body shape was also drastically different among populations: fish from some sites were elongated and relatively thin in comparison with fish from other sites which were short and relatively robust. The sites with the more robust females were associated with the highest broods (on average 63 embryos per female). In contrast, reproductive allotment was remarkably similar among our studied sites. We discuss these results attempting to relate this phenotypic variation with presumably local selective factors such as stream velocity, resource availability, and predation environment.

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872 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

James Sulikowski[1], Angela Cicia[1], William Driggers[2], Jay Williams[1], Jill Hendon[3], Eric Hoffmayer[1]

[1]University of New England, Biddeford, ME, United States, [2]National Marine Fisheries Service, Pascagoula, MS, United States, [3]Gulf Coast Research Laboratory, Ocean Springs, MS, United States

Size and Age Estimates at Sexual Maturity for the Blacknose Shark, *Carcharhinus acronotus*, from the Northern Gulf of Mexico

The blacknose shark, *Carcharhinus acronotus*, is distributed throughout the western Atlantic Ocean from North Carolina to Brazil, including the Gulf of Mexico. Although

the life history of the blacknose shark has been well described for specimens collected from the Atlantic Ocean, several key life history characteristics are lacking for specimens collected from the Gulf of Mexico. One particular parameter that is deficient, is a direct determination of age and size at sexual maturity based on reproductive tissues. This life history information forms the basis for the calculations of growth rate, and productivity, making it one of the most important variables for estimating a population's status and assessing the risks associated with its exploitation. In order to gain insight into this life history parameter, age at size will be linked to maturity by using criteria from three endpoints; steroid hormone concentrations, gross morphological examination of reproductive tracts, and histological examination of spermatogenesis. This study is timely as stock assessments for this species suggest that it is currently overfished. In addition, this will be the first study to use the three aforementioned reproductive endpoints to asses reproductive maturity in a carcharhinid shark.

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567 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

John P. Sullivan, John G. Lundberg

The Academy of Natural Sciences, Philadelphia, PA, United States

The Rag-gene Catfish Tree and the "Big Bang" Theory of Siluroid Global Diversification

We review ACSI-sponsored phylogenetic study of the major lineages of living catfishes based on nuclear rag1 and rag2 DNA sequences and hypothesize a chronological scenario for the origin and distribution of catfish clades. Our results show good concordance with morphological taxonomy at and below the family level, but with a few surprises. Relationships at the suprafamilial level, on the other hand, are largely novel and offer new perspectives on catfish global biogeography. The large, cosmopolitan suborder Siluroidei in which Bayesian analysis resolves the South American Cetopsidae as sister group to the remaining 33 family-level groups, is subtended in succession by South American Diplomystidae and Loricarioidei, suggesting a South American center of siluriform origin and early diversification. While siluroid monophyly is firm, the most prominent feature of the rag gene tree is a span of poor resolution among the basal siluroid nodes. We examine whether this "siluroid comb" is an artifact or an indicator and whether hints of resolution within it provide insight into catfish biogeographic history. In this context we examine evidence for a deep siluroid superclade comprising all remaining Neotropical catfishes and a further suggestion of a single common ancestor for all living, extra-Neotropical catfishes. Relaxed clock analysis calibrated by fossils indicates a radiation on the order of 10 million years for the siluroid comb lineages in the post-Gondwanan Late Cretaceous. Drift-vicariance explanations for global catfish distribution are rendered problematic and we discuss possible alternatives.

803 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Yik Hei Sung, Chi Hang Hau, Nancy Karraker

The University of Hong Kong, Hong Kong

A Comparative Study of Herpetofauna in Exotic Plantations and Secondary Forests in Hong Kong and Hainan Province, China

Deforestation has been extensive across southern China. Exotic tree species have been planted in Hong Kong for reforestation and in Hainan Province for timber production, yet we have little understanding as to their effects on herpetofaunal communities. In this study, we compared the herpetofauna between exotic plantations and secondary forests. Paired exotic plantations and secondary forests at four different sites were studied for one year in Hong Kong using pitfall traps, coverboards and transect surveys. For Hainan, two sites were studied in two consecutive wet seasons by transect surveys only. A total of 13 and 17 amphibian and reptile species were recorded in Hong Kong and Hainan, respectively. In Hong Kong, species diversity and abundance in plantations and secondary forests were similar. Pitfall traps were the most effective method particularly for skinks and toads, which were responsible for 92% of captures. Coverboards were least effective, contributing only 2% of captures. In Hainan, there were significant differences in species composition between forest types (82% dissimilarity) but not in species diversity or abundance. Secondary forests were characterized by three forest-dependent species, *Rana spinulosa*, *Leptobrachium hainanense*, and *Acanthosaurus lepidogaster*, while plantations were dominated by generalists including *Microhyla heymonsi and Scincella reveesii*. We found that exotic plantations serve as suitable habitats for herpetofauna on degraded hillsides in Hong Kong. In Hainan, plantations do not appear to support forest-dependent species, and this result highlights the need to protect natural forests for the conservation of forest-dependent herpetofauna in some areas.

CANCELED

Tracey Sutton[1], Joel Hoffman[2], Jeanna Kidwell[1], Odd Aksel Bergstad[3], Tone Falkenhaug[3], Filipe Porteiro[4], Mikko Heino[5], Cairstiona Anderson[6], John Horne[6], Ann Bucklin[7]

[1]Virginia Institute of Marine Science, Gloucester Point, VA, United States, [2]Mid-Continent Ecology Division, National Health and Environmental Effects Research Laboratory, Duluth, MN, United States, [3]Institute of Marine Research, Flodevigen, Norway, [4]DOP, University of the Azores, Horta, Azores, Portugal, [5]Institute of Marine Research, Bergen, Norway, [6]School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA, United States, [7]Department of Marine Sciences, University of Connecticut, Groton, CT, United States

Deep-Sea Fishes of the Mid-Atlantic Ridge: Trophic Structure and Interactions

Because deep-sea fisheries are increasing as coastal fisheries decline, fisheries scientists need baseline data on deep-sea ecosystems prior to further development of deep-water fisheries. We present preliminary results and ongoing efforts to characterize the trophic structure and energy flow of the pelagic ecosystems of the northern Mid-Atlantic Ridge, from Iceland to the Azores. This study is one component of the international CoML field project MAR-ECO (www.mar-eco.no). We found a diverse deep-pelagic fish fauna (205 spp.), with unexpectedly high bathypelagic fish biomass and spatial complexity. Based on literature reports of species present, crustacean planktivory is the dominant trophic guild (79% of individuals 47% of species), primarily within the mesopelagial. "Gelativory" was second (12% ind., 4% spp.), primarily within the bathypelagial. Omnivory (3%, 13%), "shrimpivory" (2%, 4%), and piscivory (1%, 21%) were the remaining major feeding guilds. The diets of 22 spp., primarily bathypelagic, are unknown. Based on stable isotope analysis of fish tissue, two distinct trophic modes were identified: a mode at trophic level 4 (18%; crustacean and gelatinous planktivory) and a mode at trophic level 4.5-5.0 (58%; crustacean planktivory and piscivory). The top piscivores were bathypelagic fishes. In terms of fish biomass, the gelativorous taxa dominated, followed by crustacean zooplanktivores and piscivores. Quantitative comparisons of the different trophic pathways are not possible at present, given our limited knowledge of feeding rates of most species. However, microscopical and molecular analyses are currently ongoing to fill this void, including development of techniques to identify/quantify gelatinous prey as an alternate trophic pathway.

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814 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

William Sutton[1], Yong Wang[2], Callie Schweitzer[3]

[1]Alabama A&M University, Huntsville, AL, United States, [2]Alabama A&M University, Huntsville, AL, United States, [3]U.S. Forest Service, Huntsvile, AL, United States

Amphibian and Reptile Response to Thinning and Burning in Pine-Hardwood Forests of Alabama, U.S.A.

CANCELED

Amphibians and reptiles are essential components of forest ecosystems. In[illegible]ng evidence suggests that many of these species are declining du[illegible]th[illegible]ic disturbances, such as habitat destruction and alteration. W[illegible] exami[illegible] amph[illegible]an[illegible]d reptile response to forest thinning and prescribe[illegible]n[illegible]n 18 p[illegible]h[illegible]w[illegible]d f[illegible]st stands of the William B. Bankhead N[illegible] F[illegible]st, Ala[illegible]na, U.S. from [illegible]05-[illegible]8. Experimental design consi[illegible]d o[illegible] tw[illegible]y [illegible]l d[illegible]ign wi[illegible] three re[illegible]ns. Forest treatments [illegible]nsist[illegible]f t[illegible]ee [illegible]nning l[illegible]s (no [illegible]n, 11 [illegible]es[illegible] basal area (B[illegible]nd 1[illegible]/ha [illegible]u[illegible] B[illegible] and two burn lev[illegible] and burn). Using drift [illegible]e [illegible]rap [illegible]s, w[illegible] re[illegible]pp[illegible]i[illegible]66[illegible] individual amphibians and rep[illegible]s repres[illegible]in[illegible] 42 [illegible]pe[illegible] du[illegible]e-year of pre-treatment surveys and three ye[illegible] of post-[illegible]nt [illegible]rve[illegible] Most reptile species (e.g. Green Anole, Black Racer, an[illegible]Blac[illegible]Ki[illegible]na[illegible]re[illegible]ponded positively to thin and thin/burn treatments and were hig[illegible]re[illegible]ed with increased downed woody debris and decreased canopy cover. An a[illegible]phibian species, the Slimy Salamander was not affected by thinning treatments, but declined in some burn and thin/burn treatments. Findings suggest that forest thinning is a viable conservation strategy to improve forest growing conditions without negatively affecting amphibian and reptile species inhabiting southeastern forests.

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63 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Nobuya Suzuki[1], Deanna H. Olson[2]

[1]Quest University Canada, Squamish, BC, Canada, [2]US Forest Service, Pacific Northwest Research Station, Corvallis, OR, United States

Climate Change and Wetlands in the Oregon and Washington Cascade Range: Implications for Amphibian Conservation

Climate models are predicting warming trends and variable conditions, which are expected to have profound effects on forest ecosystems. In the US Pacific Northwest, climate patterns are complex because they also reflect annual and decadal shifts in weather regimes, but support for warmer and more variable temperatures and low or unstable precipitation levels is emerging. Consequences for forested aquatic systems

include altered hydroperiods of lentic and lotic habitats, and altered moisture regimes in upland forests. Effects are predicted on the survival and reproduction of moisture-dependent species such as amphibians, which are a taxon which have a world-wide alert for declining species. We evaluate climate patterns from 1937 to 2008 relative to water availability from snow melt in the forested landscape of the Cascade Range of Oregon and Washington. We also analyze the occurrence of lentic water bodies in this area relative to areas at risk of unstable water availability, to examine the potential effects on this type of amphibian breeding habitat. We found risk of low and unstable water availability was evident for mid-elevations in Oregon, but less so for Washington. Mid-elevations in Oregon have an abundance of lentic water bodies, relative to Washington, which are breeding habitats for amphibian species of concern. In addition, 41 percent of Oregon native amphibian species occur in this elevational range, suggesting low water or moisture availability could affect a a broader set of taxa in lentic, lotic or forest upland habitats. Management designs can reduce interacting factors that may pose threats to these species.

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120 ELHS/LFC Connectivity Symposium II, Galleria South, Friday 24 July 2009

Stephen Swearer

University of Melbourne, Parkville, Victoria, Australia

Does Landscape Context Influence the Magnitude of Connectivity in Marine Metapopulations?

Benthic marine habitats exhibit tremendous diversity in the extent of patchiness and isolation. In some landscapes, such as island archipelagos, suitable habitat patches can be small and separated from each other by an unsuitable ocean matrix. In other instances, such as along continental margins, habitat patches can be quite large and have almost contiguous distributions. For a pelagic larva, the surrounding 'cuescapes' in these two landscape contexts are likely to change in fundamentally different ways as a larva disperses away from its natal source. In island environments, cues associated with suitable benthic habitat represent point sources and thus may restrict larval exchange among island populations. In contrast, larvae dispersing along continental margins will continue to receive sensory information regarding the location of suitable benthic habitat even in the face of extensive alongshore transport. As a handful of studies have found evidence for greater levels of genetic isolation in insular habitats compared to continental margins, this suggest that landscape context may have important implications for larval dispersal and population connectivity. Here I present a review of both genetic and demographic estimates of connectivity to test whether localized dispersal and restricted scales of dispersal are more ubiquitous in island systems.

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910 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Christopher Sweetman[1], Ann Bucklin[2], Brian Ortman[2], Tracey Sutton[1]

[1]Virginia Institute of marine Science, Gloucester Point, VA, United States, [2]University Of Connecticute - Avery Point, Groton, CT, United States

The Jelly Diet: Investigating the Role of Gelatinous Prey in Supporting High Deep-Sea Fish Biomass

The assemblage structure and ecology of meso- and bathy-pelagic (deep-pelagic) fishes is poorly known in general, and specifically over mid-ocean ridges. *Bathylagus euryops* (Microstomatidae sensu Nelson 2006) was found to be a biomass dominant species along the northern Mid-Atlantic Ridge, with a decreasing trend in biomass from Iceland to the Azores. Understanding the food-web structure and organic cycling of deep-pelagic ecosystems is critical for increasing our knowledge of the distributional patterns of deep-sea fishes. Microstomatid fishes are known consumers of gelatinous zooplankton. This represents a carbon vector in the deep pelagial that is poorly understood. With Real-Time PCR it is possible to identify, and even quantify, gut contents containing holozooplankton that otherwise may not be taxonomically identifiable. Probes were designed utilizing the nuclear large-subunit ribosomal RNA (28SrRNA) gene based on sequences from 125 species of gelatinous zooplankton. Each of the seven probes was designed to anneal to its corresponding genetically distinct group among Ctenophora, Scyphozoa, Hydrozoa, Siphonophora, Doliolida, Salpida, and Pyrosomida. The ability to identify and quantify gut contents that contain taxonomically unidentifiable prey with molecular methods can give us remarkable insight into the trophic ecology and spatial distribution of deep pelagic fishes.

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418 AES Ecology II, Galleria South, Sunday 26 July 2009

John Szczepanski

University of Rhode Island, Kingston, RI, United States

Feeding Habits of Skates and Rays in Delaware Bay: an Analysis of Resource Usage and Comparison to Batoids of Narragansett Bay

Feeding habits of many batoid elasmobranchs (skates and rays) have been recorded but diets, prey selection, and resource partitioning within specific populations is not fully understood. Few studies compare diets of sympatric species that potentially overlap in resource usage (most are single species assessments), diets over time, or food preferences between different regions that vary in abiotic characteristics and trophic structure. Through gut content analysis, my dissertation examines the feeding habits of these fish to understand the impact they have on each other and their prey sources. Also,

understanding the resource partitioning of these organisms becomes important as external pressures increase; specifically as they become targeted more for certain fisheries (since many are declining) and global climate changes continue to alter their habitat. Specimens are collected from Delaware (approx. 8-10 species) and Narragansett Bays (2-3 spp.) to give insight into how resources are partitioned based on the level of those resources and elucidate how competition plays a part in resource usage. Finally, I intend to examine the effect that collection method has on available data to evaluate the accuracy of my study as well as other similar ones. Various diet metrics, importance indices, and multivariate analyses will be used to incorporate the data from each species and relate it to the habits of the others as well as compare the interaction with those in a distinctly different estuary. This multispecies study will examine complex feeding dynamics and contribute to data that may be used in ecosystem-based modeling and management efforts.

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298 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Amanda Talaba[1], Daniel Rabosky[1], Stephen Donnellan[1], Mark Hutchinson[1], Irby Lovette[1]

[1]Cornell University, Ithaca, NY, United States, [2]Cornell University, Ithaca, NY, United States, [3]South Australian Museum, Adelaide, SA, Australia, [4]South Australian Museum, Adelaide, SA, Australia, [5]Cornell University, Ithaca, NY, United States

Exploring the Evolutionary and Ecological Causes of Diversification in Australia's Hyper-diverse *Ctenotus* Skinks

The rapid radiation of Australian *Ctenotus* has produced one of the world's most speciose squamate genera, with greater than 100 currently described species. These skinks are particularly diverse in the arid interior of Australia, where over ten *Ctenotus* species may occur in local sympatry. To date, however, there has been no formal phylogenetic reconstruction based on robust sampling across the entire *Ctenotus* radiation. We are building a comprehensive phylogeny for *Ctenotus* using a multi-locus Bayesian approach. Because of the potential for cryptic diversity within this group, we are integrating species-level phylogenetics with substantial population and geographic sampling for a number of species groups. This nested sampling has revealed that the exceptional *Ctenotus* diversity is even higher than previously thought. Many species appear to contain cryptic diversity and the existing taxonomy does not adequately describe species limits. We are using this comprehensive phylogenetic framework to test hypotheses about the causes of major evolutionary radiations as well as the evolutionary and ecological components of species diversity in local and regional communities.

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578 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009

Kevin Tang[1], Henry Bart[2], Andrew Simons[3], Robert Wood[1], Masaki Miya[4], Mutsumi Nishida[5], Kenji Saitoh[6], Wei-Jen Chen[1], Tetsuya Sado[4], Mary Agnew[1], Mark Clements[2], Michael Doosey[2], M. Vincent Hirt[3], Lei Yang[1], Richard Mayden[1]

[1]Saint Louis University, Saint Louis, MO, United States, [2]Tulane University, New Orleans, LA, United States, [3]Department of Fisheries, Wildlife, and Conservation Biology & Bell Museum of Natural History, University of Minnesota, Saint Paul, MN, United States, [4]Natural History Museum and Institute, Chiba, Chiba, Japan, [5]Ocean Research Institute, University of Tokyo, Tokyo, Japan, [6]Tohoku National Fisheries Research Institute, Miyagi, Japan

Cypriniformes Tree of Life: Molecular Phylogeny of the Earth's Most Diverse Clade of Freshwater Fishes

The order Cypriniformes includes approximately 3500 described species and more than 300 genera, forming the world's most speciose lineage of entirely freshwater fishes. The members of this clade are found in varied habitats throughout Africa, Asia, Europe, and North America. The diversity of cypriniform fishes includes scientifically important species like the zebrafish, *Danio rerio*, which is used as a model organism in evolutionary and developmental studies. Many cypriniforms are economically important as food fishes in different parts of the world; they are also ubiquitous in the aquarium trade, which is where they are probably best known. One of the major goals of the Cypriniformes Tree of Life (CToL) initiative is to examine this vast diversity and reconstruct a phylogeny for the entire order. To that end, we will present a preliminary draft of the cypriniform portion of the Tree of Life, using molecular data to resolve relationships among over 1000 ingroup taxa. Sequences have been collected from both mitochondrial and nuclear loci, with a total of four from each genome (mitochondrial: cytochrome b, COI, ND4, ND5; nuclear: EGR2b, IRBP, RAG1, and rhodopsin). Outgroups have been sampled from a number of ostariophysan families. Analyses of these molecular data have provided a robust phylogenetic framework for the relationships among the families and subfamilies within the order. This phylogenetic tree will be presented and its evolutionary implications will be discussed.

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881 Fish Conservation I, Parlor ABC, Sunday 26 July 2009

Christopher Taylor[1], Michael Calloway[2]

[1]Texas Tech University, Lubbock, TX, United States, [2]Mississippi State University, Mississippi State, MS, United States

A Tale of Two Rivers: Differential Change to Fish Assemblages in the Upper Tombigbee River and the Noxubee River (Mississippi) after Fragmention by the Tennessee-Tombigbee Waterway

The Tennessee Tombigbee Waterway (TTW) fragments the Tombigbee River system, disrupting the river continuum and isolating tributary streams and rivers by a series of locks and dams, and a highly modified flow regime. Two of these tributary systems, the upper Tombigbee River and the Noxubee River, are historically well documented regarding their pre-TTW fish assemblages. We have resampled both of these systems, post-TTW, to identify potential changes in fish assemblage organization, and local and regional patterns of species richness across the time period. The upper Tombigbee River fish fauna has changed markedly regarding fish assemblage organization, average local species richness, and regional species richness, whereas the Noxubee River system has changed little regarding these three faunal attributes. The upper Tombigbee River has also undergone considerable change to hydrologic regime, which is now strongly influenced by TTW operations, whereas the Noxubee River system retains a relatively intact hydrologic regime. These results indicate the importance of natural flow regimes in maintaining the ecological integrity of riverine fish assemblages.

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545 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Emily Taylor

California Polytechnic State University, San Luis Obispo, CA, United States

Hormones and Reproduction in Free-Living Snakes

Snakes exhibit extreme diversity in reproductive modes. However, very little research has been conducted on the hormonal regulation of reproduction in snakes. Studies on hormone levels in free-ranging snakes allow us to observe correlations between hormone concentrations and reproductive behaviors and physiological events in undisturbed snakes. The majority of this research has been conducted on rattlesnakes. Most studies have focused on testosterone levels in male snakes. In species with the unimodal breeding pattern, testosterone is usually elevated during summer, and in species with the bimodal breeding pattern, it is elevated in spring and fall. Spermatogenesis occurs during summer/fall in rattlesnakes, when testosterone

concentrations are elevated. Data from other species are scarce, but generally confirm that testosterone concentrations peak during the breeding season and spermatogenesis, and that peaks in testosterone are lower or absent in species in more aseasonal environments. Studies on free-ranging female snakes show that estradiol and testosterone concentrations peak during vitellogenesis, and progesterone and corticosterone levels peak during gestation in viviparous species. The trends above are relatively consistent in most of the species studied, with the exception of the red-sided garter snake, the most thoroughly studied species of snake. Several studies show that mating is testosterone-independent in males and that estradiol and progesterone levels are not necessarily elevated in reproductive females. It We need data on a more diverse array of snake species in order to gain insight into the relationship between hormones and the diversity of reproductive modes in snakes.

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472 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Christine Testerman[1], Demian Chapman[2], Mahmood Shivji[3]

[1]Guy Harvey Research Institute, Nova Southeastern University, Dania Beach, FL, United States, [2]Stony Brook University, Stony Brook, NY, United States, [3]Save Our Seas Shark Center, Guy Harvey Research Institute, Nova Southeastern University, Dania Beach, FL, United States

Population Genetic Structure of the Night Shark (*Carcharhinus signatus*) in the Western Atlantic Assessed Using Nuclear Microsatellite Markers and Mitochondrial Control Region Sequences

The night shark is a deepwater, coastal and semi-oceanic shark found in the Western Atlantic and along the west coast of Africa. It prefers tropical and warm temperate waters near outer continental shelves in depths of 300-400m during the day and around 200m at night. The night shark is of conservation concern because it is an important component of artisanal fisheries and is heavily fished off Cuba and Brazil. The night shark was assessed as Vulnerable by the IUCN Redlist in 2006, and is prohibited from landings in US waters. No information on stock structure for the night shark exists to assist in its stock assessments and guide its overall management. We report on the population structure of the night shark utilizing the complete mitochondrial control region sequence (1066 bp) and 11 microsatellite loci from 72 individuals sampled from part of its western Atlantic range. Analysis of the night shark mitochondrial sequence data set collected thus far reveals strong geographic subdivision with two genetically distinct populations (NW Atlantic and SW Atlantic), and overall high levels of genetic diversity. We are expanding these analyses with larger sample sizes and will also report on comparative inferences made from the nuclear markers.

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191 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Christine Thacker[1], Dawn Roje[2]

[1]Natural History Museum of Los Angeles County, Los Angeles, CA, United States, [2]University of Washington, Seattle, WA, United States

Phylogeny of Cardinalfishes (Teleostei: Gobiiformes: Apogonidae) and the Evolution of Visceral Bioluminescence

The cardinalfishes (Apogonidae) are a diverse group of small, mostly reef-dwelling fishes. We use DNA sequence data to hypothesize phylogenetic relationships within Apogonidae and among apogonids and other acanthomorph families, to examine patterns of evolution including the distribution of a visceral bioluminescence system. In conformance with previous studies, Apogonidae is placed in a clade with Pempheridae, Kurtidae, Leiognathidae, and Gobioidei. The apogonid genus *Pseudamia* is recovered outside the remainder of the family, not as sister to the superficially similar genus *Gymnapogon*. Incidence of visceral bioluminescence is found scattered throughout the phylogeny, independently for each group in which it is present. Examination of the fine structure of the visceral bioluminescence system through histology shows that light organs exhibit a range of morphologies, with some composed of complex masses of tubules (*Siphamia*, *Pempheris*, *Parapriacanthus*) and others lacking tubules but containing chambers formed by folds of the visceral epithelium (*Acropoma*, *Archamia*, *Jaydia*, and *Rhabdamia*). Light organs in *Siphamia*, *Acropoma*, *Pempheris,* and *Parapriacanthus* are distinct from but connected to the gut; those in *Archamia*, *Jaydia*, and *Rhabdamia* are simply portions of the intestinal tract, and are little differentiated from the surrounding tissues. The presence or absence of symbiotic luminescent bacteria does not correlate with light organ structure; the tubular light organs of *Siphamia* and chambered tubes of *Acropoma* house bacteria, those in Pempheridae and the other Apogonidae do not.

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47 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Tyler Thigpen[1], Hardin Waddle[2], Brad Glorioso[1]

[1]IAP World Services, Inc., U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, United States, [2]2U.S. Geological Survey, National Wetlands Research Center, Lafayette, LA, United States

Efficacy of Automatic Vocalization Recognition Software for Anuran Monitoring

Call surveys are a commonly employed technique for monitoring anurans, but they are costly, training is time-consuming, and survey protocol is difficult to standardize across sampling sites. Digital automated recording systems (ARS) are an affordable alternative

for obtaining recordings of frog vocalizations. The hardware can be programmed to survey at a predetermined time, thus requiring less input from operators. However, the number of audio files recorded by ARS can overwhelm listeners quickly. We tested a commercially available vocalization recognition software program for personal computers to assess whether the software is a viable technique for anuran call monitoring. We created recognizer files for three species: *Hyla cinerea*, *Lithobates catesbeianus* and *Lithobates clamitans*. It took from 3-20 hours for the software to scan 200 hours of recordings for each of the three species at the minimum quality rejection parameters we chose. The software misidentified calls at rates of 2.7%-15.8% per species. In addition, the software failed to detect calls heard by a human listener in 45%-51% of recordings. A tradeoff exists between false positive and false negative errors, which can be manipulated by changing recognition software parameters. It is unlikely that software recognition of frog calls will be 100% accurate, so methods for data analysis that take error rates into account need to be developed. While the potential for automatic frog call recognition as a monitoring tool is great, the development of the technique will require consideration of the limitations of the software used.

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697 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Rebekah Thomas, Bridgette Froeschke

Texas A&M University - Corpus Christi, Harte Research Institute, Corpus Christi, TX, United States

Evaluating the Impact of Increased Seawater Temperature and Carbon Dioxide on Development and Distribution of Larval and Juvenile Southern Flounder, *Paralichthys lethostigma*

Dramatic declines in abundance of the world's fisheries have caused concern among scientists. These declines may have cascading ecological impacts as ecosystems lose critical trophic links for stability, resilience, and persistence. It is widely accepted that overfishing is a major factor for fisheries declines. However, long-term natural environmental fluctuations and climate change may play a critical role. Studies that address the long-term, simultaneous effects of biologically relevant levels of increased CO_2 (decreased pH) and increased temperature are lacking. Southern flounder, *Paralichthys lethostigma*, populations have declined dramatically in estuarine waters of Texas, despite current management actions. We propose an ecosystem-based approach to define the optimal environmental requirements for early life stages of the southern flounder. Specifically we propose to examine the affects of climate change on the life history and population dynamics of southern flounder. We will examine the development and survivorship of larval southern flounder reared in temperatures that are normal, and in temperatures that are 5 and 10 degrees celsius above normal, and for each temperature, larvae will be reared in normal CO_2, or one of five higher levels of CO_2. CO_2 levels used will cause pH changes that are in line with those predicted from global climate change forecasts. Juvenile southern flounder will be exposed to the same

treatments and growth rates and metabolic scope will be determined. We predict that the combination of elevated temperature and CO_2 will produce significant changes in development which will significantly influence and predict both population size and distribution of southern flounder.

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558 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Alfred Thomson

Florida Museum of Natural History, University of Florida, Gainesville, FL, United States

Taxonomy of the *Amphilius jacksonii* complex (Teleostei: Amphiliidae)

African catfishes of the genus *Amphilius* (Teleostei: Amphiliidae) are small to moderate-sized fishes native to small streams throughout sub-Saharan Africa. Twenty-four species are recognized, but the taxonomy of *Amphilius* is poorly studied and the genus is believed to be much more diverse than presently recognized. Most of the species have restricted distributions and show a high level of endemicity. The species with large distributions are thought to be species complexes with many populations worthy of taxonomic recognition. Boulenger (1912) described *Amphilius jacksonii* from a tributary of Lake George in western Uganda, and since then the species has received little taxonomic attention. Walsh et al. (2000) redescribed the species using fresh material from tributaries of Lake George but did not examine material reported to be this species from elsewhere. I have examined material from across the distribution of *A. jacksonii* including western Uganda, eastern Tanzania, affluent drainages of Lake Tanganyika and Lake Rukwa and provide evidence for the recognition of several new species. Additionally, specimens reported to be *Amphilius uranoscopus* from the upper Zambezi River drainage and the Okavango basin in Namibia, Botswana and Zambia are determined to be a species closely related to *A. jacksonii*.

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436 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Michelle Tipton, Phoebe Stonebraker, Barry Chernoff

Wesleyan University, Middletown, CT, United States

Phylogeography of Blacknose Dace, *Rhinichthys atratulus*, in the Connecticut and Adjacent River Basins

Understanding the mechanisms of population differentiation on fragmented landscapes is fundamental to understanding the evolutionary processes that are critical for

conservation biology. *Rhinichthys atratulus* is widespread throughout Eastern North America. As such, the blacknose dace has recolonized many areas that were either partially or entirely glaciated during the last glacial period. *Rhinichthys atratulus* is ideal for studying the evolutionary consequences of having expanded and contracted its range throughout the Quaternary. Connecticut was completely glaciated during the last glacial episode, with ice depths in excess of 1km. Thus, the formation of the modern landscape, particularly the Connecticut, Housatonic and Thames river basins, is re-evolved in the retreat of the ice sheets and modified by humans since first colonization. Our studies on the phylogeography are based upon complete mitochondrial gene sequences of ND2 and control region. More than 200 individuals have been sequenced. The level of haplotypic variation within our study region is larger than would be expected. The results indicate that either rates of mitochondrial evolution is faster than expected (i.e., > 3%) or *Rhinichthys atratulus* has recolonized from multiple refugia.

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92 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Valorie Titus[1], Kelly Zamudio[2], Rayna Bell[2]

[1]Binghamton University, Binghamton, NY, United States, [2]Cornell University, Ithaca, NY, United States

Population Genetic Diversity and Connectivity among Populations of the Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*) in New York and New Jersey

The Eastern Tiger Salamander is endangered in New York and New Jersey primarily due to habitat modification for urban and suburban development. The historic range of the Eastern Tiger Salamander in New York include a few isolated populations just west of the Hudson River and Long Island. Presently, populations remain only on Long Island in Suffolk County. In New Jersey, the tiger salamander occurred statewide but is now restricted to a few ponds in the southern part of the state. Habitat fragmentation, if it results in isolated populations, can cause genetic erosion of populations due to cessation of gene flow and drift. Thus, it is critical to understand patterns of connectivity among populations. To guarantee the survival of this species, we need better knowledge of the genetic health of these populations. Our objective was to determine the present distribution of the tiger salamander and use population genetic techniques to assess population genetic diversity, connectivity among populations or population groups, and identify potential source populations that might be crucial for protection or this population network in a fragmented landscape. We collected tissue samples from 20 sites across the known breeding range on Long Island and from nine sites in New Jersey. We genotyped our samples at twelve microsatellite loci to infer to infer the geographic scale at which population connectivity should be maintained for conservation of this species. Molecular methods allow us to estimate dispersal among

groups of populations and define genetic demes represented in the population in both states.

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170 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Michael Tobler[1], Rudi Riesch[1], Martin Plath[1]

[1]Texas A&M, College Station, TX, United States, [2]Univ. Oklahoma, Norman, OK, United States, [3]Univ. Frankfurt, Frankfurt, Germany

Natural and Sexual Selection Against Migrants in Sulfide Spring and Cave Poeciliids

There is ample evidence for adaptation along ecological gradients, and an increasing body of literature provides evidence that local adaptation can indeed result in genetic differentiation, and ultimately speciation. The proximate mechanisms of how adaptation translates into reproductive isolation are less well understood. In theory, reproductive isolation among diverging populations may arise when maladapted individuals from other habitat types are selected against by natural and/ or sexual selection. We tested for isolation by selection against immigrants in a small livebearing fish (*Poecilia mexicana*) that occurs along a gradient of abiotic environmental conditions. Fish not only occur in normal surface creeks, but also in a toxic, hydrogen-sulfide-containing surface creek, and a sulfidic cave. Divergent environmental conditions have been shown to select for adaptive divergence in a set of morphological, physiological, and behavioral traits. We demonstrate that gene-flow is strong among sample sites situated within the same habitat type, but virtually zero among habitat types. Using translocation experiments, we could document strong natural selection against migrants between non-sulfidic and sulfidic habitats (average migrant survival was ~10% within 24 hrs), whereas migrants between cave and surface habitats did not exhibit increased mortality within the same time period. Our experiments further revealed that females of both sulfidic populations discriminate against immigrant males during mate choice. Consequently, both natural and sexual selection contribute to isolation among parapatric populations, and selection against immigrants may be a powerful mechanism facilitating speciation among locally adapted populations even over very small spatial distances.

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518 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Brian Todd[1], John Willson[2], J. Whitfield Gibbons[2], Tanner Jessel[3], Jean Freeney[4]

[1]Virginia Tech, Blacksburg, VA, United States, [2]University of Georgia, Athens, GA, United States, [3]NBII-SAIN / Information International Associates, Inc., Knoxville, TN, United States, [4]US Geological Survey NBII-SAIN, Knoxville, TN, United States

The North American Reporting Center for Amphibian Malformations and Online Amphibian Information Portal

The conservation of amphibians faces many important challenges. The dissemination of important and timely information should not be one of them. To this end, the Southern Appalachian Information Node of the USGS National Biological Information Infrastructure (NBII-SAIN) and the University of Georgia's Savannah River Ecology Lab (SREL) have partnered to launch the NBII Amphibian Site and North American Reporting Center for Amphibian Malformations. These online resources constitute a valuable information repository to support the collaborative efforts of herpetologists as they seek information about amphibian populations worldwide. By also providing the public a means of reporting malformed amphibians in an easily accessible website, SREL and NBII-SAIN assist the scientific community's need to identify amphibian populations that may warrant further study. Verified, searchable records of documented malformations from across the US can provide researchers early warning and just cause for increased monitoring. In addition to searchable records and the NARCAM reporting interface, visitors to the NBII Amphibian Site (www.nbii.gov/amphibians) can browse crucial topics pertaining to amphibian conservation, such as amphibian disease and the chytrid fungus, amphibian declines and climate change, amphibian monitoring programs, and upcoming herpetological meetings and events. The amphibian site also highlights diverse USGS science resources including datasets, species distribution maps, images, and identification guides. Specific to each topic area, the site also features predefined queries of the NBII resources catalog, making simple work of retrieving peer-reviewed online resources and upcoming conferences of interest for amphibian conservation.

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515 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

Brian Todd[1], David Scott[2], Joseph Pechmann[3], J. Whitfield Gibbons[2]

[1]Virginia Tech, Blacksburg, VA, United States, [2]University of Georgia, Athens, GA, United States, [3]Western Carolina University, Cullowhee, NC, United States

Rapid Opposing Shifts in Amphibian Reproductive Timing Correlate with Changing Climate

Amphibians are experiencing extraordinary global declines and extinctions from several factors, including climate change. Here we analyze 30 years of data on the arrival times of 10 species of pond-breeding amphibians from an isolated wetland in the southeastern United States. We found significant trends of earlier breeding in recent years for some species, as has been shown in previous phenology studies of amphibian reproduction. However, our data also show for the first time that fall-breeding amphibians can be affected by changing climate. In contrast to winter- or spring-breeding species, fall-breeding amphibians at our site breed significantly later in recent warm years. As a result of these opposing changes in reproductive timing, the expected temporal niche overlap of amphibian larvae in the shared aquatic habitat has been compressed. Even species that exhibited no change in their own reproductive timing must now contend with alterations in larval habitat use by other species. In total, 4 of the 10 species that we studied shifted breeding phenology 2.4–10.9 weeks over the past 30 years. Corresponding mean overnight temperatures during the breeding periods of these 4 species increased an estimated 1.2 ^{o}C. The arrival dates of 6 species were correlated with overnight temperatures and/or cumulative rainfall during or immediately preceding the breeding season. These unprecedented opposing shifts in reproductive timing may have significant consequences for amphibian communities given that predator-prey dynamics and competition in larval amphibians depend on aspects such as the timing of reproduction and degree of temporal niche overlap.

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592 ELHS/LFC Ecology I, Broadway 1&2, Saturday 25 July 2009; ELHS SALLY RICHARDSON AWARD

Londi Tomaro, Jessica Miller

Coastal Marine Experiment Station, Hatfield Marine Science Center, Oregon State University, Newport, OR, United States

Survival of Mid-upper Columbia River Spring Chinook Salmon: The Effects of Size and Growth During Migration

Pacific salmon survival to recruitment is important to scientists and managers focused on population regulation and abundance predictions. Populations listed as endangered

under the Endangered Species Act, such as mid-upper Columbia River (MUCR) spring Chinook salmon (SpCS), attract particular interest. Evidence is accumulating that salmon survival depends on ocean conditions during early marine residence. However, MUCR SpCS overwinter in freshwater and move quickly downriver, through the estuary, and into the ocean. Therefore, their survival may be more dependent on river conditions than other stocks. To test this we examined the relationships between the survival of MUCR SpCS and their size-at-freshwater exit and growth rates during migration and estuarine residence. Yearling SpCS were collected off the coast of Washington and Oregon from 1998-2008 and were identified as MUCR SpCS using a coastwide microsatellite DNA baseline. Otolith chemical (Sr:Ca and Ba:Ca) and structural analyses, which are ideal methodologies for differentiating between freshwater and brackish/ocean residence and determining growth rates, were applied to a sample of fish collected in four years (1999, 2003, 2004, 2006). Near-shore juvenile Chinook salmon catch and size-at-freshwater exit were positively correlated with the abundance of 3-yr old SpCS at Bonneville Dam, the lowest mainstem dam, lagged two years (R^2 = 0.79 and 0.99, respectively). Brackish/ocean growth rates were positively related to near shore juvenile MUCR SpCS catches. Therefore, the interaction between growth conditions in freshwater and brackish/ocean habitats appear to influence smolt-to-adult survival of this stock.

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729 Fish Conservation II, Pavilion West, Sunday 26 July 2009

Darin Topping, Stephen Szedlmayer

Auburn University, Auburn, AL, United States

Use of Ultrasonic Telemetry Methods to Estimate Mortality Rates, Residency, and Movement Patterns of Red Snapper, *Lutjanus campechanus*

Mortality, emigration, and site fidelity were estimated from telemetry for large (500 - 860 mm TL) red snapper *Lutjanus campechanus* (N = 87) at one natural and four artificial reef sites in the northeastern Gulf of Mexico. From Dec 2005 to 2008 we used arrays of five ultrasonic receivers at each site. Each array consisted of one receiver at the center with four receivers placed 1100 m north, south, east, and west of center that enabled detection of natural mortality, fishing mortality, and emigration. As of Dec 2008, 27% were caught, 14% died, 30% emigrated, 7% unknown, and 21% were present within the 2-km study sites. Estimates of total mortality (Z) ranged from 0.53 to 0.58, fishing mortality (F) from 0.38 to 0.45, and natural mortality (M) from 0.11 to 0.17. Median residence time was 572 d, and ranged from 1 to 829 d, with 68% of fish staying at least one year at the site. Some fish moved up to 8 km to other sites, with some returning to their original release site. Red snapper (N = 6) tracked manually by boat over continuous 24-h periods stayed near (~60 m) the site during tracking, and showed diel movements that were similar to long-term data. These mortality rates were similar to indirect estimates while residence time was longer than any previous estimate, which provides evidence that these artificial reefs are of some benefit to red snapper.

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854 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Lucas Tornabene, Ryan E. Chabarria, Frank L. Pezold

Texas A&M University - Corpus Christi, Corpus Christi, TX, United States

Preliminary Phylogeny of the Atlantic Members of the Goby Genus *Bathygobius* (Teleostei: Gobiidae)

The genus *Bathygobius* is a cosmopolitan group of gobies, commonly found in tidepools, mangroves, and rocky intertidal areas throughout the world. Three species, *Bathygobius mystacium*, *B. curacao*, and *B. soporator*, have been described from the Western Atlantic. Multiple subspecies have been described from the Atlantic and Eastern Pacific and molecular data from multiple labs suggests the presence of undescribed species occurring in the Caribbean and off the coast of Brazil. Here we analyze the complete cytochrome-b mitochondrial gene to determine a preliminary phylogeny of the Western Atlantic species. Results of this study are combined with preliminary morphological data to clarify the presence of undescribed species or subspecies from the Caribbean. Other research goals include determining the patterns of evolution between the Western Atlantic species and congeners from the Eastern Pacific and Eastern Atlantic.

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845 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Luke Tornabene[1], James Van Tassell[2]

[1]Texas A&M Corpus Christi, Corphus Christi, Texas, United States, [2]American Museum of Natural History, New York, NY, United States

Review of the Atlantic Members of the Goby Genus *Bollmannia* (Teleostei: Gobiidae)

The teleost genus *Bollmannia* Jordan is composed of fourteen nominal species, five from the Atlantic Ocean. The original description of *Bollmannia litura* is inconsistent with the holotype in counts for the second dorsal and anal fin elements and body proportions. These characters were previously used to differentiate this species from *B. communis*, *B. eigenmanni*, *B. boqueronensis* and *B. jeannae*, but the holotype of *B. litura* falls within the range of variation observed for these species. This misdiagnosis along with other discrepancies in the literature have led to confusion when determining the validity of the Atlantic species. In this study we analyzed morphometric variation in these five nominal species of *Bollmannia*. The morphometric data in combination with a traditional suite of morphological characters allowed us to reconcile the status of the Atlantic species of *Bollmannia*.

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940 Fish Ecology I, Pavilion East, Friday 24 July 2009

Julian Torres Dowdall, Corey Handelsman, Cameron Ghalambor, Daniel Ozzello, Kyle Lenling, Aree Kongmuang, Robert Wildermuth

Colorado State University, Fort Collins, CO, United States

Phenotypic Plasticity as the Result of Temporal and Spatial Heterogeneity in Predation Pressure

Predation pressure has been shown to be an important factor driving evolution. Increased predation pressure in fish populations often drives the evolution of behavior, morphology, coloration, and life history traits. Additionally, predation pressure is also expected to show spatial and temporal variation. Thus, phenotypic plasticity is expected to evolve in populations experiencing heterogeneity in predation pressure. Here we use a multi-trait approach to determine if plasticity is higher in populations exposed to higher variation in predation. The Trinidadian Guppy (*Poecilia reticulata*) inhabits tropical streams and rivers along a gradient of predation pressure. Large piscivores are excluded from up-stream habitats by waterfalls resulting in reduced heterogeneity in predation pressure. Because heterogeneity is predicted to favor plasticity, we predicted guppies from high predation environments would exhibit greater plasticity. We compared phenotypic plasticity in behavior, morphology, coloration and life history traits between populations exposed to high and low predation pressures in the Yara River. Plasticity was measured using a split brood design, rearing siblings with or without predator chemical cues from the piscivorous pike cichlid (*Crenicichla alta*). We found that both populations showed plasticity with regard to all traits, but there was also variation in the slope of the reaction norms for some, but not all traits. Contrary to expectations, high predation populations were not more plastic. We discuss reasons why the predicted patterns were not observed in the context of cost of plasticity and relaxation of selection pressure.

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848 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Justin Touchon

Boston University, Boston, MA, United States

Reproductive Mode Plasticity in the Treefrog *Dendropsophus ebraccatus*

Terrestrial reproduction has independently evolved from aquatic origins in many animal lineages, including anurans. Since the shift to reproducing on land occurred long ago, the aquatic/terrestrial transition is poorly understood. The Neotropical treefrog

Dendropsophus ebraccatus offers an excellent opportunity to directly test hypotheses about the selective pressures for aquatic or terrestrial egg-laying. *Dendropsophus ebraccatus*, common throughout Central America, has long been known as a leaf-breeding treefrog. However, I recently discovered that the reproductive mode of *D. ebraccatus* is plastic. In shaded forest ponds, frogs only lay eggs on leaves above water. However, in open, disturbed habitats, where terrestrial egg desiccation is high, *D. ebraccatus* lays eggs directly in water. To test for reproductive plasticity, I measured oviposition choices of frogs from aquatic- and terrestrial-breeding populations in both open and shaded mesocosms. All frogs from all populations tested responded to canopy shade appropriately. In addition, females can lay both aquatic and terrestrial eggs during a single night. Intraspecific variation in aquatic/terrestrial reproduction is unprecedented within populations, much less individuals, and *D. ebraccatus* is the first vertebrate known to exhibit such reproductive plasticity. Phylogenetically, *D. ebraccatus* is sister to a clade of terrestrially breeding species, nested within a larger lineage of mostly aquatic-breeding frogs. Reproductive plasticity in *D. ebraccatus* may represent a retained ancestral state intermediate in the evolution of terrestrial reproduction; alternatively, it may be a novel trait recently evolved. Terrestrial reproduction has independently evolved at least four times within *Dendropsophus*, making the group well-suited for studying the evolution of terrestrial egg-laying.

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596 Herp Biogeography, Galleria North, Saturday 25 July 2009

Ted Townsend, Dean Leavitt, Tod Reeder

San Diego State University, San Diego, CA, United States

Phylogenetics and Biogeography of the Mexican Blind Lizard, *Anelytropsis papillosus*

Dibamidae is a clade of limbless, fossorial lizards with a curiously disjunct distribution. This distinctive group also represents an ancient lineage, with recent phylogenetic evidence suggesting it is the sister taxon to all remaining squamate reptiles. The genus *Dibamus* contains approximately 20 southeast Asian species, and the only other known dibamid populations, which collectively comprise the species *Anelytropsis papillosus*, are found in western Mexico. Recent molecular systematic research has confirmed that *Anelytropsis* is indeed a dibamid, but morphological conservatism within the family has left detailed interrelationships unknown. We used DNA sequence data from one mitochondrial and five nuclear regions from several mainland and island *Dibamus* species as well as *Anelytropsis papillosus* to obtain a phylogeny and clarify the biogeographic history of the group. Surprisingly, *Anelytropsis* does not appear to be the sister taxon of *Dibamus*. Instead, we find two major clades of dibamids, one comprising taxa from the Malay Peninsula, New Guinea, and intervening islands, and another from mainland southeast Asia; *Anelytropsis* belongs to this latter clade. We will discuss potential biogeographic scenarios as well as taxonomic implications of our findings.

916 Fish Ecology I, Pavilion East, Friday 24 July 2009

Eleonora Trajano[1], Maria Elina Bichuette[2]

[1]Instituto de Biociências da Universidade de São Paulo, São Paulo, São Paulo State, Brazil, [2]Departamento de Ecologia e Biologia Evolutiva, Universidade Federal de São Carlos, São Carlos, São Paulo State, Brazil

Population Ecology of Brazilian Subterranean Fishes: Patterns of Individual Growth

The population ecology of Brazilian troglobitic (exclusively subterranean) fishes was investigated by mark-recapture methods, revealing patterns that may be related to extreme conditions of hypogean life. Our first studies, limited to the dry seasons, pointed to two general patterns of individual growth in the cave habitat: highly heterogeneous growth rates and a pronounced slow down in growth during dry periods in caves subject to accentuated seasonality and a strong food shortage (e.g. *Trichomycterus itacarambiensis* and *Pimelodella spelaea*). In these species, cases of negative growth were frequent, resulting in mean growth rates tending to zero in the population. Recently, long-term studies using permanent individual marks, as in *Rhamdia enfurnada*, confirmed the pattern of growth in pulses, with almost all growth occurring during rainy seasons. In a three-years long study, rates around 4 mm per month were recorded for fish > 30 mm SL after a single rainy period, whereas maximum rates of 0.5 were recorded during a single dry period, with mean rates between -0.16 (2006) and 0.35 (2007). Mean rates of 0.85 mm per month were estimated for fish recaptured after at least one rainy season, representing an average value for the population. At the individual level, growth appears to proceed in an accordion-like fashion, pointing to very high life-spans. The highly heterogeneous individual growth, observed in all studied species even during more favorable periods, indicates a variable ability to obtain food, associated to a strongly heterogeneous distribution of food items, and may explain the exceptionally large individuals occasionally found.

75 Snake Reproduction Symposium, Grand Ballroom II, Saturday 25 July 2009

Stanley Trauth[1], David Sever[2]

[1]Arkansas State University, State University, AR, United States, [2]Southeastern Louisiana University, Hammond, LA, United States

Comparative Male Urogenital Anatomy of North American Colubroid Snakes

We examined the male urogenital anatomy of 38 species within five families (Colubridae, Crotalidae, Dipsadidae, Natricidae, and Xenodontidae) of North American colubroid snakes. We utilized macroscopic as well as microscopic investigational techniques including macroscopic photography, light microscopy, and scanning and transmission electron microscopy to elucidate the anatomy of posterior urogenital structures (i.e., the ductus deferentia, ampullae ductus deferentia, ampullae ureteri, ampullae urogenital papillae, and urogenital papillae). Complete serial histological sectioning of posterior urogenital tracts in 25 species revealed that male colubroid snakes fall into two anatomically distinct groups based upon the presence of ampullae ureteri (characteristic of pitvipers) or ampullae urogenital papillae (characteristic of colubrines). A single urogenital papilla or bilateral urogenital papillae exhibited one or two orifices and varied both interspecifically and intergenerically. The genera *Cemophora*, *Coluber*, *Lampropeltis*, *Opheodrys*, *Pantherophis*, *Regina*, *Sonora*, *Tantilla*, and *Virginia* exhibited conspicuously prominent ampullae ductus deferentia. Transmission electron microscopic analysis revealed that sperm associate closely with the highly secretory ampullary epithelium of the ductus deferentia in the genus *Pantherophis*. This urogenital study is the first to clarify an anatomical separation between viperid and colubrine sperm storage structures in male snakes.

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269 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

Joel Trexler

Florida International University, Miami, FL, United States

Population Dynamics and Control of Local Density of Three Poeciliid Species in a Dynamic Landscape

Understanding the role of density dependent (endogenous) and density independent (exogenous) factors in controlling population dynamics is a central challenge in population ecology and has implications for management. We used 12-year time series with five estimates per year (60 samples total) from 20 locations scattered over the southern Everglades to estimate the contribution of density-dependent and density-independent factors in controlling the dynamics of eastern mosquitofish, least killifish, and sailfin mollies. Density-dependent factors were food limitation and predation and

density-independent ones were disturbance by marsh drying and habitat area. Migration triggered by marsh drying was a factor in dynamics with an impact that varied among species. We used response surface modeling to document nonlinear components and time lags in population dynamics. Mosquitofish re-colonize rapidly following droughts and their dynamics were little affected by periodic drying; their population dynamics were dominated by density-dependent factors over most of the study area most of the time. In contrast, least killifish, and to less extent sailfin mollies, took much longer to regain pre-drought densities and was well below asymptotic density over much of the study area at any point in time. Thus, mosquitofish experienced near asymptotic density much of the time over most of the study area, while least killifish and sailfin mollies experienced expanding populations much of the time. This contrast has implications for life history evolution in these species.

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972 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Timothy Tricas[1], Kelly Boyle[1], Marc Lammers[2]

[1]Dept of Zoology and Hawaii Institute of Marine Biology, University of Hawaii at Manoa, Honolulu, HI, United States, [2]Hawaii Institute of Marine Biology, University of Hawaii at Manoa, Honolulu, HI, United States

Look Who is Talking! Remote Acoustic Monitoring of Hawaiian Coral Reef Fish Behavior

Monitoring of sounds on coral reefs is a potential tool for assessment and management of local fish populations. However, the identities of most acoustic fish species on coral reefs are not known because of the high background noise caused by open circuit scuba, and the brief duration or low intensity of most fish sounds. Two long-term acoustic recorders were deployed at a depth of 20 m on two coral reefs with high species diversity. These recorders collect five minutes of ambient sounds at hourly intervals each day, and are retrieved periodically by divers for download of the acoustic data. We also used closed circuit rebreather diving to record video and sonic behaviors of fish near the recording site. From the videos we have identified 37 putative acoustic species many of which produce multiple sound types during behaviors associated with intra and interspecific aggression, feeding, courtship and spawning. Cluster analysis of waveform correlations was used to identify acoustic clades among and within species. Acoustic waveform templates were then constructed for different species and used to screen sound files retrieved from the long-term recorders. Periodic acoustic activity was identified for several species and confirms the potential to remotely characterize species-specific diel, lunar and annual patterns of spawning, feeding and social interactions.

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997 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Timothy C. Tricas, Ariel Rivera-Vicente, Josiah Sewell

University of Hawaii at Manoa, Honolulu, HI, United States

Heads-up Display of the Shark Electrosensory Array

The ampullary electrosense of sharks and rays is used to detect weak electric fields from prey, predators, mates and for orientation/navigation. However, the function and spatial organization of the electrosensory array complex is poorly understood in relation to detection of different stimulus forms. We compared the projection patterns of electrosensory arrays in the Scalloped Hammerhead (*Sphyrna lewini*), Sandbar Shark (*Carcharhinus plumbeus*), and brown stingray (*Dasyatis lata*) to assess possible divergent and convergent functions. The superficial ophthalmic posterior (SOp) cluster of both sharks contains the longest, most sensitive canals with primary projections in the posterior lateral quadrants of the horizontal plane. In contrast, stingray SO canals are short and reduced in number, with the long posterior lateral projections subsumed by hyoid (HYO) canals. In the hammerhead shark, there was strong overlap in the posterior lateral quadrant of buccal (BUC) and SOp canals. In the stingray, there was overlap in the lateral direction among the BUC and HYO. Several patterns of omnidirectional complementarity among cluster groups were also identified. The superficial ophthalmic anterior (SOa) cluster in sharks, and SO and BUC in stingrays contain short canals located anterior to the mouth best suited for detection of nearby prey. The vertical sampling range is limited in the dorsoventrally flatted morphology of the hammerhead cephalofoil and the stingray body compared to the fusiform shark, and indicates reduced sensitivity to vertical electric fields. These shared and divergent canal projection patterns are consistent with specialized functions for the electric detection of prey and geomagnetic induced fields.

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673 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Daryl Trumbo[1], Amber Burgett[2], Elizabeth Biro[2], Jon Chase[2], Jason Knouft[1]

[1]Saint Louis University, St. Louis, MO, United States, [2]Washington University in Saint Louis, St. Louis, MO, United States

Using GIS and Field Survey Data to Investigate the Abiotic and Biotic Factors Regulating Local Assemblages of Pond Breeding Amphibians in Eastern Missouri

The goal of this research is to examine the abiotic and biotic factors that potentially regulate species richness in local assemblages of pond-breeding amphibians in eastern

Missouri. In particular, we investigated whether species within the pond-breeding Anuran and Caudate groups respond to a similar array of environmental variables. We also examined whether local or regional-scale environmental factors were more important in determining the local assemblages of amphibians within ponds. In 2007 and 2008, we surveyed 103 ponds in eastern Missouri for amphibian species. During the same time, we collected data on abiotic and biotic variables hypothesized to be important in regulating the distributions of the study species. Regional-scale environmental variables, primarily associated with temperature and precipitation, were also assembled for each sampling location using GIS databases. We used a Boosted Regression Tree (BRT) technique to investigate the relationships between the presence of the study species and abiotic and biotic predictor variables. BRT models successfully predicted the presence of six of nine pond-breeding amphibians in the study area, including five anurans and one caudate. Results suggest that the presence of each species is best predicted by a unique combination of local and regional-scale environmental variables within the study area. A qualitative assessment of predictor variables for each species indicates that regional-scale variables may be more important than local-scale variables in regulating the distributions of Anuran species that occur at the edge of their geographic ranges in Missouri.

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174 ELHS/LFC General Ichthyology II, Broadway 1&2, Saturday 25 July 2009

Katsumi Tsukamoto

Ocean Research Institute, The University of Tokyo, Tokyo, Japan

Ontogenetic Change of Buoyancy in Eel Leptocephali: An Adaptation for Life in the Ocean Surface Layer

Many planktonic organisms have adaptations such as floats or lighter substances to obtain buoyancy to help remain in the surface layer of the ocean where primary production occurs and food is most abundant. The almost totally transparent eel larvae, called leptocephali, are a unique member of the planktonic community of the surface layer, but their ecology and physiology are poorly understood. A comparative study was conducted on the specific gravity of the larval stages of the Japanese eel and other planktonic animals including 25 taxa of 7 phyla of marine invertebrates and 6 taxa of leptocephali. The specific gravity values of the freshly caught marine invertebrate taxa varied widely from 1.020 to 1.425, but leptocephali had some of the lowest values (1.028 to 1.043). Another study on the buoyancy of artificially cultured Japanese eel larvae showed that live leptocephali had even greater buoyancies with specific gravities of 1.019 - 1.025 that were close to or lower than seawater, and their buoyancy showed ontogenetic changes among eel eggs, leptocephali and glass eels. Leptocephali appear to have a unique mechanism of buoyancy control using chloride cells all over their body surface to osmoregulate the extracellular matrix of transparent gelatinous glycosaminoglycans filling their bodies. This adaptation is likely important to help

remain in the surface layer where food is abundant, while being transparent for predator avoidance. The ontogenetic change in buoyancy of Japanese eel eggs and larvae likely enhances their larval survival, transport, and recruitment to freshwater habitats.

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229 Herp Conservation III , Grand Ballroom II, Monday 27 July 2009

Tracey Tuberville[1], Terry Norton[2], Travis Glenn[3], Bradley Waffa[4]

[1]Savannah River Ecology Lab, Aiken, SC, United States, [2]St. Catherines Island Wildlife Center, Midway, GA, United States, [3]University of Georgia, Athens, GA, United States, [4]University of the South, Sewanee, TN, United States

Mating System In A Gopher Tortoise Population Established Through Multiple Translocations: Apparent Advantage Of Prior Residence

Population manipulations such as translocation are becoming increasingly important tools in the management of rare and declining species. Evaluating the effectiveness of such manipulations requires comprehensive monitoring of population processes, including dispersal, survivorship, and reproduction. We investigated the mating system of a translocated population of gopher tortoises (*Gopherus polyphemus*) established through multiple releases, which occurred primarily during 1987-1994. During 2006-2007, we sampled and genotyped 27 candidate males, 34 candidate females, and 121 offspring from 19 clutches at 5 polymorphic microsatellite loci to determine the relative frequency of multiple paternity and to estimate individual reproductive success. Multiple paternity was detected in 57% of clutches genotyped, and females of single-sire clutches and females of multiple-sire clutches were of similar size. Reproductive success varied among male tortoises, and successful sires were significantly larger than males to which no offspring were attributed. Among successful sires, previously established males sired a disproportionate number of the offspring sampled, despite being significantly smaller than subsequently released males. The high variance in individual reproductive success and the apparent reproductive advantage associated with prior residence observed in this gopher tortoise population has important implications for the design of future translocation studies.

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305 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Tracey Tuberville[1], James Westervelt[2], John Macey[3], Larry Carlile[3]

[1]Savannah River Ecology Lab, Aiken, SC, United States, [2]US Army ERDC, Champaign, IL, United States, [3]Fort Stewart Army Installation, Ft. Stewart, GA, United States

Using Individual Behavior-Based Modeling to Predict Long-term Viability of Gopher Tortoise Populations on Ft. Stewart Military Installation, Georgia

The presence of rare species on military installations requires the Department of Defense to simultaneously manage land to support natural resource stewardship and military training and testing. Gopher tortoises (*Gopherus polyphemus*) occur on at least 19 military installations throughout the southeastern U.S. At Ft. Stewart (GA), new training areas are likely to be developed to meet increased training demands, resulting in relocation of tortoises within the installation. In addition, Ft. Stewart expects to serve as a recipient site for tortoises displaced from elsewhere in the species' range. Therefore, there is a need to identify potential recipient sites that promote the long-term persistence of the species on the installation while maintaining military readiness. Complete life history data for the gopher tortoise are lacking, but the species' natural history and individual behavior are well-characterized. Using this literature, we have developed a spatially explicit individual behavior model (IBM) for gopher tortoises using the program NetLogo and we will illustrate how we apply it using spatially-explicit data from Ft. Stewart to: 1) evaluate habitat suitability across the installation, 2) identify unoccupied or under-occupied habitat, 3) prioritize potential recipient sites for displaced tortoises, and 4) predict which patches are likely to contribute to long-term metapopulation dynamics. Our approach links the behavioral responses of individuals with the likely population- or metapopulation-level consequences and our results will be used by Ft. Stewart resource managers to meet the often conflicting missions of land stewardship and military training.

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961 Fish Ecology III, Pavilion West, Monday 27 July 2009

Jason Turner

University of Hawaii at Hilo, Hilo, HI, United States

Feeding Ecology of *Eleotris sandwicensis* and *Xenoconger fryeri* Found in Hawaiian Anchialine Ponds: A Possible Paradox

Anchialine ponds are characterized by lack of surface connection to the sea, yet have measurable salinities, damped tidal fluctuation, and are limited to porous substrates like recent lava flows. Although distributed globally, ponds are restricted to the subtropics and tropics, are few in number, and are confined within the United States to the

Hawaiian Islands. Hawaiian anchialine ecosystems are dominated by hypogeal shrimps (typically *Halocaridina rubra*), frequently occurring in concentrations exceeding hundreds of individuals per square meter. Typically, fishes identified in anchialine ponds are juvenile marine species that were introduced into ponds intentionally or during storm events. Therefore, identification of pond-dwelling fish are thought to signal the lack of hypogeal shrimp, and possibly pond degradation. Here I describe feeding ecology of two fishes [*Eleotris sandwicensis* (Hawaiian sleeper) and *Xenoconger fryeri* (Fryer's false moray)] rarely found in anchialine ponds. *E. sandwicensis* and *X. fryeri*, along with specimens of pond flora and fauna were collected from six anchialine ponds on Hawaii Island in 2006 and 2007. These fishes were found colonizing pristine anchialine ponds with exceedingly high *H. rubra* abundances, perhaps indicating a paradox. Stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$) and gut contents revealed that fishes were feeding upon *H. rubra*, although larger, more substantial shrimp and prawns were available in large quantities. These data appear to refute the claim that fishes cannot occur in pristine ponds, rather that these species (rarely found in other pond systems), may be sustainable in climax anchialine pond ecosystems whereas introduced marine species degrade them.

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764 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Thomas Turner[1], Dominique Alo[1], William Matthews[2]

[1]University of New Mexico, Albuquerque, NM, United States, [2]University of Oklahoma, Norman, OK, United States

Phylogeography of the Orangebelly Darter

We studied phylogeography of the orangebelly darter, *Etheostoma radiosum*, over its geographic range in the Ouachita highlands of southwestern Arkansas and southeastern Oklahoma, USA. Analyses focused on uncovering evolutionary forces that shaped present-day distributions of three subspecies, with emphasis on evaluating concordance of haplotype divergence in the mitochondrial (mtDNA) control region and morphological variation. A mtDNA genealogy, derived from nucleotide sequence data, indicated monophyletic Blue and Little River clades that differed from remaining clades by nine and six substitutions, respectively. Samples from the Kiamichi and Ouachita Rivers shared a common haplotype, but unique haplotypes were also identified at lower frequency within each basin. Clear Boggy and Washita River samples shared a common haplotype that differed by one substitution from the common Kiamichi-Ouachita haplotype. Blue and Little River populations were isolated from the remainder of *E. radiosum* earliest in evolutionary time, followed by more recent divergence of Clear Boggy and Washita systems from the Kiamichi and Ouachita rivers. Morphological divergence and subspecific designations are mostly concordant with findings of the molecular analysis. Recognition of a distinct Little River form appears warranted.

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694 Fish Ecology III, Pavilion West, Monday 27 July 2009

Jason T. Turnure, Kenneth W. Able, Thomas M. Grothues

Rutgers University, Institute of Marine and Coastal Sciences, New Brunswick, NJ, United States

Effects of Reproductive Phenology on Habitat Use and Movement in Weakfish (*Cynoscion regalis*): Observations from a Small New Jersey Estuary Using Acoustic Telemetry

A critical component of delineating essential fish habitat is the identification of areas of reproduction. Observing fish habitat use and movement patterns in relation to spawning phenology should be considered an important step towards elucidating these crucial habitats. In weakfish (*Cynoscion regalis*), spawning is generally restricted to the late spring and summer months (May-August) in both coastal and estuarine systems. Our objective was to contrast the broad-scale patterns of habitat use and movement in weakfish during and after the spawning season in a small, relatively undisturbed estuary (Great Bay-Mullica River, New Jersey.) Over two reproductive seasons in 2007 and 2008, fifty-nine weakfish (273-864 mm) were sexed (presence or absence of drumming) and internally tagged with acoustic transmitters (Lotek, Inc.) These were monitored with 1) a gated array of continuously recording wireless hydrophones to detect fish movement into and out of the estuary as well as upriver into mesohaline habitats and 2) weekly sampling using mobile tracking methods to determine fine-scale habitat use patterns. Estuarine residency was observed for a majority of tagged fish from spring through summer. We also examined seasonal changes based on shifts in home range; site fidelity; and water quality preferences. Our preliminary data indicates that local site fidelity within the estuary was common during the spawning season, with higher rates of movement and broader ranging behavior occurring during the post-reproductive season. Although not considered an estuarine-dependent species, seasonal utilization of estuaries suggests the important role that these habitats play in the life history of weakfish.

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924 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Thomas Tyning[1], Anne Stengle[2]

[1]Berkshire Community College, Pittsfield, MA, United States, [2]University of Massachusetts, Amherst, MA, United States

Movements of the Eastern Ratsnake (*Pantherophis alleghaniensis*) in an Urban Setting at the Northeastern Edge of its Geographic Range

The eastern ratsnake (*Pantherophis alleghaniensis*) is widespread across the eastern United States and southern Canada. In New England, is reaches the northern edge of is geographic range in Massachusetts where it is listed as an endangered species. This study was initiated as part of a rare species survey required by state regulation in response to a proposed roadway development project. Thirty-one different adults and a single neonate ratsnake were located between May 2007 to April 2009. Beginning in the summer of 2007 through to the present, 13 adult ratsnakes are being followed using radio telemetry at a site in western Massachusetts. Just under 1000 locations provided data on habitat selection, home ranges, population and natural history, which are the primary points of this study. Nine of the 13 snakes followed or crossed the proposed roadway, two crossed existing roads multiple times, and four spent significant time on or near roadside edges. There were no known road mortalities of the snakes that were monitored. Estimating long-term survival of this population will require careful analysis of movement data over several years to determine what habitat elements are especially important to individuals in this endangered species population.

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129 Poster Session I, Exhibit Hall, Friday 24 July 2009

Shem Unger, Rod Williams

Purdue University, Department of Forestry and Natural Resources, West Lafayette, IN, United States

Ecology and Genetics of the Eastern Hellbender

The eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) is a large paedamorphic salamander experiencing population declines throughout its range. Causes for declines across the U.S. include habitat destruction, degradation, and illegal harvesting. In Indiana, hellbenders are critically endangered and restricted to small areas located within the Ohio River drainages. Little is known about the reproductive status, population demography, or genetic composition of eastern hellbenders in Indiana. We will use a combination of field sampling, simulation modeling, and molecular tools to investigate the ecology and genetics of eastern hellbenders in Indiana. Life history data

collected during the field component of this project will be used to develop a stage-structured life history model and assess long-term population viability. Questions regarding habitat quality and food availability will be evaluated by extensively sampling and comparing benthic macro-invertebrate communities from within Indiana and neighboring states. We will develop a suite of hypervariable genetic markers (microsatellites) to indirectly assess population size and gene flow as well as levels of genetic variation and structure at local and regional scales. By utilizing this combination of approaches, we will address questions that were previously intractable and thus further our knowledge of hellbender ecology.

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652 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Peter Unmack[1], Mark Adams[2], Chris Hardy[3], Diana Hartley[3], Gerald Allen[4], Jerald Johnson[1]

[1]Brigham Young University, Provo, UT, United States, [2]South Australian Museum, Adelaide, SA, Australia, [3]CSIRO, Canberra, ACT, Australia, [4]Western Australian Museum, Perth, WA, Australia

Phylogeny and Species Boundaries within the Catfish Family Plotosidae

Plotosid catfishes are unusual within Siluriformes in that they are only one of two families with marine representatives. As currently defined the family has 9 genera and ~40 species. Five of those genera are restricted to freshwaters in Australia and New Guinea, while the remaining four genera are marine. Of the marine genera, all but one is by and large restricted to seas around Australia and New Guinea. The last marine genus, *Plotosus* is extremely widespread, occurring from South Africa to Japan to Australia. We reconstructed phylogenetic relationships within the family based on nearly all freshwater species and all of the genera except *Euristhmus* which was unavailable to us. We sequenced ~5,700 bp from mitochondrial DNA plus two nuclear genes, 18S (~1800 bp) and RAG1 (~1000 bp). Results suggest that the family was originally marine, with an invasion into freshwaters. Most genera were resolved as monophyletic, except for one species in *Porochilus* which came out within *Neosilurus*, one species of *Tandanus* formed an independent lineage and the genus *Plotosus* was not clearly resolved. We had broad geographic coverage of Australian freshwater species to assess species boundaries using allozyme electrophoresis and the cytochrome b gene. The most widespread species, *Neosilurus hyrtlii* appears to consist of as many as four species, while *N. pseudospinosus* maybe separated into two species. We also support the previous recognition of two undescribed species in the genus *Tandanus*. The remaining species all showed levels of variation consistent with their current designations.

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794 Poster Session I, Exhibit Hall, Friday 24 July 2009

Josef Uyeda[1], Mike Pfrender[2], Stevan Arnold[1]

[1]Oregon State University, Corvallis, OR, United States, [2]Utah State University, Logan, UT, United States

Evolving Across the West: Phenotypic Evolution and Secondary Contact in the *Thamnophis elegans* Complex

The complicated phylogeographic structure of the western terrestrial garter snake (*Thamnophis elegans*) suggests that repeated instances of range expansion, contraction and secondary contact have played an important role in the radiation of the western garter snakes. Our cytochrome b phylogeny reveals that *T. elegans* is paraphyletic and polyphyletic with respect to several other species of *Thamnophis*. We also identify several instances of discordance between the phylogeny and current subspecific designations based on phenotype. While species-level changes may eventually be required, it is important to examine secondary contact zones before making such taxonomic changes. One such contact zone occurs between the mountain garter snake (*T. elegans elegans*) and the wandering garter snake (*T. elegans vagrans*). These two subspecies meet and hybridize at several locations along a longitudinal suture zone that spans several hundred miles from central California north into Oregon. In southern Oregon, populations gradually transition in phenotype across a broad introgression zone. These populations possess unique phenotypic characters and have previously been recognized as a distinct subspecies, *T. elegans biscutatus*. In contrast, the central California contact zone is quite narrow and represents a typical tension zone between two phenotypically distinct subspecies. These two contact zones illustrate that different phenotypic and evolutionary outcomes are possible depending on the nature of the contact zone. We present a combined analysis of quantitative traits and genetic markers to examine the effect of different environmental contexts on the evolutionary outcomes of secondary contact between the two lineages.

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787 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009; ASIH STOYE AWARD ECOLOGY & ETHOLOGY

Elyse Vaccaro

Oregon State University, Corvallis, OR, United States

Pheromone Signaling System Modulates Female Receptivity in a Plethodontid Salamander

Female sexual receptivity is a behavior at the crux of mechanistic and evolutionary perspectives of reproductive behavior. Recent work addressing receptivity has

established that plethodontid salamander courtships show a reduced time to insemination when the female has received male pheromone. Pheromones are delivered during courtship when the male repeatedly taps his pheromone-producing chin gland on the female's nares. Pheromones enter the nasal cavity and are shunted to the vomeronasal organ (VNO). This VNO-initiated pathway transmits pheromonal information to sites in the brain known in other vertebrates to be involved in endocrine regulation and modulation of sexual behavior. I investigated three candidate mechanisms by which male pheromones may augment receptivity in *Plethodon shermani* females: 1) by influencing a non-specific state of placidity (or stimulation), 2) by enhancing a central state of sexual motivation, or 3) by affecting specific sensorimotor integration mechanisms in individual sensory modalities. Females treated with pheromone were assayed for enhanced response to visual and olfactory cues (both male- and food-related), as well as differences in heart rate, general locomotor activity, startle response, and foraging activity. Pheromones enhanced female response to sexual (male) olfactory cues and inhibited feeding activity. Female response to pheromone is likely mediated by multiple sensory systems: a diversity of signals is present in pheromone secretions and even the major components of *P. shermani* pheromone encompass multiple isoforms. Investigating the proximate aspects of a signal-response system may provide insights into how the perception of a chemical signal can induce changes in behavior.

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789 Poster Session I, Exhibit Hall, Friday 24 July 2009; ASIH STORER HERPETOLOGY AWARD

Elyse Vaccaro

Oregon State University, Corvallis, OR, United States

Male Courtship Pheromones Modify Specific Female Behaviors in a Plethodontid Salamander

Female sexual receptivity is a behavior at the crux of mechanistic and evolutionary perspectives of reproductive behavior. Recent work addressing receptivity has established that plethodontid salamander courtships show a reduced time to insemination when the female has received male pheromone. Pheromones are delivered during courtship when the male repeatedly taps his pheromone-producing chin gland on the female's nares. Pheromones enter the nasal cavity and are shunted to the vomeronasal organ (VNO). This VNO-initiated pathway transmits pheromonal information to sites in the brain known in other vertebrates to be involved in endocrine regulation and modulation of sexual behavior. I investigated three candidate mechanisms by which male pheromones may augment receptivity in *Plethodon shermani* females: 1) by influencing a non-specific state of placidity (or stimulation), 2) by enhancing a central state of sexual motivation, or 3) by affecting specific sensorimotor integration mechanisms in individual sensory modalities. Females treated with pheromone were assayed for enhanced response to visual and olfactory cues (both male-

and food-related), as well as differences in heart rate, general locomotor activity, startle response, and foraging activity. Pheromones enhanced female response to sexual (male) olfactory cues and inhibited feeding activity. Female response to pheromone is likely mediated by multiple sensory systems: a diversity of signals is present in pheromone secretions and even the major components of *P. shermani* pheromone encompass multiple isoforms. Investigating the proximate aspects of a signal-response system may provide insights into how the perception of a chemical signal can induce changes in behavior.

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681 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Jessena Valdez, Yadira Hinojosa, Teresa Muniz, Frederic Zaidan III

University of Texas-Pan American, Edinburg, TX, United States

Does Thermal Variation Translate into Variation in Growth? A Test Using *Nerodia rhombifer* as a Model

The effects of temperature on many physiological processes have been well studied, but the effects of thermal variability have received less attention. To address this issue for an energetically demanding process (growth) we used a common and locally abundant snake species, the diamondback water snake. We assigned 99 neonates from five litters to one of three thermal treatments that averaged 26C under a 12L:12D photoperiod regime: T0 (26C across the photocycle), T2 (24C during scotophase and 28C during photophase), and T4 (22C during scotophase and 30C during photophase). After an initial weighing and measuring, snakes ate an average relative prey mass of 13% weekly for 16 weeks. After the final weighing and measuring, we randomly reassigned the snakes to three new thermal treatments and repeated the experiments for 16 weeks at an average relative prey mass of 29% weekly. Repeated measures analyses of covariance (with initial mass and SVL as the covariates) and Tukey post-hoc tests revealed that the high resource treatment yielded significantly higher growth rates (both mass and length; all $P < 0.0001$) than the low resource treatment and that the temperature treatment with no variation yielded significantly higher growth rates (again, both mass and length; all $P < 0.0294$) than the two variable ones (which were not different from each other). Decreases in physiological performance at lower temperatures are apparently not compensated for by increases at higher temperatures and may have important implications for ectotherms in the field.

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277 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Nicholas VandenBroek

Southeastern Louisiana University, Hammond, LA, United States

Microhabitat use of Herpetofauna in Bottomland Hardwood Forests of Atchafalaya National Wildlife Refuge

The Atchafalaya River Basin, a distributary of the Mississippi River, contains the largest contiguous area of bottomland hardwood forest in North America encompassing an area of roughly 5,670 square kilometers (Hupp et al. 2008, Kelso et al. 1997). This alluvial floodplain basin is characterized by seasonal flooding occurring during early spring and late winter resulting in an ever-changing interface between mesic and xeric areas. The duration and amount of water inundating this system causes seasonal microhabitat variation. These changes result in shifts of alpha diversity within a community as a result of species response to changing habitat. This project aims to: 1) characterize the herpetofaunal community of bottomland hardwood forests through use of drift fence arrays and 2) to understand relationships between herpetofauna and microhabitat use in bottomland hardwood forests.

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25 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Geraldine Vander Haegen, Lee Blankenship

Northwest Marine Technology, Inc, Tumwater, WA, United States

Using Visible Implant Elastomer to Tag Rare Species

Visible Implant Elastomer (VIE) tags are injected beneath transparent or translucent tissue and remain externally visible. Visible Implant Elastomer is a biocompatible, medical-grade material that has been widely applied to many species of fish, cephalopods, crustaceans, reptiles, and amphibians and are often suitable for animals that are too small for other tagging methods. Visible Implant Elastomer is most often used for batch tagging, but individual coding can be achieved by combining tag colors and locations. Because it has little effect on the host and can be used in small specimens, VIE is gaining widespread acceptance as a method for identifying endangered and rare species. We survey some of the ways VIE tags are used with rare species to gather basic biological information about their life cycle (e.g. seahorses in Australia), habitat use (e.g. bullhead in Belgium, desert pupfish in the USA), growth rates (e.g Coloradao squawfish in the USA) and population sizes (e.g. tui chub in the USA). In restocking programs, VIE has been used to distinguish stocked animals from their naturally occurring counterparts (e.g. blue crab, boulder darters, pallid sturgeon, and Rio Grande silvery minnow in the USA; leopard frogs in Canada) and to evaluate the success of

supplementation hatchery programs (spring Chinook in the USA). Observations of tagged animals have given new insights into their behavior (e.g. seahorses in Australia).

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735 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Robin Van Meter[1], Joel Snodgrass[2], Christopher Swan[1]

[1]Univeristy of Maryland, Baltimore County, Baltimore, MD, United States, [2]Towson University, Towson, MD, United States

Road Deicers and Gray Treefrogs: Unexpected Interactions in Pond Food Webs

Freshwater salinization is an ongoing concern in northern latitudes where road deicers are applied in excess during the winter and spring months. Emerging data is showing that road salt has a high residence time, especially in urban areas, such that it is mobilized in pond habitats even during summer months. This study was designed to evaluate the direct and indirect effects of road salt on tri-trophic interactions in pond food webs. In May 2008, forty 600-L polyethylene mesocosms were filled with tap water and inoculated with algae and zooplankton. Using a 2x2x2 factorial design, 20 mesocosms received salt (645 mg/L Cl-), 100 gray treefrog tadpoles (Gosner 25), and/or 2 Dytiscid beetle predators. Periphyton, phytoplankton and zooplankton were measured weekly for 10 weeks. Upon metamorphosis, gray treefrogs were weighed, and all remaining tadpoles were staged and weighed. Tadpoles reared in the salt treatments metamorphosed both significantly faster and larger than those reared in non-salt treatments. Salt had negative direct and indirect effects on zooplankton, positive direct effects on both periphyton and phytoplankton resources, and negative indirect effects on phytoplankton in the presence of tadpoles. Differing from the expectations outlined by the widely accepted Wilbur-Collins model, gray treefrog development departed from the standard tradeoff between size at and time to metamorphosis. Road salt may induce physiological changes in tadpoles or a shift in algal resources. While common pollutants such as road deicers are known to have direct effects on taxa, the indirect effects can be pronounced, even at relatively low levels.

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114 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Mikal van Oene[1], Eric Suarez[1], Akiyele Akiwumi[1], Gerald Johnston[1], Joseph Mitchell[2]

[1]Santa Fe College, Gainesville, FL, United States, [2]Mitchell Ecol Research Service, Gainesville, FL, United States

Invasive Cuban Treefrogs on a North Florida Urban Campus: Preliminary Results on Population Fluctuations and Effects on Native Hylids

Discovery of the predatory *Osteopilus septentrionalis* in Oct 2008 on an urban college campus in Gainesville, FL, allowed us to evaluate the effects of this invasive on native hylids. We installed pairs of 1 m high PVC pipes (2.54 in and 5 dia cm) every 10 m around each of the 10 wetlands (210 stations) to test the hypothesis that native hylids are not affected by *O. septentrionalis*. Our hypothesis was tested preliminarily in an unplanned natural experiment in Jan 2009. We obtained frog body and ambient temperatures on two mornings following -7.8 to -7.3°C local temperatures. Of the 8 *O. septentrionalis* found, 6 were dead (-3.0 to 0.8°C) ; t_b of the two living frogs were 1.2 and 4.0°C. One large female with a tb of -2.6 was found dead 2 days later. Recapture rates of frogs marked in Nov-Dec 2008 and registered in Feb-March 2009 were 17% for *O. septentrionalis*, 13% for *H. cinerea*, and 36% for *H. squirella*. Numerically, *O. septentrionalis* declined from 53 in Nov-Dec to 35 in Feb-March. In contrast, native hylids increased after Jan: 31 to 51 for *H. cinerea*, and 42-128 for *H. squirella*. Conclusions: *O. septentrionalis* populations in northern Florida likely fluctuate cyclically, cold winter temperatures will influence the northern limit of this hylid and influence the cycles, and reduction in *O. septentrionalis* numbers appears to cause a positive numerical response in the two native hylids.

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310 General Herpetology, Galleria South, Sunday 26 July 2009

Fernando Vargas-Salinas, Adriana Dorado-Correa, Adolfo Amézquita

Graduate Program in Biological Sciences, University of Los Andes, Bogota DC, Colombia

Abiotic Noise Explains Intraspecific Divergence in Advertisement Calls of *Ranitomeya bombetes* (Anura: Dendrobatidae)

Noise from streams and waterfalls has been proposed as a selective force that evolutionarily shaped signal traits in species with acoustic communication, but empirical evidence directly supporting this hypothesis is still scarce. Males of the frog *Ranitomeya bombetes* (Dendrobatidae) were found calling away from streams in cloud-forested habitats of the Colombian Andes but strongly associated to streams in a

historically xeric habitat. To test whether these frogs evolved auditory signals that better contrast against the background noise produced by streams; we studied geographic variation in call traits, acoustic environment, microclimatic conditions, and habitat use. Frogs associated to streams call at higher frequencies than other frogs. Variation in call frequency was not explained by either distance between populations or by pleiotropic effects, since body size is not related with call frequency. Ambient temperature increased and humidity decreased with the distance from the stream (up to 20 m) in the xeric-habitat population but not in the populations inhabiting cloud forests. The spatial distribution of individuals suggests that *R. bombetes* colonize xeric habitats through gallery forest alongside streams, thereby confronting masking interference by abiotic noise. Our data support the hypothesis that individuals of *R. bombetes* from xeric habitats reduce masking interference of auditory signals by calling at higher frequencies and indicate that streams noise may promote intraspecific divergence in the advertisement call of *R. bombetes*.

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17 Catfish Symposium, Grand Ballroom I, Friday 24 July 2009

Richard Vari, Carl Ferraris, Jr.

Smithsonian Institution, Washington DC, United States

The Neotropical Whale Catfishes; Unknown Diversity and Consequences of Phylogenetic Studies

Catfishes of the family Cetopsidae (the Whale Catfishes) were analyzed in parallel phylogenetic and revisionary studies. The revisionary analysis revealed a pronounced degree of undetected species level diversity in the genus. Causes for the situation are summarized and the recent changes in practices that complicate such studies are discussed. The implications for the continued recognition of highly distinctive species in more generalized groups are detailed.

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420 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Tiago Vasconcelos[1], Tiago Santos[1], Denise Rossa-Feres[2], Célio Haddad[1]

[1]Sao Paulo State University, Rio Claro, SP, Brazil, [2]Sao Paulo State University, Sao Jose do Rio Preto, SP, Brazil

Spatio-Temporal Distribution of Tadpoles (Amphibia, Anura) in a Seasonal Dry Tropical Forest from Southeastern Brazil

In the present study we determined spatial and temporal distribution of tadpoles in six breeding habitats from Morro do Diabo State Park (MDSP), southeastern Brazil. Then, we tested whether the occurrence of tadpoles in each breeding habitat is different from a null model of random placement of species in those habitats. We tested whether tadpole occupancy in breeding habitats is organized according to different ecomorphological guilds of tadpoles, and we analyzed spatial partitioning of tadpoles among breeding ponds by using similarity analysis. For temporal distribution we analyzed temporal partitioning of tadpole occurrence along one year also by using similarity analysis, and we assessed what climatic variable better predicts tadpole temporal occurrence at the MDSP region, using regression analysis. Among tadpoles from 19 anuran species, distribution was different from a null model, but co-occurrence patterns did not differ among different guilds of tadpoles in the breeding habitats analyzed. On the other hand, breeding habitats with similar hydroperiods had similar species composition, which may be related to the pattern of reproduction of species. Among three climatic variables analyzed (rainfall, temperature, and photoperiod), temporal occurrence of monthly tadpole richness was only correlated with rainfall. Most species occurred only during the months of rainy season, where overlap occurred within three groups of species. Thus, temporal distribution seems not to be an important mechanism in species segregation at the MDSP, where the dry season is pronounced. In this case, spatial partitioning tends to be more important for species coexistence.

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143 AES GRUBER AWARD I, Parlor ABC, Thursday 23 July 2009

Jeremy J. Vaudo, Michael R. Heithaus

Florida International University, Miami, FL, United States

Foraging Ecology of a Nearshore Australian Batoid Community Inferred from Stable Isotopic Analysis

Shark Bay, Australia, supports a diverse batoid fauna that show a high degree of spatial overlap. To explore whether these species are engaged in interspecific competition and how they might partition resources, we examined the foraging ecology of six batoids using stable isotope analysis. Delta 13C values indicate all species feed predominantly

from a seagrass-based food web. Despite considerable overlap in delta 15N values obtained from all species, interspecific differences were detected. *Himantura fai* and *Glaucostegus typus* are slightly elevated in 15N compared to the other the species, suggesting that they feed at a higher trophic level, while *Aetobatus narinari* has lower delta 15N values compared to all other species. Examination of stomach contents suggests that similar delta 15N and 13C values are the result of similar diets. Over the size ranges examined, *H. fai*, *Pastinachus sephen*, and *G. typus* displayed relationships between size and both delta 15N and 13C values, suggesting ontogenetic shifts in diet. *Glaucostegus typus* tended to become less enriched in 13C and more enriched in 15N as length increased. *Himantura fai* and *P. sephen* displayed the opposite pattern with larger individuals more enriched in 13C and less enriched in 15N. With the exception of *A. narinari*, there is little evidence that Shark Bay's batoid species are partitioning food resources. Lack of resource partitioning could be the result of the high productivity of Shark Bay's seagrass beds (i.e., resources are not limiting) and population regulation occurring at life history stages not feeding on the flats we studied.

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857 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jason Vaughan[1], Selina Heppell[1], Sheryan Epperly[2]

[1]Oregon State University, Corvallis, OR, United States, [2]NOAA, NMFS-SEFSC, Miami, FL, United States

Analysis Of Loggerhead Sea Turtle Juvenile And Subadult Length Distributions Over Time: Combining Data Sets To Identify Patterns Of Population Change

Analyzing trends of nests and adult females is insufficient to determine the overall status of a sea turtle population, due to the 25-30 year time lag between hatching and maturation. For example, while nest counts of the threatened loggerhead sea turtle (*Caretta caretta*) on Peninsular Florida - the NW Atlantic's largest subpopulation - declined to one-half of their peak in 1998, catch rates of juvenile turtles in North Carolina increased an average of 13% year^{-1} and in Florida increased an average of 11% year^{-1}. To better understand this population and its demographic shifts, we examined length frequency data and catch rates of neritic turtles collected from 1980–2007 at 4 sites ranging in the southeast US (n=10,496). All datasets showed a similar pattern in length distributions over time, which provides compelling evidence that the data are revealing true population change. While juvenile catch rates were increasing, there was an increase in median size of juveniles and a decrease in the proportion of small juveniles. The shift in median size coupled with the increased catch rates indicates that there is a large cohort of turtles that should reach maturity in the next decade. Changes in size distributions through time could indicate changes in recruitment or size at recruitment, survival rates, or behavior. The shifts we observed, coupled with a stochastic growth curve developed using skeletochronology growth data collected in North Carolina

(n=92), will help us assess overall population status more completely and potentially make cautious predictions about future population trends.

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49 Amphibian Pathogen Ecology, Broadway 1&2, Thursday 23 July 2009

Matthew Venesky[1], Matthew Parris[1], Ronald Altig[2]

[1]The University of Memphis, Memphis, TN, United States, [2]Mississippi State University, Mississippi State, MS, United States

Pathogenicity of *Batrachochytrium dendrobatidis* in Larval Ambystomatid Salamanders

Chytridiomycosis is a disease of amphibians caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*) and has contributed to the decline of amphibians. Considerable progress has been made in understanding the host-pathogen ecology of *Bd* in larval anurans, yet little is known about how *Bd* affects larval salamanders. Because the structure of keratinized jaw sheaths in *Ambystoma* larvae have not been thoroughly documented, we first described the structure in four species of larval *Ambystoma*. We then conducted a laboratory experiment to test if *Bd* affects growth and developmental rates of larval *A. opacum*. We observed keratinized jaw sheaths in all four species of *Ambystoma*, but the sheath was not present in all individuals. In our exposure experiment, none of the *A. opacum* whose mouthparts were screened for *Bd* tested positive nor was there an effect of *Bd* on larval life history responses. We are uncertain why larval *A. opacum* are not susceptible to *Bd*, given that we observed keratinized jaw sheaths in this species. One possible explanation is that larval *Ambystoma* jaw sheaths may differ in structure or keratin type so that *Bd* may not be able to successfully infect them. Alternatively, *Bd* infections could have been restricted to the feet (not tested for *Bd* in this study), where keratinized tissues are present in *Ambystoma* larvae. Additionally, it is possible that larval *A. opacum* are resistant to *Bd* infections.

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474 Poster Session I, Exhibit Hall, Friday 24 July 2009

Dráusio Véras[1], Ilka Branco[2], Fábio Hazin[2], Catarina Wor[2], Mariana Tolotti[1]

[1]Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil, [2]Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil

Reproductive Biology of the Pelagic Stingray, *Pteroplatytrygon violacea*, in the Southwestern Atlantic Ocean

The pelagic stingray, *Pteroplatytrygon violacea*, the only member of the Dasyatidae family with an entirely pelagic behavior, has a worldwide distribution with highest abundances in tropical and subtropical regions. The species has been reported as an

important bycatch of the tuna longline fisheries throughout the world. In the present work a total of 367 specimens, 137 females (37.3%) and 230 males (62.7%), were examined, with a view to study their reproductive biology. The specimens were collected between October 2005 and January 2008, by observers onboard of Brazilian commercial longliners. The disc width (DW) ranged from 34.0 to 59.6 cm, for females, and from 34.0 to 59.6 cm, for males. Females were classified as immature (n= 30; 22.4%); maturing (n= 41; 30.6%); pre-ovulatory (n= 25; 18.7%); pregnant in early gestation (n= 14; 10.4%); pregnant in mid gestation (n= 8; 6.0%); pregnant full term (n= 2; 1.5%); postpartum (n= 4; 3.0%); and resting (n= 10; 7.5%). For the 24 (17.9%) pregnant females the DW ranged between 46.0 and 60.8 cm. The monthly distribution of the reproductive stages does not indicate a clear seasonality for the reproductive cycle of the species. Ovarian vitellogenesis seems to happen simultaneously with gestation, indicating that females are ready to ovulate close after parturition. Size at first sexual maturity was estimated at around 45 cm DW for females, and at or below 34 cm for males, since all sampled specimens were equal or larger than this size and were all already mature.

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431 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

Ana Verissimo, Jan McDowell, John Graves

Virginia Institute of Marine Science, Gloucester Point, VA, United States

Worldwide Population Structure of the Spiny Dogfish *Squalus acanthias*

The spiny dogfish *Squalus acanthias* is a small, coastal squaloid shark that occurs in cold temperate waters of the Atlantic and Pacific oceans. It is also a heavily exploited resource in several regions along its range. The antitropical distribution of this species and its habitat preferences suggests that warm, tropical waters may act to isolate populations on the northern and southern hemispheres. However, long distance migrations along potentially suitable cold-temperate coastal areas, such as those reported between the east and west coasts of the North Atlantic and North Pacific, may connect populations at considerable geographic distances. To elucidate the worldwide population structure of the spiny dogfish, individuals collected from throughout the species' range (except South Africa) were genotyped at eight nuclear microsatellite loci and sequenced at the mitochondrial ND2 locus. Both types of molecular markers revealed strong divergence between North Pacific collections and those taken from the rest of the species' range. In addition, microsatellite loci detected small but significant differences between North Atlantic collections and those from all southern hemisphere locations. These data suggest that spiny dogfish comprise at least three genetic stocks: North Pacific, North Atlantic, and southern hemisphere. The magnitude of the genetic differences among regions suggests that North Pacific spiny dogfish have been isolated for a relatively long period of time, while gene flow between the North Atlantic and southern hemisphere fish seems to have been limited only recently.

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136 ELHS/LFC Connectivity Symposium I, Grand Ballroom I, Thursday 23 July 2009

Russ Vetter

NOAA Fisheries Southwest Fisheries Center, La Jolla, CA, United States

Darwin's Hammer: Larval Mortality and Population Persistence in an In-Temperate World

Temperate and tropical systems differ fundamentally in patterns of solar irradiance. Solar irradiance in turn drives patterns of heat flux, winds and currents, nutrient flux, and primary productivity. As a result, temperate fish communities are more subject to cycles at daily, seasonal, decadal and millennial scales and are arguably adapted to different types of uncertainty than their more tropical counterparts. This may be reflected in their reproductive strategies and genetic legacies. For fish species with proscribed adult home ranges patterns of population genetic structure reflect persistent patterns of early life-stage dispersal strategies and physical barriers to connectivity. Early life-stage dispersal can be broken down into diffusive, advective and behavioral forces. Different fish species emphasize different aspects of these three components to achieve persistence over evolutionary time. While it is generally recognized that obligate self-recruitment may be maladaptive in changing environments, it is not as well recognized that full connectivity throughout the species' range inhibits local genetic adaptation. Marine metapopulation theory suggests that self-recruitment with a significant level of external replenishment may be an intermediate strategy for accumulating some level of local fitness but with access to genetic novelty from other portions of the species' range. Locally adapted metapopulations may be more critical in temperate species that extend across wide latitudinal gradients than in tropical systems. The conservation of metapopulation structure may be key to designing MPA networks that protect the genetic legacy and future adaptability of temperate reef fishes in a changing world.

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641 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Jessica Veysey, Kimberly Babbitt, Jennifer Purrenhage

University of New Hampshire, Durham, NH, United States

Buffer Width Mediates the Effects of Clearcutting on Pool-breeding Amphibian Demography

Forested upland buffers are the most common technique used to manage local populations of vernal-pool-breeding amphibians in eastern North America. Cumulative evidence suggests these buffers protect habitat that is critical to numerous amphibian

life-history processes, yet the demographic consequences of buffer size have not been experimentally tested. We used clear cutting to experimentally manipulate upland buffer widths at 11 vernal pools in central Maine. Each pool was randomly assigned to one of three possible treatments: >1000-m buffer (i.e., a reference or uncut treatment), 100-m buffer, or 30-m buffer. Over the next four years, we catalogued all amphibians using the pools, and measured and marked each exiting spotted salamander (*Ambystoma maculatum*) and wood frog (*Lithobates sylvaticus*). For these two species, we used linear mixed-effects regression to assess the impact of buffer width on demographics. For both species, smaller buffer sizes were associated with reduced inter-sexual size differences, fewer adults breeding at pools with short hydroperiods, and strong interactions between recaptured adult size and pool hydroperiod. Additional species-specific results were also observed. Our findings indicate effects of forest clear cutting on spotted salamander and wood frog demography, even when 30-m and 100-m buffers are preserved. Additional research is needed to ascertain the long-term effects of these demographic changes, which may have implications for local population persistence.

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582 General Ichthyology, Parlor ABC, Sunday 26 July 2009

Dave Vieglais, Ed Wiley, Andrew Bentley

Biodiversity Research Center, University of Kansas, Lawrence, KS, United States

FishNet 2 - A Network of Ichthyology Collections Offering Realtime Analysis and Visualization

Distributed networks of specimen and observation records have proven valuable in improving access to primary biodiversity data and have led to taxa or domain specific networks such as the original FishNet, MaNIS, ORNIS, HerpNet and similar successful networks. The fully distributed nature of these systems has led to performance issues however, where effective analysis and visualization of those data is limited by the requirement to continually retrieve content over the Internet from many sources, with varying levels of performance and capacity. The new version of FishNet helps alleviate that problem by generating a replica of the specimen data in a way that is synchronized with the data sources, and so enables much richer interaction with the data, with typical query response times of less than one second for the entire holdings. FishNet2 additionally supports multiple data provider protocols (including DiGIR, TAPIR, and CSV) as well as "serverless" data sources which push content to the network, enabling a much lower cost of participation in the network. Specimen data is also augmented with additional information such as environmental variables which enables queries such as "specimens within a temperature range" to be efficiently executed. Queries may be saved for later use, and data is available for download in a variety of common formats. Status and usage reports are available for data contributors. An overview of the system capabilities and mechanisms for participation will be presented.

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891 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Thomas Vigliotta

Macaulay Library, Cornell Lab of Ornithology, Ithaca, NY, United States

The Macaulay Library: A Resource for the Preservation of Natural History Audio and Video Collections

For naturalists and natural history collections alike the challenge of organizing and curating non-traditional preparations or data types, such as sounds and videos, is ever increasing. As more affordable and higher-quality digital recording equipment becomes available at the consumer level, the challenge will only intensify. Proper curation of recorded sounds, and more recently video, has been the focus at the Macaulay Library for several decades. The Macaulay Library at the Cornell Lab of Ornithology is the world's largest natural sound and video archive of animal behavior. Its mission is to collect and preserve recordings of each species' behavior and natural history and to make them available for research, education, conservation, zoos and aquaria, wildlife managers, publishers, the arts, and both public and commercial media. Since 1930, recordists of all backgrounds have contributed their recordings, which now number to several hundred thousand in total. A large percentage of the recordings can be searched and played online and are accompanied by available metadata. Traditionally, birds have been the taxonomic focus of the archive, but recently efforts have been made to widen the taxonomic breadth. We encourage recordists with diverse taxonomic interests and backgrounds to strongly consider contributing to the archive.

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352 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Francisco Villa-Navarro[1], Francisco Villa-Navarro[2], Arturo Acero P.[3]

[1]Grupo de Investigacion en Zoologia, Universidad del Tolima, Ibague, Tolima, Colombia, [2]Programa de Doctorado, Departamento de Biologia, Universidad Nacional de Colombia, Bogota, DC, Colombia, [3]CECIMAR, Universidad Nacional de Colombia sede Caribe, Santa Marta, Magdalena, Colombia

Advances in the Systematic Relationships of the Genus *Pimelodus* and its Related Taxa

Lundberg et al. (1991) presented a hypothesis of the relationships of the catfish genus *Pimelodus* to eleven genus level taxa, proposing the name *Pimelodus* group for such clade. Within the *Pimelodus* group, *Pimelodus* was included in an unresolved polytomy with the genera *Duopalatinus*, *Exallodontus*, *Cheirocerus*, *Iheringichthys*, *Parapimelodus* and *Hypophthalmus*. Later, Lundberg and Parisi (2002) described the new genus *Propimelodus* as another member of that polytomy. Herein we propose an alternative preliminary

hypothesis based on skeletal features with a *Pimelodus* group (*Iheringichthys* (*Parapimelodus* (*Propimelodus* + *Pimelodus*))), sister to (*Calophysus* + *Megalonema*). Such group is proposed as sister to another clade formed by (*Exallodontus* (*Cheirocerus* + *Duopalatinus*)).

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355 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Peter Vize, Erik Segerdell, Jeff Bowes

University of Calgary, Calgary, Alberta, Canada

An Ontology for *Xenopus* Anatomy and Development

The frogs *Xenopus laevis* and *Xenopus* (*Silurana*) *tropicalis* are model systems that have produced a wealth of genetic, genomic, and developmental information. Xenbase is a model organism database that provides centralized access to this information, including gene function data from high-throughput screens and the scientific literature. A controlled, structured vocabulary for *Xenopus* anatomy and development is essential for organizing these data. We have constructed a *Xenopus* anatomical ontology that represents the lineage of tissues and the timing of their development. We have classified many anatomical features in a common framework that has been adopted by several model organism database communities. The ontology is available for download at the Open Biomedical Ontologies Foundry http://obofoundry.org. The *Xenopus* Anatomical Ontology will be used to annotate *Xenopus* gene expression patterns and mutant and morphant phenotypes. Its robust developmental map will enable powerful database searches and data analyses.

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752 Turtle & Tortoise Symposium, Grand Ballroom II, Sunday 26 July 2009

Richard C. Vogt

Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil

Nesting Strategies of Amazonian Freshwater Turtles

The species of freshwater turtles in the Brazilian Amazon represent a diverse conglomeration of three cryptodires, in the families Emydidae, Geoemydidae and Kinosternidae, and eleven pleurodires, five species in the family Podocnemididae, and six Chelidae. Egg, size shape, and texture as well as number of eggs per clutch and number of clutches per nesting season vary widely, as do nesting habits, habitats, and seasons. At least one of these species of turtles can be nesting at any time of the year in some part of the Amazon. The idea of Tropical nesting patterns vs Temperate Zone

nesting patterns is not reinforced by data from the heart of the Amazon. Temperature dependent sex determination occurs along family lines, with only the Chelidae displaying genetic sex determination. Twenty years of field work spanning all months of the year collecting turtles in rain filled jungle pools, jungle ponds, jungle streams, flooded forests, lakes, black water rivers, clear water rivers, and white water rivers has allowed us to comprehend the reproductive cycles of this diverse group of turtles. Through long term mark and recapture studies, radio telemetry, and dissections the different reproductive patterns have been determined. I. Multiple clutches of large eggs or 1 extremely large clutch, laid when river levels are lowest. II. Single egg clutches of large eggs during the rainy season. III. Multiple clutches of medium sized eggs laid at the end of the rainy season; IV. Multiple clutches of medium sized eggs laid at the beginning of the vazante.

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807 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

Rudolf von May, Maureen Donnelly

Florida International University, Miami, FL, United States

Do Trails Affect Relative Abundance Estimates of Rainforest Frogs and Lizards?

The selection of a sampling protocol is critical to study amphibian and reptile communities and in many instances researchers have combined the use of visual encounter surveys conducted on trails and off trails. The effect of human-made trails on relative abundance estimates of amphibians and reptiles has been assessed in a few temperate locations, but data are lacking for tropical sites. We designed this study to compare abundance estimates of frogs and lizards on and off trails in a lowland rainforest in southeastern Peru. We used nocturnal visual encounter surveys (VES) to sample frogs and lizards along transects established on trails and off trails in two different forest types. We found that the observed relative abundance estimates of frogs and lizards were affected by the location of transects (on trail vs. off trail) and the type of forest (floodplain forest vs. terra firme forest). We also found an interaction between the two main effects, indicating that the effect of transect location with respect to trails varies as a function of habitat. Observed frog abundances were higher on trails than off trails, indicating that studies that include VES on trails will bias relative abundance estimates in contrast to studies that include only VES off trails. We suggest that transects should be established only off trails, especially for monitoring studies because trail use by humans can have a strong influence on observed animal abundance.

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811 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

Rudolf von May[1], Jennifer Jacobs[2], Roy Santa Cruz[3], Jorge Valdivia[3], Jusmell Huaman[4], Maureen Donnelly[1]

[1]Florida International University, Miami, FL, United States, [2]San Francisco State University, San Francisco, CA, United States, [3]Universidad Nacional de San Agustín de Arequipa, Arequipa, Peru, [4]Universidad Nacional Amazonica de Madre de Dios, Puerto Maldonado, Madre de Dios, Peru

Amphibian Community Structure as a Function of Forest Types in Amazonian Peru

Our study focuses on the importance of habitat heterogeneity in lowland rainforests of southwestern Amazonia. Our goal was to test the hypothesis that amphibian communities in different forest types differ in species richness, composition, and abundance. We used standardized visual encounter surveys to quantify the species composition and abundance of amphibians at four sites in southeastern Peru (distance among sites varied 3.5-105 km), each containing four forest types (floodplain, terra firme, bamboo, and palm swamp). No species appears to have experienced population declines in the lowlands of southeastern Peru, suggesting that the region still contains the original species pool. We describe the variation in amphibian community structure across forest types and evaluate the relationship between species composition and geographic distance among sites. We compare our data with data from other herpetofaunal studies conducted in southwestern Amazonia. Overall, we found that patterns observed at the local scale (one site) are similar at the regional scale (four sites). In our study region, an important proportion of the gamma diversity is represented by habitat-related beta diversity. Our study provides the first standardized, quantitative comparison of amphibian community structure across four major forest types in southwestern Amazonia.

1043 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Rudolf von May[1], Kelsey Reider[1], Kyle Summers[2]

[1]Florida International University, Miami, FL, United States, [2]East Carolina University, Greenville, NC, United States

Effect of Body Size on Intraguild Predation Between Tadpoles of Bamboo–breeding Poison Frogs and Predaceous Mosquito Larvae

Our study focused on intraguild predation (IGP) between poison frog (*Ranitomeya biolat*) tadpoles and predaceous mosquito (*Toxorhynchites* sp.) larvae that use water-filled bamboo internodes as primary microhabitat. We conducted an experiment using

artificial pools in southeastern Peru to test the importance of body size of interacting individuals for individual survival. We found that body size strongly affected the outcome of the trophic interaction. We documented a case of symmetric IGP in which members of two phytotelm-breeding species acted as predator or prey depending on their individual and relative body sizes. We found that tadpole relocation by the parent frog may change the relative size of interacting individuals and that priority effects alone cannot be used to predict all outcomes of this interaction.

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40 Herp Conservation II, Grand Ballroom II, Monday 27 July 2009

Hardin Waddle[1], Susan Walls[2], Robert Dorazio[2]

[1]National Wetlnads Research Center, U.S. Geological Survey, Lafayette, LA, United States, [2]Florida Integrated Science Center, U.S. Geological Survey, Gainesville, FL, United States

Occupancy Dynamics in a Louisiana Assemblage of Anurans

As part of the U. S. Geological Survey's Amphibian Research and Monitoring Initiative (ARMI), we conducted vocalization surveys for anuran amphibians at 40 sites in the Atchafalaya Basin of Louisiana, USA from 2002 to 2006. We used a hierarchical Bayesian formulation of a dynamic occupancy model to estimate temporal changes in probabilities of occupancy, detection, colonization, extinction, and species turnover in an assemblage of anurans. We detected a total of 12 species, all but two of which demonstrated decreasing patterns of occurrence probabilities over the course of our 5-yr study. The patterns of change in occupancy varied from those species that exhibited gradual, but steady decreases to those that showed abrupt decreases in occupancy between successive years. Changes in probability of occurrence corresponded mostly with variation in estimates of local extinction probabilities although, for two species, changes in occupancy appeared to be a consequence of both local extinction and colonization events. By identifying the processes (extinction and colonization) that are leading to changes in occurrence, our approach helps reveal the relative importance of each of these vital rates to the dynamics of species within communities. Such analyses can help identify the mechanisms of decline and prioritize which species-specific life history characteristics (e.g., adult survival and reproduction versus juvenile dispersal and colonization) should be targeted in a broad, landscape-level monitoring effort.

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740 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Brett Catherine Wagner, Willian Silva, Nancy Staub

Gonzaga University, Spokane, WA, United States

The Atypical Plethodontid Salamander *Karsenia koreana* has Typical Plethodontid Skin

The first Asian Plethodontid salamander, *Karsenia koreana*, was recently discovered inhabiting montane woodlands in southwestern Korea. Our main goal was to identify and describe the glands in the skin of male and female *K. koreana*. We hypothesized that mucous, granular, modified granular, and mixed glands would be present, though in variable frequencies in different body locations. Furthermore, we predicted there would be no sexual dimorphism in gland size and frequency except for the typically dimorphic courtship gland on the chin of males. Skin from the following regions was stained using standard histological techniques: mentum, post-cloacal , sacral, mid-ventral , and mid-dorsal. We examined the size and frequency of mucous, granular and modified granular glands. In general, the skin of *K. koreana* is similar to that described for other plethodontid species, with mucous, granular, modified granular, and mixed glands present. As expected, males have relatively large modified granular glands in the mental gland. On the dorsal tail surface, males have fewer mucous but more modified granular glands than females do. In the mid-dorsum area however, modified granular and granular glands are more frequent in females than in males. In summary, mucous granular, and modified granular glands are present in varying frequencies in different body locations. There is sexual dimorphism in size and frequency for some glands.

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24 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

Peter Wainwright

University of California, Davis, Davis, CA, United States

Darwin and Macroevolution: Comparative Analysis of Innovations and Diversity

In addition to his watershed contributions to understanding the mechanisms of evolution by natural selection, Darwin also recognized that diversifying lineages generated interesting patterns as they radiated and adapted to available niches. Today we have a plethora of tools for looking back in time to reconstruct these processes and the patterns of diversity that they generated across the tree of life. Among the recent conceptual insights into factors that shape the phylogenetic distribution of diversity is the realization that estimates of the rate of trait evolution are a phylogenetically corrected way to compare morphological diversity between groups, just as lineage diversification rate is a phylogenetically corrected metric of species richness. In this talk

I will explore the influence of functional innovations in the feeding mechanism of parrotfishes on the morphological diversity of this group of labrid fishes. Parrotfish possess a highly modified pharyngeal jaw apparatus that they use to pulverize the matrix of coral rock, algae and detritus that they feed on. They are the only group of reef fishes able to feed in this way on this resource, and our analyses reveal that their oral jaws have underwent explosive morphological and functional diversification as they radiated into many specialized niches that have further capitalized on their unique food processing ability. At least one major secondary feeding innovation is seen in parrotfish, that is associated with a slow-down in diversification of the feeding mechanism.

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83 Darwin Symposium, Grand Ballroom I, Monday 27 July 2009

David Wake

University of California, Berkeley, CA, United States

Darwin's Species

Darwin said little directly about species concepts or species formation, despite the title of his most famous book. He focused on variation, natural selection and adaptation and the reader was left to infer that adaptive divergence, in a geographic setting, led to species formation. Darwin discussed "doubtful species" and the often difficult distinction between species, subspecies, and varieties, repeatedly making the point that species formation is generally a long, slow process. The sole figure in "On The Origin --" is a depiction not of phylogeny, as often stated, but of species formation, showing how phenotypes become distinct from the combined effects of adaptive divergence and extinction. In fact, the whole book is about species formation. Ring-species are ideal representations of darwinian species formation. In California a complex of lungless salamanders, *Ensatina*, has a geographical distribution in the form of a ring. Gradual adaptive divergence is taking place from a northern stock in two geographic directions, along the coast and along the interior mountains, and in two divergent adaptive directions, leading ultimately to different end-points that overlap in the south, where two distinct forms occur in sympatry at one site with no genetic interchange. *Ensatina* is a ring-species complex that is an appropriate representation of Darwinian species formation.

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271 Snake Ecology, Pavilion East, Monday 27 July 2009

Jayme L. Waldron[1], Shane M. Welch[1], Stephen H. Bennett[2]

[1]University of South Carolina, Columbia, SC, United States, [2]South Carolina Dept. of Natural Resources, Columbia, SC, United States

Growth and Age at Maturity in Sympatric Populations of Eastern Diamondback Rattlesnakes and Canebrake Rattlesnakes

Numerous life history attributes serve as indicators of increased vulnerability to extinction. Previous research compared sympatric populations of eastern diamondback rattlesnakes (*Crotalus adamanteus*) and canebrake rattlesnakes (*C. horridus*) and determined that habitat specificity disproportionately contributed to the decline of *C. adamanteus*. Here, we present data comparing other known attributes of species vulnerability from the same sympatric populations. We used growth intervals from a long-term mark recapture study (14 years) to model growth and age at reproductive maturity for female *C. adamanteus* and *C. horridus*. We failed to detect differences in growth and age at reproductive maturity between the two species, which did not support these attributes as significant contributors to *C. adamanteus* imperilment. However, we observed strong sex biases, which limited our analyses but might further explain imperilment in *C. adamanteus*.

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448 Poster Session I, Exhibit Hall, Friday 24 July 2009

Christina J. Walker, James Gelsleichter

University of North Florida, Jacksonville, FL, United States

Metallothionein as a Biomarker for Metal Exposure and Effects in Shark Populations from the Southeastern United States

Approximately 50% of the heavy metals emitted into our atmosphere through anthropogenic and natural processes reach our oceans, where they enter the food chain. It has been shown that, through bioaccumulation and biomagnification, sharks are likely to exhibit high concentrations of these metals, specifically mercury and cadmium, due to their long life span, slow growth and metabolism, and migratory nature. However, no studies have attempted to examine the possible effects of exposure to toxic metals in these organisms. The purpose of this study was to develop and use methods for detecting effects of toxic metal exposure in sharks. Previous studies have demonstrated that in the presence of elevated metal concentrations, organisms exhibited increased levels of metallothionein (MT), a protein responsible for metal regulation, making it a good indicator of harmful exposure levels. We explored the use of MT as a reliable biomarker for metal exposure in sharks by determining if bonnethead shark, *Sphyrna*

tiburo, populations exposed to higher metal concentrations exhibit elevated physiological effects, as shown by increased MT expression, compared to populations residing in less polluted areas. This was accomplished by measuring MT levels in previously collected *S. tiburo* liver samples from estuaries, varying in metal contamination, in the southeastern US. We also examined MT expression in erythrocytes from large coastal sharks, which accumulate higher levels of toxins than their smaller relatives, in order to determine if blood cells could be used as a non-lethal method for measuring MT, as shown to be possible in some other vertebrates.

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257 Amphibian Ecology II, Pavilion West, Monday 27 July 2009

Susan Walls[1], Stephen Richter[2], William Barichivich[3]

[1]USGS-Florida Integrated Science Center, Gainesvile, FL, United States, [2]Eastern Kentucky University, Richmond, KY, United States, [3]USGS-Florida Integrated Science Center, Gainesville, FL, United States

Ephemeral Wetland Ecosystems in the Face of Climate Change: An Amphibian Perspective

Under the threat of climate change, temporary freshwater ponds are likely one of the most imperiled aquatic ecosystems on Earth. In the Southeastern United States, 59 species of amphibians use seasonal, isolated wetlands for breeding, capitalizing on the high productivity of these fishless ephemeral habitats. According to climate change models developed by the Canadian Climate Centre and the Hadley Centre in the UK, temperatures in the 21st century could increase by as much as 5.6° C in the southeast. Other climate models suggest the intensity of droughts during La Niña phases will be strengthened in this region as atmospheric CO_2 increases. Under such projected climate change, evapotranspiration losses from temporary ponds will most likely increase, resulting in shortened hydroperiods and increased frequency of reproductive failures by pond-breeding amphibians. Insufficient rainfall and shortened hydroperiods have already been linked to catastrophic reproductive failure and amphibian declines at some sites in the Southeastern US. We review meteorological factors and physiographical characteristics that make ephemeral freshwater habitats especially susceptible to climate change. We also compare the life history characteristics of species that breed exclusively in ephemeral habitats, versus those that breed in a broad array of aquatic habitats. We emphasize the potentially serious conservation concern of a synergistic effect of habitat fragmentation and climate change. Understanding how amphibians cope with environmental uncertainty in general, and climatic variation and hydrologic fluctuations in particular, will aid in predicting how these and other temporary pond breeders respond to future climate change and landscape alterations.

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629 ELHS/LFC Connectivity, Galleria South, Friday 24 July 2009

Harvey Walsh[1], Simon Thorrold[1], Katrin Marancik[3], Jonathan Hare[2]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA, United States, [2]NOAA NMFS Northeast Fisheries Science Center, Narragansett, RI, United States, [3]NOAA NMFS NEFSC/SEFSC, Woods Hole, MA, United States

Multi-scale Larval Transport Mechanisms Along the Eastern United States Coast

The continental shelf along the east coast of the United States is bounded by the Gulf Stream western boundary current. The area is influenced by multi-scale larval transport mechanisms, which produce heterogeneous larval transport regions. Analysis of satellite-tracked drifters and a probability model based on drifter flow was used to examine macro- and meso-scale transport mechanisms. The analyses indicate the region exhibits a continuum of dispersal distances ranging from local retention to long distance transport. To corroborate the model, we constructed potential dispersal pathways using otolith microchemistry of *Lutjanus* spp. collected to five estuaries from south Florida to North Carolina. We found agreement among the probability model and the otolith-based larval transport pathways. However, neither the model nor otolith microchemistry were able to resolve fine-scale transport mechanisms influencing larval transport. For example, Gulf Stream intrusions on the east coast of the United States result in both onshore and offshore larval transport and exchange of larvae among water masses. In order to understand larval transport, efforts need to be made to integrate the multi-scale mechanisms into testable models.

1001 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Christine Ward-Paige, Joanna Mills Flemming, Heike K. Lotze

Dalhousie University, Halifax, NS, Canada

Monitoring Sharks: Evaluating and Correcting for Bias in Underwater Visual Surveys

In visual sampling, animal density is commonly calculated as the number of animals observed standardized by area sampled. This calculation is suitable for stationary or slow moving organisms that are unlikely to leave or enter the area during the survey. In these cases, surveys produce reliable density estimates because they are essentially instantaneous counts and the same result would be obtained if conducted instantaneously or for a longer duration of time, assuming equal detectability in both scenarios. However, for mobile animals like sharks, counts depend upon the survey-

time, the visibility, and the animal's speed. When densities of mobile animals are calculated using number per area calculations, overestimates of density result which considerably misrepresents their contribution to the total biomass. For example, an overestimate of 0.01 individuals $\cdot m^{-2}$ of an animal weighing 1000g and one weighing 10,000g would result in an overestimate of 10g $\cdot m^{-2}$ and 100g $\cdot m^{-2}$, respectively - a 10-fold difference. This apparent inconsistency raises fundamental questions about the significance of studies relying on visual censuses to estimate community abundance and/or biomass. We developed a model to simulate densities obtained by divers. Results were used to examine bias between observed and true density. Bias increased with fish speed and was a function of survey-time, visibility and diver speed. Generalized additive models were fit to develop corrections for better estimates of true density. Corrected estimates should allow for direct comparisons between species with differing mobility. Using the scientific literature, we demonstrate the impact these calculations have on density and biomass estimates.

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657 Poster Session I, Exhibit Hall, Friday 24 July 2009

Daniel Warner, Fredric Janzen

Iowa State University, Ames, IA, United States

Parent-offspring Conflict and Selection on Egg Size in Turtles

Offspring size and number are important components of life-history theory, and the trade-off between these two variables often presents a conflict between parents and their offspring. For example, because egg size is constrained by clutch size, the optimal egg size for offspring fitness is not always equivalent to the egg size that maximizes parental fitness. This trade-off has generated considerable theoretical interest, but empirical tests of theoretical predictions are scarce. In this study, our objective was to evaluate the strength of selection on egg size in three North American turtle species (*Apalone mutica*, *Chelydra serpentina*, and *Chrysemys picta*) to determine if the optimal egg size differs between offspring and their mothers. Our results show strong selection in favor of large egg size, but the strength and form of selection varied among species. Moreover, for all three species, the optimal egg size for offspring was greater than that for mothers. As predicted by optimality theory, mean egg size in the population was more similar to the egg size that maximizes maternal fitness, rather than offspring fitness. These results provide strong evidence that stabilizing selection has maximized maternal fitness so that the optimal balance between egg size and egg number is achieved.

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838 NIA STUDENT PAPER AWARD, Parlor ABC, Sunday 26 July 2009

Linet Cynthia Watson, Donald Stewart

State University of New York, College of Environmental Science and Forestry, Syracuse, NY, United States

Age and Growth of the Giant Arapaima in South-western Guyana

The giant Arapaima is one of the most heavily exploited and threatened freshwater fishes in Guyana. Arapaima occurs in the Essequibo and Branco River basins and grows to about 3 meters in length. Unregulated harvesting over the past 30 years has reduced the Guyanese Arapaima population to about 2500 adults. Development of a management and conservation plan is hindered, in part, by a lack of basic data on the biology and ecology of this species which has been suggested to be morphologically and behaviorally distinct from central Amazonian populations. We collected scale samples from approximately 300 individuals during the low water season in 2007 and 2008 to estimate age and growth patterns. The number of rings deposited on hard parts annually was determined by tagging and recapture of individuals with Passive Integrated Transponder (PIT) tags. Determination of age and growth patterns was done through marginal increment analysis and the von Bertalanffy growth function was used to model lifetime growth.

1031 Poster Session I, Exhibit Hall, Friday 24 July 2009

Robert Weaver, Kenneth Kardong

Washington State University, Pullman, WA, United States

Behavioral Responses to Potential Prey Through Chemoreception by the Sharp-Tailed Snake (*Contia tenuis*)

The Sharp-tailed snake (*Contia tenuis*) is a small (usually < 30 cm total length), cryptic snake species found along the west coast of the United States and north into southwestern British Columbia. Because of its secretive nature, little is known about the behavioral ecology of *C. tenuis*. We tested the behavioral responses of 13 adult *C. tenuis* collected from a site in eastern Washington to potential invertebrate prey odors. We presented snakes with 2 control odors (water, cologne) and 2 possible invertebrate prey odors (earthworm, slug). Overall, there was a significant difference in both the time-to-first-tongue flick (latency) and mean tongue flick rate (during each 60 s trial) for the odors tested. The latency period for earthworm was 6.0 ± 1.87 s, and 4.1 ± 1.57 s for slug. Mean tongue flick rate for both earthworm and slugs was 13.8 ± 4.09 s, and 39.7 ± 15.79 s, respectively. These results support prior claims made by some authors and statements made in regional field guides of a preference for slugs by *C. tenuis*. This preference for

slugs may also explain the presence of *C. tenuis* in areas of anthropogenic disturbances with an abundance of slugs, both native and non-native.

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777 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Nicholas C. Wegner[1], Chugey A. Sepulveda[2], Jeffrey B. Graham[1]

[1]Scripps Institution of Oceanography, La Jolla, CA, United States, [2]Pfleger Institute of Environmental Research, Oceanside, CA, United States

Adaptations for Fast, Continuous Swimming: Functional Morphology of the Gills in the Shortfin Mako, *Isurus oxyrinchus*

The gills of the shortfin mako are highly specialized for increasing gas exchange required by high aerobic demands and for enhancing gill rigidity to maintain gill orientation in face of the high-pressure branchial flow induced by ram ventilation. The mako has larger gill surface areas and shorter diffusion distances in comparison to other elasmobranchs studied to date. Mako gill lamellae have a diagonal blood-flow pattern similar to that described for many high-energy demand teleosts (e.g. scombrids and billfishes) which likely increases functional gill area and decreases vascular resistance through the gills. Although the mako lacks the filament and lamellar fusions that are found in many ram-ventilating teleosts, the basic elasmobranch gill design stiffens the gill filaments, and the lamellae appear to be stabilized by previously undescribed vascular "sacs." These sacs, which are located near the water-entry edge of the lamellae, may be subject to pressure-based or vasoactive control which may allow for some manipulation of size under varying physiological conditions. Despite a high degree of specialization for increased gas exchange and ram ventilation in comparison to other sharks, the basic elasmobranch gill design appears to limit the convergence of mako gill structure with that of tunas. Specifically, mako gill surface area is much smaller, and this may ultimately prevent the scope of sustainable aerobic performance achieved by tunas.

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416 Herp Conservation III , Grand Ballroom II, Monday 27 July 2009

Linda Weir[1], Ian Fiske[2], J. Andrew Royle[1]

[1]USGS Patuxent Wildlife Research Center, Laurel, MD, United States, [2]North Carolina State University, Raleigh, NC, United States

Trends in Anuran Occupancy from 10 Northeast States

We present the first multi-year occupancy trends from North American Amphibian Monitoring (NAAMP) data in 10 northeastern states using seven years of data (2001-2007). NAAMP uses a calling survey technique where observers listen for anuran vocalizations along assigned random roadside routes. Each route has 10 stops, spaced 0.5 miles or more apart, located near wetland habitat. We were able assess occupancy trends in 10 northeastern states for 16 species and one species complex, for a total of 94 species/state combinations. No significant trends were found for 64 species/state combinations. For the remaining 30 species/state combinations with significant trends, these were split evenly between declining and increasing trends. On a species-by-species basis, two species had declining trends, with significant trends in six states for *Pseudacris crucifer* and four states for *Anaxyrus americanus*. *Lithobates catesbeianus* had significant increasing trends in four states, with no trend in the remaining states.

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564 Herp Reproduction & Behavior, Broadway 1&2, Friday 24 July 2009

Stacey Weiss, Alexa Fritzsche

University of Puget Sound, Tacoma, WA, United States

Chemical Cues Indicate Familiarity and Body Size in Striped Plateau Lizards

Reptilian chemical cues may communicate information about discrete character states such as species, gender, and individual identification, as well as continuously varying characteristics such as individual body size and condition. Here, we investigate whether chemical cues of the striped plateau lizard, *Sceloporus virgatus*, allow for the assessment of familiarity and body size. We first tested male tongue-flicks and other chemosensory behaviors in response to familiar vs. novel sociochemical environments (i.e., tanks with paper substrates marked by the focal male and a familiar female or by an unfamiliar male-female pair). We found that males performed significantly more chemosensory behavior in the novel environment. Male response to the novel environment was unrelated to the body size of the previous male resident but was positively related to the body size of the previous female resident, though only in one of two test years. To further investigate whether males gain information about female body size via chemical signals, we used a choice-test paradigm to assess male response to chemical cues from females that differed in body size by ~12%. We found that males responded more strongly to the largest and smallest females than they did to the intermediate-sized

females. Combined, these results suggest that *S. virgatus* chemical cues provide information about familiarity and female body size. However, male response is more complicated than expected; we did not find a consistent preference for the cue from the largest available female, as is expected based on the selective advantage of mating with larger, more fecund females.

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270 Herp Ecology, Galleria North, Monday 27 July 2009

Shane Welch[1], Jayme Waldron[1], Steve Bennett[2]

[1]University of South Carolina, Columbia, SC, United States, [2]South Carolina Department of Natural Resources, Columbia, SC, United States

Crayfish Burrow use by Herpetofauna

Although herpetofauna have been documented to use crayfish burrows, researchers often ignore the potential importance of crayfish burrows as refugia. To demonstrate the nuances of crayfish/amphibian relationships, we subjected *Ambystoma talpoideum* larvae to artificial crayfish burrows occupied by four crayfish host species and unoccupied control burrows for two weeks. We selected the four crayfish host species because each species constructed burrows and was observed in temporary lentic habitats similar to those occupied by *Ambystoma talpoideum* larvae during May 2006. Survival analysis indicated that larval survival varied among the crayfish host species. Further, larval survival in unoccupied control burrows and in burrows occupied by some crayfish species did not differ, indicating that some crayfish species provide refugia for amphibian larvae, even when they occupy the burrows.

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719 Amphibian Ecology I, Pavilion West, Saturday 25 July 2009

Hartwell Welsh, Garth Hodgson

US Forest Service PSW Redwood Sciences Lab, Arcata, CA, United States

Fluvial/Geomorphic Process Domains and the Distributions of the Riparian and Aquatic Herpetofauna: A Landscape Study in an Undammed Northwestern California River Catchment

Recent developments in fluvial geomorphology have yielded multi-scale conceptual models of the dynamic processes that alternately create, maintain, and destroy tributary and main channel aquatic and riparian environments in mountain catchments. Such models have been applied to understanding the distribution of fish and fish habitats at the basin scale, but we are unaware of similar approaches with herpetofauna. Here we analyze the distributions of the herpetofauna in a 112 km un-damned river and its'

tributaries in a 789 km^2 watershed in northern California - the Mattole River - as they relate to landscape level geomorphic and fluvial processes (i.e. process domains). We examine and compare the faunal assemblages that occur along: (1) low gradient, shallow, unconfined, multiple or migrating channels; (2) slightly entrenched, higher-gradient, meandering riffle/pool channel with flood plain; (3) moderately entrenched channel with 2-4% gradients, structurally controlled by moderately steep valley; and (4) high-gradient tributaries with narrow, gorge-defined channels, with step pool/cascade structure. These channel categories, with unique herpetofaunal assemblages, represent a consistent dendritic geometry of linear habitat units that intersect to create a hierarchical network of connected branches. We link these channel types and the unique habitats within to the natural histories of resident herpetofauna.

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208 Fish Ecology I, Pavilion East, Friday 24 July 2009

Stuart Welsh[1], Brandon Keplinger[2]

[1]USGS, WV Cooperative Fish and Wildlife Research Unit, Morgantown, WV, United States, [2]West Virginia Division of Natural Resources, Romney, WV, United States

Minnows, Mutualism, and Mixed-species Shoals

Species of pelagic cyprinids often segregate vertically within the water column. In the case of native and non-native cyprinids, vertical segregation in the form of habitat shifts may have important consequences for conservation. Alternatively, studies have documented mutualism between native cyprinid species in the form of mixed-species shoals. Few studies, however, have examined the effects of nonnative cyprinids on vertical habitat use of native cyprinids. This experimental laboratory study quantified habitat shifts of two native species of the New River drainage (New River shiner *Notropis scabriceps* and spotfin shiner *Cyprinella spiloptera*) in the presence of nonnative species (telescope shiner *N. telescopus* and whitetail shiner *C. galactura*). Four 246 L aquaria and six vertical position categories were used to experimentally-examine shifts in water column positions. We examined differences in vertical distributions between single species (allotopic) and mixed species (syntopic) experimental trials. Although native/nonnative pairs differed significantly in vertical habitat use for both allotopic and syntopic comparisons, the overlap of vertical distributions between native/nonnative pairs increased greatly during syntopic trials. Laboratory results indicate that these native/nonnative species do not segregate during syntopy, but rather integrate into mixed-species shoals.

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962 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Kevin Weng[1], John O'Sullivan[2], Manuel Ezcurra[2], Joe Welsh[2], Scott Reid[2], Mike Murray[2], Chris Lowe[3], Chuck Winkler[4], Oscar Sosa Nishizaki[5], Barbara Block[6], Salvador Jorgensen[6], Chris Perle[1], Andre Boustany[7]

[1]University of Hawaii at Manoa, Honolulu, HI, United States, [2]Monterey Bay Aquarium, Monterey, CA, United States, [3]California State University at Long Beach, Long Beach, CA, United States, [4]Southern California Marine Institute, Los Angeles, CA, United States, [5]Centro de Investigación Científica y de Educación Superior de Ensenada, Ensenada, BC, Mexico, [6]Stanford University, Stanford, CA, United States, [7]Duke University, Durham, NC, United States

Juvenile White Shark Research at the Monterey Bay Aquarium

The Monterey Bay Aquarium initiated a research program into the biology and husbandry of juvenile white sharks in 2002. The program's goals are to learn about the biology of the most vulnerable life stages, determine the key conservation issues for the species, bring white sharks into the aquarium for exhibit, and educate the public about the species. Four white sharks have been brought into the Outer Bay Waters exhibit for public display, resulting in a major public education and awareness program, both through direct visitation as well as high profile media coverage. Satellite telemetry results for sharks in the wild indicate that zero to three-year-olds remain primarily in neritic waters, and undertake movements between US and Mexican waters. The home range of this age class of white sharks includes the California Current system off California and Baja California, as well as the Gulf of California. In contrast, adults and subadults do not appear to move between US and Mexican waters, instead making offshore movements from their respective nearshore aggregation sites into pelagic waters towards Hawaii. The neritic habitat of juveniles, combined with their smaller size, makes them more vulnerable to fishery interactions than adults. The primary management issue for white sharks in the Eastern Pacific is capture in gillnets in the US and Mexico. Adults are not reported in commercial or recreational fisheries with any regularity.

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755 Poster Session I, Exhibit Hall, Friday 24 July 2009

Steven Werman

Mesa State College, Grand Junction, CO, United States

Nucleotide Sequence Comparisons of Putative Concolor Toxin genes, from the Midget Faded Rattlesnake (*Crotalus oreganus concolor*), with other Rattlesnake Neurotoxin DNA Sequences

Putative genes for concolor toxin (from *Crotalus oreganus concolor*), representing both acidic and basic PLA2s, were amplified using PCR and are presently being sequenced. The gene sequence information and any derived amino acid sequence information will be aligned and compared to existing sequence information of other rattlesnake heterodimeric PLA2 neurotoxins. This study in ongoing and the sequence analyses are forthcoming. Phylogenetic analyses are yet to be performed. This study will hopefully provide insights into the evolutionary relationships of concolor toxin relative to crotoxin, mojave toxin, sistruxin and other crotaline neurotoxins.

1028 Evolution & Ontology Symposium, Grand Ballroom I, Saturday 25 July 2009

Monte Westerfield[1], Melissa Haendel[1], Ceri Van Slyke[1], Yvonne Bradford[1], Suzanna Lewis[2], Chris Mungall[2], Nicole Washington[2], Michael Ashburner[3], George Gkoutos[3], David Sutherland[3]

[1]University of Oregon, Eugene, OR, United States, [2]University of California Berkeley, Berkeley, CA, United States, [3]Cambridge University, Cambridge, United Kingdom

Linking Animal Models and Human Diseases

Phenotypes are the result of interactions of the whole genome with the environment. Studies that correlate genotype with phenotype are crucial for unraveling biological pathways and gene product interactions and, hence, are required for reaching the long-term goal of understanding how genes regulate developmental and physiological processes. Together with the NCBO and FlyBase we developed a bipartite "EQ" (Entity + Quality) syntax to describe phenotypes. The Entity is the part of the phenotype being described, the Quality describes how the entity is affected. The entities may be terms from anatomical ontologies or the Gene Ontology (GO; for biological processes, cellular components, and molecular functions). The Quality terms come from the Phenotype and Trait Ontology (PATO) that provides a hierarchy of qualitative or quantitative qualities that may be applied to an observable structure or process. We used EQ syntax and ontologies to annotate human disease genes (OMIM), and their *Drosophila* and Zebrafish homologs. We show that these data can be comparatively queried by

phenotype alone, using an information content-based similarity search algorithm. To test whether usage of EQ syntax and the PATO ontology is sufficiently reproducible for annotating phenotypes, three curators independently annotated the same records. Differences in the annotations recorded by the three curators may arise from deficiencies in PATO, the anatomy or Gene ontologies, or the syntax itself. A comparison of these annotations allows testing and development of curatorial standards for phenotype annotation.

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727 Fish Systematics II, Pavilion East, Saturday 25 July 2009

Mark Westneat

Field Museum of Natural History, Chicago, IL, United States

Higher-level Relationships Among Reef Fishes, the Evolution of Developmental Regulatory Genes and the Use of New Visualization Tools for Large Phylogenies

A phylogenetic analysis of over 250 species in more than 50 fish families, including species from most major perciform coral reef clades is presented, based on nucleotide sequences from 8 genes, including mitochondrial and nuclear loci and several nuclear regulatory genes that play a role in development of the vertebrate head. Relationships are proposed among labroid and squamipinne families and their close relatives, and the frequency of freshwater and estuarine close relatives to coral reef groups is examined. Phylogenetic analyses of regulatory gene evolution are presented at the species level for 5 worldwide coral reef groups: the families Labridae, Pomacentridae, Chaetodontidae, Pomacanthidae and Balistidae. The central finding is that non-synonymous rates of regulatory genes are accelerated in some regions of reef-fish phylogeny, often associated with accelerated rates of morphological and functional evolution of the skull. Regulatory genes can add important phylogenetic data at deeper nodes as well as at finer levels of fish phylogeny, and help to integrate structural, functional, and developmental research with a phylogenetic framework. In order to view large phylogenies, new software tools are emerging that can improve the visual experience of the user and heighten our cognitive ability to recognize patterns in large branching networks. Highlights of new research efforts in tree visualization will be presented.

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767 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Mark Westneat[1], John Lundberg[2]

[1]Field Museum of Natural History, Chicago, IL, United States, [2]Academy of Natural Sciences, Philadelphia, PA, United States

A MegaTree for all Fishes: a Higher-Level Framework for Vertebrate Evolution

Aggregation of information about biodiversity is happening at a massive scale across biology, often faster than we can organize and visualize the data for informative patterns. A large phylogenetic framework is a useful way to organize and visualize information, with new tools being developed to empower the searching of large trees for evolutionary trends, diversification rates, character correlations, data richness, etc. Large phylogenies are powerful heuristic tools for data exploration and are informative for both research and education long before every node is supported by detailed character data (and in fact can be used to highlight areas in need of new data). Here we present an initial version of a MegaTree of all families of fishes and fish-like vertebrates, with most groups resolved according to classical or recent hypotheses of relationships. The phylogeny contains all 700+ fish families, both fossil and living, with taxonomy derived from Eschmeyer and Nelson. The phylogeny is dynamic, flexible, and subject to simultaneous manipulation by multiple users. It is freely available as a Mesquite file for editing and use by the community. Group effort is needed in the resolution of family name lists, the application of published phylogenies to the hierarchical structure of the tree, and the splicing in of more fully resolved phylogenies at the species level. Tree splicing or grafting, to produce MegaTrees, is available in a workflow using tools such as PhyloGrafter, that will enable the ichthyological community to make a MegaTree of all fish species using the current backbone.

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819 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Michael Westphal[1], Steven Morey[1]

[1]Bureau of Land Management, Hollister, CA, United States, [2]U.S. Fish and Wildlife Service, Portland, OR, United States

Molecular Phylogeny of the Sand-dwelling Surfperch, Subfamily Amphistichinae (Teleostei: Embiotocidae), Reveals a Convergent Loss of Red Pigmentation in a Rapidly Evolving Lineage

Studies of fish pigmentation can provide insights into basic evolutionary processes. The essential components for historical reconstruction of character evolution are a robust phylogeny and relevant phenotypic data. We present molecular and phenotypic data from a completed phylogenetic study of surfperch in the Amphistichinae, a division of

Embiotcidae. Multiple mitochondrial loci and two nuclear loci show low levels of differentiation within the subfamily, suggesting a recent radiation. We revise the existing phylogeny by placing *Hyperprosopon anale* at the base of the subfamily, and designating *Amphistichus argenteum* and *A. rhodoterus* as sister species. *A. rhodoterus* and *A. koelzi*, and *H. ellipticum* express red pigmentation, whereas *A. argenteus* and *H. argenteum* do not. By tracing the character on the new molecular tree, we show that red pigmentation has likely experienced convergent loss in the two latter species. Our results lay the foundation for ecological and microevolutionary studies of the mechanisms of pigment evolution in the Amphistichinae.

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471 AES Ecology I, Pavilion West, Saturday 25 July 2009

Bradley Wetherbee[1], Mahmood Shivji[2], Richard Nemeth[3]

[1]University of Rhode Island, Kingston, RI, United States, [2]Guy Harvey Research Institue, Oceanographic Center, Nova Southeastern University, Dania Beach, FL, United States, [3]University of the Virgin Islands, St. Thomas, USVI, United States

Environmental Preferences of the Tiger Shark (*Galeocerdo cuvier*) Tracked with Pop-up Archival Satellite Transmitters in the US Virgin Islands

Tiger sharks are abundant apex predators worldwide, playing important roles in trophic dynamics of these ecosystems. However, in many ways tiger sharks are enigmatic and do not conform to typical patterns of feeding, reproduction, genetics, morphology, and migration into which many other species of sharks neatly fall. We investigated site fidelity, movement patterns fine-scale environmental preferences of depth, temperature and location by tracking seven tiger sharks (260-358 cm) tagged with pop-up archival satellite transmitters (Microwave Telemetry Inc.) in March and June 2008 at a grouper spawning site in the US Virgin Islands. Five sharks were tagged with transmitters that recorded light, temperature and depth at 3-min intervals for 30 days and two sharks were tagged with standard transmitters that record this data every 15-min over several months. Over 40,000 records of depth and temperature were obtained, which indicated that sharks spent over 80% of their time at less than 40 m depth and over 75% of their time in water 26-30^{o}C. Although average depth and temperature occupied by sharks was fairly consistent, patterns of habitat utilization varied among individuals and there were no obvious consistent patterns or differences among size classes, sexes, or time of year. The majority of sharks moved less than 100 km in 30 days, but one shark moved nearly 1300 km from the tagging site in the USVI to coastal Venezuela. Overall, tiger sharks had surprisingly narrow environmental preferences and occupied a relatively restricted portion of the marine realm, but readily deviated from their preferred habitat.

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722 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

Patrick V. Wheatley, Paul L. Koch

University of California, Santa Cruz, Santa Cruz, CA, United States

Estimating Long-term Diets of Alligators from Rockefeller Wildlife Refuge Using Stable Isotope Analysis

Studying herpetological diet typically consists of either observing animals feeding in their natural habitats or analyzing gut contents. However, it is particularly challenging to observe aquatic animals when they are partially or fully submerged. Additionally, both of these techniques offer only a narrow temporal view of the animal's diet with each observation. Many mammalian and ornithological studies have benefited by utilizing the stable isotope compositions of animal tissues to help elucidate food sources of those animals. In this study we analyzed the stable isotope compositions of bone and tooth collagen from alligators and numerous prey species from Rockefeller Wildlife Refuge in southwestern Louisiana. We expect that interpreting stable isotope ratios of nitrogen and carbon from bone and tooth collagen can reveal average diet for this alligator population on time frames ranging from ~100 days to ~five years. These time frames allow us to take a much longer temporal view of the diets of the animals as well as the possibility of incorporating information about changes in diet as a function of life history for an individual. This study is bolstered by the fact that the region has a strong history of observational and gut content analysis studies. These previous studies both inform our choice of animals to sample as potential prey items and make it possible to compare the results of our study to the more traditional studies of alligator diets.

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615 Fish Phylogeography, Pavilion West, Sunday 26 July 2009

Matthew White

Ohio University, Athens, OH, United States

Intraspecific Phylogeography of the Sauger

Sauger is a widespread and recreationally important species found throughout the Mississippi, Hudson Bay, and Great Lakes' drainages. Unlike the closely related walleye, saugers have not been used in widespread stocking programs, although supplementation with locally derived stocks is common. Thus range-wide population structuring should not be influenced by stocking of non-native strains. We undertook a phylogeographic study of populations from throughout the range. Approximately 760 bases from the mitochondrial control region were determined. We identified 15 haplotypes among 18 populations that differed by 0.1 to 1.2% suggesting divergences in the mid to late Pleistocene. Patterns of divergence are consistent with at least two glacial

refugia. However, no geographic groupings of populations were observed. Our data suggests that there has been substantial dispersal since the retreat of the glaciers. These results are similar to those observed in walleye, suggesting a common Pleistocene and post-Pleistocene history.

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938 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Steven Whitfield, Kelsey Reider, Sasha Greenspan, Maureen Donnelly

Florida International University, Miami, FL, United States

Do Litter Dynamics Regulate Population Densities of Amphibians and Reptiles in a Declining Terrestrial Herpetofauna?

Populations of terrestrial amphibians and reptiles have declined dramatically over the past four decades at La Selva Biological Station, a protected rainforest reserve in lowland Costa Rica. Because the quantity of standing leaf litter on the forest floor is the predominant determinant of abundance for the litter herpetofauna, it was suggested that changes in litter dynamics may be related to faunal declines for both amphibians and reptiles. We conducted a 16-month experimental investigation of the relationship between litter depth and herpetofaunal density. We established nine 15x15m capture-recapture plots in fall 2006, and sampled frogs and lizards on each plot on 99 separate occasions during which all encounters of frogs and lizards were recorded, and captured animals were assigned unique marks. After a 6-mo pre-treatment period, plots were assigned to three treatments: litter addition (L+), litter removal (L-), or sham treatment controls (C). Total encounters of pooled amphibians and reptiles were higher on L+ plots than on control plots in the post-treatment period, while total encounters were fewer in C plots. Species-level response to treatments were individualistic; some common species showed strong increases in density in L+ treatments and reduced density in L- treatments while other species showed no effects. Manipulation treatments had a profound effect on species composition. We discuss the results of capture-recapture analyses, relation to standing litter dynamics, and the potential role of climate change and mesopredator release as factors shaping quantity of standing litter, and - ultimately - density of amphibian and reptile populations at this site.

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483 AES Behavior & Morphology, Galleria South, Thursday 23 July 2009

Nicholas Whitney[1], Wes Pratt[2], Theo Pratt[2], Jeffrey Carrier[3]

[1]Center for Shark Research, Mote Marine Laboratory, Sarasota, FL, United States, [2]Center for Shark Research, Mote Marine Laboratory Center for Tropical Research, Summerland Key, FL, United States, [3]Department of Biology, Albion College, Albion, MI, United States

Biologging Love: Identifying Shark Mating Behavior Using a Three-dimensional Acceleration Data Logger

In the few shark species for which it has been observed, mating behavior has involved various postures and movements that appear to be very different from those involved in typical daily activities such as swimming, feeding, and resting. A data logger that records these postures and movements may therefore allow us to identify mating behavior in species for which direct observations are impossible. We applied Vemco, three-dimensional acceleration data loggers, sampling at a rate of 5 Hz, to four adult nurse sharks during their mating season in the Florida Keys. Loggers were carried for periods ranging from 24 to 106 hrs, and were recovered through animal recapture or logger shedding and recovery after corrosion of a galvanic link. Logger-equipped sharks were directly observed carrying out several behaviors (e.g., resting, slow swimming, avoidance, fast swimming, courtship/mating) providing visual corroboration of acceleration data. This allowed us to distinguish the movements associated with mating from those associated with other behaviors, and thereby differentiate the time and duration of mating-related events. We also used acceleration data to construct ethograms for each animal over the experimental period, and we discuss these results and the potential for these devices in future studies of shark reproductive behavior.

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501 Poster Session I, Exhibit Hall, Friday 24 July 2009

Nicholas Whitney[1], William Robbins[2], Richard Pyle[3], Jennifer Schultz[1], Brian Bowen[1], Kim Holland[1]

[1]Hawaii Institute of Marine Biology, University of Hawaii at Manoa, Kaneohe, HI, United States, [2]Cronulla Fisheries Research Centre, NSW Department of Primary Industries, Cronulla NSW, Australia, [3]Bernice P. Bishop Museum, Honolulu, HI, United States

Movements of the Whitetip Reef Shark, *Triaenodon obesus*, from Photo-identification and Population Genetics

Little is known about the movements of whitetip reef sharks, but past studies indicate that they are strongly site-attached, with home ranges of approximately 1 km^2. This is

surprising because of their broad distribution, from the western Indian Ocean to the East Pacific. Unlike reef teleosts, whitetips have no pelagic larval stage for long-distance dispersal. We sought to investigate this paradox using community-based photo-identification to quantify the movement of individual whitetips in the Hawaiian Islands, and mtDNA sequence analyses to describe the species' global population structure. Photo-identification of at least 178 individuals revealed coastal movements of up to 26 km, and two movements requiring transit of a 140 m deep channel. Other animals appeared strongly site-attached, being sighted at the same location up to 13 times over a seven year period. Sequence analysis of a 1025 bp sequence from the mtDNA control region of 310 individuals revealed low genetic diversity ($h = 0.550 + 0.025$ and $\pi = 0.00213 + 0.00131$). SAMOVA and Barrier analyses both showed the strongest barrier to gene flow was located along the Sunda Shelf with other strong barriers throughout the western Pacific. East Pacific sharks all shared a single haplotype, possibly indicating a recent eastward expansion of this species across the East Pacific Barrier. Our results expand the known range of movements for individual whitetip reef sharks, and demonstrate that historical land boundaries have a lasting impact on population structure whereas large oceanic distances may be traversed over time.

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411 AES Ecology I, Pavilion West, Saturday 25 July 2009

Jeff Whitty[1], Stirling Peverell[2], David Morgan[1], Dean Thorburn[1], Colin Simpfendorfer[3]

[1]Centre for Fish and Fisheries Research, Murdoch University, Murdoch, Western Australia, Australia, [2]Queensland Primary Industries & Fisheries, Sustainable Fisheries, Northern Fisheries Centre, Cairns, Queensland, Australia, [3]Fishing and Fisheries Centre, James Cook University, Townsville, Queensland, Australia

Movements and Habitat Use of Juvenile Freshwater Sawfish (*Pristis microdon*) in a Riverine Environment

Inhabiting rivers as juveniles, Critically Endangered (IUCN 2006) freshwater sawfish (*Pristis microdon*) are vulnerable to habitat degradation, although it is unclear to what extent as little is known about their habitat use. Between June 2007 and November 2008 passive acoustic tracking methods employing Vemco V13TP-1L and V16TP-5H tags, monitored by VR2W receivers, were used to investigate the movements and habitat use of *P. microdon* in a riverine environment. Tracking data revealed that individuals were selective of the depths they used at different ages, times of day and when exposed to different environmental parameters including depth and temperature. In general, new recruits (0+ age class) occupied shallow waters (<0.6 m) while ≥1+ age classes *P. microdon* inhabited deeper water (>0.6 m). A vertical movement pattern was observed primarily in ≥1+ *P. microdon*, moving to deeper water at sunrise and moving shallower in the afternoon. Body size, predator/prey interactions, temperature and light intensity are hypothesised to be reasons for depth selection as observed with other

elasmobranchs. Data also revealed that tides influenced the direction of inter-pool movement for 0+ *P. microdon*, moving with tidal flow (98% of time), and provided ≥1+ *P. microdon* access through shallow runs normally only manoeuvrable by 0+ *P. microdon*. Due to varying behaviours of different age classes and habitat use changing with environmental conditions, investigating impacts of habitat degradation on *P. microdon* is a complicated process. However, it can be concluded from this study that decreased water levels will limit access to habitat and resources for *P. microdon*.

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899 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Rachel Wilborn, Erin Ferer

Florida Fish and Wildlife, Miami, FL, United States

A Comparison of Damselfish Densities, Guarding Behavior, and Territory Size on Patch Reef and Coral Rubble Sites in Dry Tortugas National Park

Loss of coral coverage due to widespread disease, recurring cold events, and severe storms has largely reduced the once expansive branching coral communities to areas of relatively featureless rubble. It is still relatively unclear how overall complexity loss in Dry Tortugas National Park, one of the least disturbed coral reef systems in North America, may affect fish density, behavior, and territory. Our study evaluated differences in density, chase encounters, and territory size of dusky, beaugregory, and three spot damselfish on coral rubble and nearby patch reefs within Dry Tortugas National Park. Damselfish populations were encountered on both patch reef and coral rubble sites, with differences in distribution and abundance found between species and habitat types. For all three species, the greater density occurred on the patch reef. Increased density on patch reef accounted for a larger number of chase encounters; however, no significant difference was found due to habitat type or species. Although all three damselfish species defended a larger territory size on coral rubble than patch reef, significant differences were only detected among dusky damselfish.

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424 Poster Session I, Exhibit Hall, Friday 24 July 2009

Erik Wild

University of Wisconsin-Stevens Point, WI, United States

Natural History and Reproductive Behavior of *Cruziohyla craspedopus* (Anura: Hylidae)

The reproductive biology of *Cruziohyla craspedopus* (Anura: Hylidae) is described from observations made during four three-week field sessions at a site in lowland Amazonian

rainforest of Departamento de Madre de Dios, Peru. Two different breeding sites were studied during the rainy seasons of 2000-01, 2002-03, 2004-05, and 2006-07. The unique breeding microhabitat, pools in plank buttresses of trees, differs from that previously described for the species. Information regarding population size, site fidelity, and individual frog activity were made using unique color patterns on the dorsum of each frog. Several individuals were recorded calling and two types of vocalizations are presented. The complete episode of amplexus through oviposition is documented and involves extensive movements around the pool with the female carrying the male. Egg clutches were usually deposited on vertical faces of the buttress within 0.5 m above the surface of the water. Observations regarding clutch size, mortality, and predation are reported. Tadpoles present in the water were of various developmental stages and the dispersal of metamorphosed froglets is reported. A wiping behavior of stroking the body and head with hind limbs is described. Examination of all large trees in ca. 50 hectares of forest failed to find additional similar plank buttress pools, indicating that these specialized microhabitats are rare and may be a factor limiting abundance of these frogs in a given area, thus explaining the relative rarity of the species and the lacuna of information on its natural history.

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337 General Ichthyology, Parlor ABC, Sunday 26 July 2009

E. O. Wiley

University of Kansas, Lawrence, KS, United States

Serial Homology and Teleost Epurals

Teleost epurals are usually numbered sequentially. This practice potentially leads to non-homologous epurals received the same label and homologous epurals receiving different labels, masking potentially informative characters and creating misleading statements of identity leading to potentially misleading statements of homology. For example, *Elops* has three epurals representing detached spines of ural centra 1-3. *Thymallus* has three epurals representing detached spines of preural centra 1 and 2 and ural centrum 2. The identity of epural elements in many groups is questionable due to lack of developmental data.

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216 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Cheryl Wilga[1], Anabela Maia[1], Sandra Nauwelaerts[2], George Lauder[3]

[1]University of Rhode Island, Kingston, RI, United States, [2]Michigan State University, East Lansing, MI, United States, [3]Harvard University, Cambridge, MA, United States

Prey Capture Using Whole Body Fluid Dynamics in Batoids

Traditionally, suction feeding is described as rapid expansion of the buccal cavity. However, when feeding on the substrate, suction can be generated by lifting the body away from the substrate. This mechanism has been exploited by batoid species, in particular, due to the dorsoventrally flattened body form. Digital particle image velocimetry and high speed video was used to compare the hydrodynamics of feeding behavior in little skates, *Leucoraja erinacea* and round stingrays *Urobatis halleri*. We hypothesize that the difference in stiffness of the rostrum and extent of the pectoral fins onto the head between the species should result in behavioral differences; the more flexible rostrum and greater fin area of stingrays will allow more extensive use of body suction. When simulating attached or buried prey, stingrays approach the prey with raised rostral ends of the pectoral fins and then press the edges against the substrate to constrain prey. Stingrays make a tent by raising the rostrum and curling up the pectoral fin edges, then raising the head while rapidly projecting the fins forward and over the prey to generate suction. Skates show a similar behavior, although the smaller fin area does not allow lateral occlusion, thus resulting in weaker flow. Also, skates use a rostral strike behavior that pushes fluid towards the substrate potentially to stun or uncover prey. Thus skates and rays use the body to direct flow in different ways to accomplish similar tasks. This may be explained by the evolutionary divergence in rostral and pectoral fin morphology.

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498 Fish Ecology I, Pavilion East, Friday 24 July 2009

Lance Williams, Marsha Williams, Bethany Riley

University of Texas at Tyler, Tyler, TX, United States

The Relationship Between Fish Assemblages, Watershed Form and Function, and Local Habitat in Highly Disturbed Headwater Streams

In 2003 and 2006, fishes and habitat variables were quantified at 36 headwater sites from three different sub-watersheds within the Sugar Creek basin. The goal of the project was to examine how the structure and function of aquatic food webs in headwater streams are impacted by various land management practices with the aim of enhancing aquatic ecosystem function and water quality in agriculturally impaired watersheds. Sugar

Creek, in northeast Ohio, is the second most degraded watershed in the state, and agriculture is the major source of impairment to stream water quality. We found that fish assemblages were only weakly associated with local, instream habitat conditions and were in fact more strongly related to watershed hydrology and geomorphology. In general, fish assemblages were similar across most sites, and local land use conditions were not always indicative of fish assemblage quality, as measured by Index of Biotic Integrity (IBI) scores. We suggest that headwater fish assemblages in highly disturbed landscapes may be weakly associated with instream habitat and more strongly associated with watershed scale form and function. Establishing a clear link between forested riparian areas and aquatic biota can be difficult in these types of systems. Understanding habitat in the landscape matrix may be more important than local habitat conditions in the types of systems we examined.

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759 AES Reproduction & Genetics, Galleria South, Saturday 25 July 2009

L. Jay Williams, James Sulikowski

University of New England, Biddeford, ME, United States

The Use of Steroid Hormone Concentrations to Determine Individual Variability in the Reproductive Cyclicity of the Little Skate, *Leucoraja erinacea*, in the Western Gulf of Maine

The little skate, *Leucoraja erinacea*, inhabits a broad geographical range extending from Nova Scotia to Cape Hatteras, NC. In the Gulf of Maine (GOM), the little skate is considered to be the most common of the seven endemic inshore skate species. A recent study (2007), found the GOM population to be close to both the overfishing and minimum biomass thresholds. The analysis of circulating steroid hormones is a non-lethal technique proven to effectively assess reproductive parameters in elasmobranch species. However, describing reproductive cyclicity with this technique has been problematic due individual variability in the stage of ovulation amongst sampled mature females. The goals of this study are to investigate the appropriate temporal sampling periodicity in order to reduce the variability of hormone levels observed in previous studies. Circulating steroid hormones, estradiol (E_2) and testosterone (T), will be used to establish individual variability and reproductive cyclicity in the little skate. Steroid hormones are currently being extracted from weekly blood samples collected from a laboratory population of mature little skates. Hormone levels will be determined by radioimmunoassay and variations in the concentrations of E_2 and T between skates will be evaluated to assess the extent of individual hormone variability. In addition, trends of elevated hormone levels will be used to determine the annual reproductive cycle.

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505 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Marsha Williams[1], Lance Williams[1], Richard Moore[2]

[1]University of Texas at Tyler, Tyler, TX, United States, [2]Ohio State University, Columbus, OH, United States

A Watershed Scale Approach for Headwater Stream Restoration

The Sugar Creek watershed in Northeast Ohio is the second most degraded watershed in Ohio, with agriculture the major source of impairment. From 2003 to 2006, headwater tributaries were sampled for habitat and biota in three subwatersheds, which differ in farming practices and geomorphology. Organic matter, riparian vegetation, and stable isotope analyses were used to examine cycling of carbon in food webs. Linkages between stream ecosystem function, riparian corridors, and adjacent agricultural land use were examined to create a framework for headwater stream restoration priorities. The degree of fragmentation and the location of woodlots within the watershed may be more critical than local habitat in improving water quality. Restoration efforts that focus on connecting high quality habitat patches rather than on site–specific restoration of local habitats may be more effective. Stable isotope data showed a disconnect between organic matter dynamics and stream food webs, indicating restoration should focus on floodplain development. Industries and landowner partnerships are driving further restoration efforts based on the data collected from this study. Sugar Creek partners (a landowner partnership) have used the data from 81 sites in the headwaters to prioritize stream miles in need of restoration. Alpine Cheese, a major industry in the watershed, is now involved in a nutrient trading plan to reduce phosphorus inputs and fund stream restoration to degraded subwatersheds. In addition, efforts are now underway to link researchers and watershed ecology curricula with local schools within the watershed in the form of an NSF GK-12 project.

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230 Herp Genetics, Galleria North, Saturday 25 July 2009

Rod Williams, J. Andrew DeWoody

Purdue University, West Lafayette, IN, United States

Reproductive Success and Sexual Selection in Wild Tiger Salamanders (*Ambystoma tigrinum*)

Variation in reproductive success is most pronounced in species with strongly biased operational sex ratios, prominent sexual dimorphisms, and where mate competition and choice are likely. We studied sexual selection in tiger salamanders (*Ambystoma tigrinum*) and examined the role of body size on reproductive success. We genotyped 155 adults and 1341 larvae from 90 egg masses at six microsatellite loci. Parentage analyses

revealed both sexes engaged in multiple matings, but was more common among females (64%) than males (27%). However, the standardized variance in mating and reproductive success was higher in males. Bateman gradients were significant and nearly identical in both sexes, suggesting that sexual selection was roughly equal between sexes. Body size was not correlated with mating or reproductive success in either sex. The apparent lack of sexual selection on body size may be a result of sperm storage, sperm competition, alternative mating tactics, and/or random induction of spermatophores.

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351 Fish Systematics I, Grand Ballroom II, Thursday 23 July 2009

Stuart Willis[1], Izeni Farias[2], Guillermo Orti[1]

[1]University of Nebraska-Lincoln, Lincoln, NE, United States, [2]Universidade Federal do Amazonas, Manaus, AM, Brazil

Testing Species Boundaries and Phylogeny in Satan's Fishes (Cichlidae) Using Unlinked Gene Genealogies

Where morphological data are ambiguous or misleading, molecular data provide an objective alternative to discover species boundaries, a fundamental paradigm in systematic biology, and one often taken for granted in other biological disciplines. We applied systematic methods based on the coalescent to test the reality of putative species meta-populations in the Neotropical cichlid genus *Satanoperca*. Using DNA sequences from 2 mitochondrial and 6 nuclear loci, a total of 7 unlinked genealogies, we estimated a species phylogeny of putative meta-populations using phylogenetic methods that do not expect genes to share a single genealogical history. Using this phylogenetic context as a base, we used the coalescent probability of observed gene genealogies to discriminate between gene flow and incomplete lineage sorting in select pair-wise comparisons of putative species. Our results suggest that while the current taxonomy of *Satanoperca* recognizes only 7 species, at least 3 additional species remain to be described, most of which are endemic to regions of the Amazon that are under increasing deforestation and agricultural pressure. Phylogenetic results confirm the distinctness of the spotted, pit-spawning group of Satanoperca (*S. daemon*, *S. lilith*, & *S. acuticeps*), but more natural historical data are needed to understand a complicated pattern of evolution of ovophilous mouthbrooding in the remaining species (*S. jurupari*, *S. pappaterra*, *S. leucosticta*, et al.).

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373 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Stuart Willis[1], Jason Macrander[1], Shane Gibson[1], Carmen Montaña[2], Izeni Farias[3], Nathan Lovejoy[4], Guillermo Orti[1]

[1]University of Nebraska-Lincoln, Lincoln, NE, United States, [2]Texas A&M University, College Station, TX, United States, [3]University of Toronto-Scarborough, Toronto, ON, Canada, [4]Universidade Federal do Amazoans, Manaus, AM, Brazil

Molecules in a Putative Neotropical Vertebrate Hybrid Zone: The Case of the Polyphyletic Butterfly Peacock Cichlid

Butterfly peacock cichlids (*Cichla orinocensis*) are easily identifiable among congeners by the possession of a distinct green color and three ocellated spots along the flank. However, in surveys of mitochondrial DNA of *Cichla*, we discovered that the populations of *C. orinocensis* from the Orinoco+upper Negro and middle+lower Negro Rivers were fixed for different monophyletic lineages of mtDNA. Further, in the *Cichla* tree these two lineages grouped with two different species of *Cichla*, and one of these lineages was deeply nested among another clade of species. Three hypotheses potentially explain this distribution: convergent morphology, incomplete lineage sorting, and ancient hybridization. Further, if these two populations experienced hybridization but are now isolated, this introgression may have instigated the speciation of a hybrid taxon. Using mitochondrial and nuclear DNA, we distinguish between these hypotheses using phylogenetic and population genetic techniques.

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760 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Andrew Williston, Karsten Hartel

Museum of Comparative Zoology, Cambridge, MA, United States

Georeferencing in Ichthyology Collections: Considerations for Aquatic Geospatial Data

Coordinates have long been a part of ichthyology collections- especially for marine stations where collectors can't use landmarks to describe a locality. These data have been kept in museum collections and been useful to many aspects of ichthyological research. Increasingly, initiatives are coordinating and sharing coordinate associated specimen data. In an effort to increase the available data, especially valuable historic references, several zoological disciplines have begun adding coordinates to locality descriptions, a practice commonly called "georeferencing." Wide scale, coordinated georeferencing efforts have been made in mammalogy, herpetology and ornithology, however not yet in ichthyology. In 2008, the MCZ ichthyology department georeferenced its Massachusetts collections, trying the best practice standards used by

major georeferencing initiatives. The department made several observations on the feasibility of georeferencing ichthyology collections, particularly the high-quality of river junctions and river-street intersections. However, there were concerns relating to spatial fit (how well a reference matches the actual feature). While ponds may be well defined by a central point and radius, long or winding rivers are likely not well suited to the point-radius method. Knowing that shared, geospatial networks are continuing to develop, ichthyology collections, researchers, and collectors should work together towards standards that will provide the best possible geospatial collection data for the future of aquatic research.

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263 SSAR SEIBERT ECOLOGY AWARD, Galleria North, Thursday 23 July 2009

John Willson[1], Brian Todd[2], Christopher Winne[1]

[1]*University of Georgia, Savannah River Ecology Lab, Aiken, SC, United States,*
[2]*Virginia Polytechnic Institute and State University, Blacksburg, VA, United States*

Trap-happiness, Temporary Emigration and Other Factors Affecting Detectability and Population Estimation in Aquatic Snakes

Although mark-recapture methods are among the most powerful tools for monitoring wildlife populations, the secretive nature of snakes has historically hindered the effectiveness of mark-recapture for estimating snake population parameters (e.g., population size, survivorship). Here, we apply advanced mark-recapture methods to gain a comprehensive understanding of the factors that affect capture probability in aquatic snakes, with the goal of maximizing accuracy and precision of population parameter estimates for snakes. Specifically, we used intensive field sampling and robust design mark-recapture analytical methods in program MARK to evaluate factors influencing detectability of two species of aquatic snakes, the banded watersnake (*Nerodia fasciata*) and the black swamp snake (*Seminatrix pygaea*). We constructed a set of a priori mark-recapture models incorporating various combinations of time and group (sex)-varying capture and recapture probabilities, behavioral responses to traps (i.e., "trap-happiness" or "trap-shyness"), and temporary emigration, and we ranked models for each species using Akaike's information criterion. For both *N. fasciata* and *S. pygaea*, we found strong support for time-varying capture and recapture probabilities and strong trap-happy responses, suggesting that the use of standard open population models would violate modeling assumptions and yield biased estimates of population sizes and vital rates. We also found evidence of temporary emigration in S. pygaea that varied between the sexes. This study is among the first comprehensive assessments of factors affecting detectability in snakes and provides a framework for studies aimed at monitoring snake populations.

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369 Snake Ecology, Pavilion East, Monday 27 July 2009

Kevin Wiseman[1], Harry Greene[2], Douglas Long[3], Michelle Koo[4]

[1]Garcia and Associates, San Francisco, CA, United States, [2]Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, United States, [3]Department of Natural Sciences, Oakland Museum of California, Oakland, CA, United States, [4]Museum of Vertebrate Zoology, University of California at Berkeley, Berkeley, CA, United States

Feeding Ecology of the California Kingsnake (*Lampropeltis getula californiae*)

We studied the feeding ecology of the California Kingsnake (*Lampropeltis getula californiae*) through the examination of 2,638 museum specimens from nine natural history collections, in addition to records from published literature, unpublished field notes, and personal communications. Twenty-nine percent of 423 prey items eaten by 374 L. g. californiae were mammals (primarily rodents), 28% were snakes, 25% were lizards, 11% were nestling birds and eggs, 3% were squamate eggs, 1% were unidentified squamate reptiles, and 1% were amphibians. Murid rodents, colubrid snakes, and sceloporine lizards were particularly important prey; rattlesnakes accounted for only 6% of total prey. We detected a positive relationship between snake mass and prey mass; relative prey mass values averaged 0.24 ± 0.19 (range 0.01-0.73; n=43). Differences in kingsnake body size (SVL) between groups that consumed different prey types were highly significant. The relative frequency of lizards consumed was negatively correlated with SVL, while relative frequencies of rodents and bird eggs and nestlings were positively associated with SVL; California kingsnakes consumed snakes with similar frequency throughout life. During the months of April, May, and June, lizards, rodents, and snakes were the most frequent prey types taken, respectively. Seasonally available prey such as the eggs and nestlings of birds and squamate eggs were consumed from April to August. Kingsnakes from arid bioregions, particularly the Mojave and Sonoran Deserts, consumed significantly more snakes, fewer rodents, and fewer lizards than *L. g. californiae* from non-arid, temperate bioregions.

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643 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Sharon Wise[1], Bryant Buchanan[1], Patrick Dawes[2]

[1]Utica College, Utica, NY, United States, [2]Nashville Zoo, Nashville, TN, United States

Artificial Night Lighting Alters Surface Activity of Red-backed Salamanders

Expansion of human habitation near and within natural habitats increasingly exposes wildlife to pollutants. Light pollution, night lighting in naturally dark areas due to artificial sources, has the potential to alter the behavior of nocturnally-active

amphibians. Exposure of amphibians to constant bright light in the laboratory causes changes in activity patterns, metabolism, and growth. However, the impact of artificial night lighting comparable to that in affected habitats has not yet been addressed widely in the literature. We examined changes in nocturnal activity of Red-backed Salamanders (*Plethodon cinereus*) exposed to natural and artificial night lighting in both the natural habitat and in the laboratory. On humid and rainy nights, these woodland salamanders emerge from under cover objects and forage above-ground. We hypothesized that artificial night lighting would delay emergence from under cover objects. We tested this hypothesis in twelve 16-m forest transects in which six were artificially lit (10^{-2} lx) and six were left dark (10^{-4} lx). We found fewer salamanders active 1 h after dark in the lighted transects, suggesting a delay in time of emergence for salamanders in lighted transects. In a laboratory experiment, we tested this hypothesis by examining the effect of four different nocturnal light levels (10^{-4} to 100 lx) on emergence time and nocturnal activity. Salamanders emerged sooner and were active longer under darker conditions. Our results suggest that artificial night lighting has the potential to alter the normal nocturnal activity of salamanders associated with foraging and breeding.

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74 SSAR SEIBERT CONSERVATION AWARD, Galleria North, Friday 24 July 2009

Samantha S. Wisniewski, Scott E. Henke

Caesar Kleberg Wildlife Research Institute, Kingsville, TX, United States

A Brown Tree Snake Risk Assessment for the Continental United States

Brown tree snakes (*Boiga irregularis*) are a mildly venomous, rear-fanged constrictor that is native to Australasia. These snakes were unintentionally introduced to the island of Guam sometime after WWII, possibly on a cargo shipment from Australia. Due to population explosions around 1960, the brown tree snake (BTS) is now an exotic invasive causing significant economic, biological, and human health problems on Guam. Brown tree snakes have been found in Hawaii, Texas, Alaska, and Oklahoma as hitchhikers in planes, ships, and cargo coming from Guam. Risk of brown tree snake invasion is expected to increase greatly over the next 10-12 years due to extensive military expansion and development on Guam. A similarity assessment was completed using climatic data from both the native range and the invaded range of BTS to compare to locations in the continental United States. Climatic suitability, along with shipping data from Guam to the continental United States (military household goods, cargo, and commercial shipment destinations and weights as well as data on missed inspections) helped define high-risk areas for BTS introduction. High-risk areas are important targets for the North America Brown Tree Snake Control Team (NABTSCT) for increased public education, training and awareness.

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880 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Guin Wogan[1,2]

[1]University of California, Berkeley, Berkeley, CA, United States, [2]California Academy of Sciences, San Francisco, CA, United States

Testing Refugial Hypotheses and Ancestral Range Changes in the *Fejervarya limnocharis* species complex (Anura: Dicroglossidae)

The geologic history of Southeast and Insular Asia is highly dynamic. Changes in sea levels have dramatically altered the connectivity of landmasses, particularly those lying on the Sunda Shelf, giving rise to highly complex biogeographic histories across the region. Here I investigate the phylogeographic patterns of a widespread "weedy" species complex (*Fejervarya limnocharis*) distributed throughout Asia. 650 individuals were sequenced for two mitochondrial and one nuclear gene revealing deep genetic divergences and substantial geographic structuring. Two approaches are used to investigate the phylogeographic patterns: in the first GIS models are built reconstructing 26 natural habitat types, thereby creating snapshots of the changing landscape throughout the Pleistocene. These landscapes are then coupled with spatially-explicit individual based coalescent simulation approaches, to develop and test refugial hypotheses. In the second approach, ancestral range reconstructions are generated using a spatially-explicit Maximum Likelihood approach. Congruent phylogeographic patterns are further examined.

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888 Herp Conservation I, Grand Ballroom I, Saturday 25 July 2009

David Wojnowski[1], Patrick Malonza[2]

[1]University of North Texas, Denton, TX, United States, [2]National Museums of Kenya, Nairobi, Kenya

When is a Worm not a Worm? When it is a Critically Endangered Caecilian

An investigation was conducted on the effects of a conservation workshop and naming contest for the Sagalla caecilian *Boulengerula niedeni* on southeast Kenyan villagers' perspectives about this animal (n=18). Most caecilians are underground dwelling amphibians often mistaken for other vertebrate and/or invertebrate animals (e.g. snakes or worms). Prior to the contest, many villagers of Sagalla Hill would kill any large caecilian they dug up while tilling their fields thinking it was a snake, while smaller specimens were killed indiscriminately as they were considered worms and insignificant. The Sagalla caecilian, rated critically endangered by the World Conservation Union, is found only on Sagalla Hill where available suitable habitat is

limited and being altered at an alarming rate, however, this species seems tolerant of small-scale farming efforts. This study determined that having an indigenous name, "kilima-mrota", for this strange animal helped participating villagers to differentiate the Sagalla caecilian from snakes and worms and, coupled with increased knowledge and understanding of its ecology and biology, tended to increase contest participants' perspectives toward a more positive orientation as well as sharing this information with others in their families and community.

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586 Herp Biogeography, Galleria North, Saturday 25 July 2009

Dustin A Wood[1], Robert N Fisher[1], Andrew T Holycross[2], Julio A Lemos Espinal[3]

[1]U.S. Geological Survey, Western Ecological Research Center, San Diego Field Station, San Diego, CA, United States, [2]Arizona State University, School of Life Sciences, Tempe, AZ, United States, [3]Universidad Nacional Autonoma de Mexico, Laboratorio de Ecologia, Los Reyes Iztacala, Edo de Mexico, Mexico

Conflicting Phylogenetic Signals in the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*): Unraveling Historical versus Contemporary Patterns of Diversity

We analyzed the phylogeography and population genetic variation of the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*) using rapidly evolving mitochondrial and nuclear DNA sequence data. This highly aquatic species is distributed along the headwaters of the Gila River system in Arizona and New Mexico, and sporadically throughout much of the Sierra Madre Occidental in Mexico. Due to the threatened status of *T. rufipunctatus* in the U.S. and the uncertain phylogenetic relationships among U.S. and Mexico populations, understanding how genetic variation is partitioned across their rare and often patchy aquatic habitat is a key component of their future management. Phylogenetic analyses based on mtDNA identify three major clades, one corresponding to all U.S. and northern Sierra Madre populations and two within the southern Sierra Madre Occidental. Nuclear DNA sequences from two unlinked introns displayed low levels of variation and differed in topology with respect to each other and/or the mtDNA genealogy. However, within each nuclear genealogy no alleles were shared between U.S. and Mexico populations, corroborating the geographic exclusivity of these northern populations. Our results suggest that the mtDNA genealogy provides a snapshot of historical diversification, while patterns of nuclear variation reflect more recent and current interactions among populations. Since both mtDNA and nuclear data provide evidence that U.S. populations contain a unique subset of the total genetic diversity found throughout the range of the species, we discuss important management practices that can mitigate critical losses of genetic diversity in an already threatened landscape.

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885 SSAR SEIBERT SYSTEMATICS & EVOLUTION AWARD, Galleria North, Friday 24 July 2009

Perry Wood[1], Todd Jackman[1], Aaron Bauer[1], Lee Grismer[1], Kumthorn Thirakhupt[1], Anchalee Aowphol[1], Jesse Grismer[1], Chan Kin Onn[1], Norhayati Ahmad[1]

[1]Universiti Kebangsaan, Bangi, Malaysia, [2]Chulalongkorn University, Bangkok, Thailand, [3]La Sierra University, Riverside, Ca, United States, [4]Villanova University, Villanova, United States

Systematics of the Genus *Acanthosaura* Gray 1931 (Squamata: Agamidae) Inferred from Mitochondrial and Nuclear Genes

The Southeast Asian lizard genus *Acanthosaura* is distributed throughout Myanmar, Thailand, Cambodia, Laos, China, Malaysia, and its offshore islands, Pulau Aur, Pulau Tioman, Pulau Penang, Pulau Perhentian, and Pulau Langkawi. I investigated the phylogenetic relationships of all nine of the currently recognized species of *Acanthosaura* using one mitochondrial gene (ND2 859bp) and two nuclear genes (KIF24 502bp; PRLR 583bp). Maximum parsimony, maximum likelihood, and Bayesian analyses of the mitochondrial DNA recover the wide-ranging *Acanthosaura lepidogaster* as a paraphyletic group. *Acanthosaura lepidogaster* from Vietnam, Laos, and China form a monophyletic group, but *A. lepidogaster* from Myanmar are sister to *A. crucigera* from Thailand and southern Myanmar and an undescribed species from Cambodia. Acanthosaura *bintangensis* and *A. titiwangsaensis* form a monophyletic group with *A. armata*. There are two distinct clades within in the *A. armata* clade, one from the Seribuat Archipelago and the rest from Peninsular Malaysia and its other adjacent islands. The nuclear gene trees resolve the shallow nodes but the deeper nodes of the trees were not recovered. This could be due to incomplete lineage sorting.

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960 Poster Session I, Exhibit Hall, Friday 24 July 2009

Julie Worley[1], Justin Touchon[2]

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Reproductive Mode Plasticity Under Conflicting Egg Predation and Desiccation Risk

An organism's fitness is determined by its ability to reproduce viable offspring. For animals that lack parental care, assessing and discriminating between oviposition sites may increase offspring survival. The Neotropical treefrog, *Dendropsophus ebraccatus*, presents an excellent opportunity to evaluate ovipostition site choices in multiple

habitats, since adults demonstrate reproductive mode plasticity and can lay eggs both terrestrially and aquatically in response to canopy shade. Laying eggs in water may subject eggs to hypoxia and aquatic predation but removes the chance of egg desiccation, whereas terrestrial oviposition may lessen predation risk but increase egg desiccation, which varies with canopy shade. To measure adult reproductive choices in response to opposing costs associated with aquatic versus terrestrial reproduction, we 1) quantified aquatic predation risk in a natural setting, 2) tested whether *D. ebraccatus* demonstrates oviposition site discrimination in response to an aquatic egg predator, and 3) measured the individual and combined effects of egg desiccation and aquatic predation risk on *D. ebraccatus* ovipostion decisions. Aquatic egg predation risk is high in nature and the presence of an aquatic egg predator altered reproductive mode choices by *D. ebraccatus*. Not only did *D. ebraccatus* discriminate against pools with aquatic egg predators, but aquatic egg predation risk outweighed terrestrial egg desiccation risk, causing frogs to lay out of water even in unshaded habitats where desiccation risk is high. Plastic oviposition site choices by adults can be made in response to egg-stage risks in multiple habitats and adults make fine-tuned decisions to increase egg survival.

1005 Fish Ecology III, Pavilion West, Monday 27 July 2009

Clare Wormald[1], Mark Steele[1], Graham Forrester[2]

[1]California State University, Northridge, CA, United States, [2]University of Rhode Island, Kingston, RI, United States

Positive Effects of Group Living on Recruitment and Survival of a Harvested Coral Reef Fish

Effective conservation and management strategies are needed to sustain harvested coral reef fish populations that are impacted by overexploitation and habitat loss, however, little is known about how the demographic rates of harvested reef fish respond to fluctuations in population density. We used a large-scale density manipulation of a harvested coral reef fish, the schoolmaster snapper (*Lutjanus apodus*), to test for effects of population density on recruitment and survival. The experiment uncoupled the relationship between density and habitat, revealing positive effects of high population density on recruitment during an ontogenetic shift from nursery habitats to coral reefs, and positive effects of group living on survival in late juvenile and adult schoolmasters. These positive effects of density on recruitment and survival of the schoolmaster contrast with the results of most studies on small, non-exploited coral reef fishes. Positive effects of group living detected in the schoolmaster imply that regulatory mechanisms that would help populations recover from overfishing may be absent in this species, but that marine protected areas may be particularly effective for management of this species.

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986 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Amber Wright

University of California Davis, Davis, CA, USA

Lizard (*Anolis sagrei*) Niche Breadth Changes with Experimental Manipulation of Perch Availability: Males Specialize, Females Generalize

I compared lizard perch use between 4 treatment plots (4"x4" posts added as artificial perches) and 4 control plots. Plots were unenclosed 5 x 5 m vegetated areas inhabited by naturally occurring resident lizards (brown anoles, *Anolis sagrei*). Plots were established on Staniel Cay (Exuma Chain, Bahamas) in Sept 2007, and behavioral observations continued through May 2008. The addition of artificial perches resulted in the availability of novel resources for this site, as posts were much wider and taller than the naturally occurring vegetation. On average, lizards in treatment plots used wider perches than lizards in control plots, with treatment males using perches roughly twice as wide as treatment females. Treatment females became more generalized relative to control females, while treatment males became more specialized. This pattern is explained by shifts in the types of resources used: treatment males largely shifted onto wider perches, while treatment females expanded their resource use across niche space. These sex-specific responses are likely explained by brown anole social structure: males defend territories that contain several females. The artificial perches were much taller than the natural vegetation, and therefore may have facilitated vigilance and transmission of visual displays. Alternatively, the artificial perches may be more important for thermoregulation in males as they are much larger. Overall, the observed niche breadth flexibility and rapid behavioral shift to utilizing novel resources may be related to this species' success as an invader of both disturbed and non-native areas.

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911 Poster Session II, Exhibit Hall, Saturday 25 July 2009; ASIH STORER ICHTHYOLOGY AWARD

Jeremy Wright

University of Michigan, MI, United States

Aposematism and Müllerian Mimicry in a Group of Lake Tanganyikan Catfishes

The *Synodontis* species of Lake Tanganyika all share, at some point in their ontogeny, a color pattern that is unique in this genus of over 120 known species. Though this strong similarity in color pattern has been noted by various authors, no selective scenarios have been advanced to explain this conservative pattern of coloration. The results of experiments using two Tanganyikan *Synodontis* species (*S. multipunctatus* and *S.*

petricola) with a model predatory fish species (*Micropterus salmoides*) indicate that the color pattern found in these catfishes is aposematic in nature. Individuals of the predator species quickly learned to avoid attacking each Tanganyikan *Synodontis* species. Multiple controls indicated that the presence of the common Tanganyikan color pattern was solely responsible for preventing additional attacks by *M. salmoides* individuals. Individuals of the predator species that had learned to avoid attacking one Tanganyikan *Synodontis* species would also not attack when presented with its Tanganyikan congener. The fact that either *Synodontis* species was able to serve as an aposematic model for its congener strongly suggests that this system represents an example of Müllerian mimicry, the first such case to be reported in fishes. These results strongly suggest that selection from Lake Tanganyikan predators, rather than simple nonadaptive retention of an ancestral color pattern, is responsible for the strong similarity of color pattern between Tanganyikan *Synodontis* species.

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562 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Elvis H. H. Wu, M. Christine McMahon, Richard Mayden

Saint Louis University, St. Louis, MO, United States

Social Networking and Cyber-enabled Scientific Collaboration in the Nomenclatorial Process: A Case Study from North American Freshwater Fishes

Names in scientific nomenclature serve as critical objects with which a plethora of information is and can be indexed and connected in cyberspace. With the increasing number of revisionary studies emerging from phylogenetic research and the need to have taxonomies logically consistent with phylogenetic relationships, taxonomies are currently in various stages of fluidity with emerging changes. Traditionally, name changes require considerable time following publication and involve limited input from individuals. Emerging cyber technologies provide outstanding opportunities to enhance community participation and expedited changes. We propose a new social networking-based and community-driven nomenclature system to aid in these objectives. The system integrates two web applications beneficial for biodiversity studies. We adopt database applications to provide species data. We also use a blog system that allows registered users to post proposed changes, announce new publications, or discuss proposed name changes. Users may also post content information regarding a proposed taxonomic change. The system provides also announces recent changes for comment and the most up-to-date list of species and their current classification that can be used to link out to other resources about groups. The advantage of this system is that it records and tracks change on posts and comment information, allows user input, and provides the community with free and current information. The registration procedure for the system also allows the community to use this tool as an academic resources needed for nomenclatorial discussion as well as an educational tool for non specialists interested in following the scientific process.

810 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009; AES GRUBER AWARD

Barbara E. Wueringer[1], Lyle Squire Jr.[2], Stephen M. Kajiura[3], Nathan S. Hart[1], Shaun P. Collin[1]

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Functional Adaptations of the Elongated Rostrum of Pristid Sawfish

Within batoids, the two families of sawfish (extinct sclerorynchids and extant pristids), which are both derived from rhinobatid shovelnose rays, have evolved an elongated rostrum. Comparison of the internal structure of the rostrum in the three taxa indicates that in pristids the anterior portion of the rostrum lengthened, which results in a slimmer construction than that of the sclerorhynchid rostrum. Moreover, pristid rostral teeth grow continuously from the base, whereas sclerorhynchids possess functional rostral teeth and dormant replacement teeth. Both characteristics present in pristids are interpreted as adaptations to reduce weight and therefore allow fast lateral swipes of the rostrum during food manipulation, as observed in freshwater sawfish, *Pristis microdon*. Comparison of the two dimensional sensory array of the electroreceptive ampullae of Lorenzini in rhinobatids and pristids reveals how the elongation of the rostrum may have expanded the food spectrum of pristids: the total number of ampullary pores distributed ventrally on the head and rostrum of the pristid *Anoxypristis cuspidata* (490.3±68.7) equals that of the rhinobatids *Glaucostegus typus* (452.0±162.8) and *Aptychotrema rostrata* (461.5±17.7). However, *A. cuspidata* possesses more than seven times the number of pores on the dorsal surface of the rostrum (297.1±56.6 pores) than the rhinobatids (*A. rostrata* 40.7±2.3 pores, *G. typus* 24.9±5.1 pores), indicating that pristids can potentially sense the electric field of prey in the water column. Behavioural experiments demonstrate that, in *P. microdon*, the ability to detect weak electric fields in the water column might come with a decreased sensitivity for electric fields simulating benthic prey.

11 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Leren Xu, Hong Chen, Kaigong Wang, Dongmei Yang

Guizou University, Hauxi, Guiyang, Guizhou, China

Mast Cell Reaction in the Lesion Tissues of Sparganosis in Frog *Rana nigromaculata*

Hauxi district of Guiyang,China is know to be an endemic area of sparganosis in frog (*Rana nigromaculata*). Histopathological study of sparganosis in frog (*Rana nigromaculata*) was carried out to detect the possible relactionship between mast cell reaction and the forming of the lesion of sparganosis. The characteristic lesions of frog sparganosis included cavitary necrosis by moving of the larvae, granulomatous reaction by infratration of eosinophils, neutrophils, macrophages and lymphoid cells, and proliferation of epithelioid cells and fibroblast cells. It was noted that mast cells proliferated remarkablely in the granulomatous lesion which intend to around the wall of the cavitary necrosis by moving of the larvas, and also diffused among the lesion tissue. The mast cell desidy (MCD) in the muscle tissuse around the lesion of affected frog(86±15/ mm^2) was significantly higher than that in the unaffected frog(9±3/ mm^2) (P<0 .001). In a few cases entirety fragmatation following death of the larva was found. It was suggested that there are close relationship between mast cell reaction and the forming of the eosinophil granulomatous lesion, and mast cell may play an important role in anti-parasite immuno-reaction in frog sparganosis.

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455 Poster Session I, Exhibit Hall, Friday 24 July 2009

Katharine Yagi, Jacqueline Litzgus

Laurentian University, Sudbury, Ontario, Canada

Spatial Ecology and Thermoregulation of Spotted Turtles (*Clemmys guttata*) in a Southern Ontario Population

Ectotherms have evolved behavioural and thermoregulatory mechanisms to adjust body temperatures to minimize energetic costs. Assessing habitat selection is important for describing thermoregulatory behaviour since ectotherms choose habitats based on their thermoregulatory needs. One such behaviour is aestivation; a summer dormancy that includes inactivity, fasting and physiological adjustments to protect against water loss. The purpose of this project is to determine the effect of changing habitat (i.e., flooding) on the spatial ecology and thermoregulation of spotted turtles (*Clemmys guttata*), specifically looking at aestivation. Spotted turtles from a population in southern Ontario will be radio tracked, and body temperatures (T_b) and environmental temperatures (T_e) recorded. To examine the relationship between thermoregulation and habitat selection, artificial turtle models outfitted with temperature loggers will be placed throughout the

available habitat. Temperatures chosen by turtles will be compared to those available to determine if habitat selection is related to thermal properties. Spotted turtle preferred body temperature (T_{set}) will be determined by observing active individuals in a thermal gradient. We will examine whether turtles in nature choose habitats based on thermal properties that allow them to maximize time spent at T_{set}. Spatial ecology will be compared before and after the habitat change using historical radio telemetry data collected by the Ministry of Natural Resources and data collected during the current study. Understanding the response of a species at risk, such as the spotted turtle, to a rapid change in habitat will help biologists determine the best long-term course of action to take to maintain populations.

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408 AES Conservation & Management I/AES Age & Growth, Parlor ABC, Friday 24 July 2009

Atsuko Yamaguchi, Keisuke Furumitsu, Gen Kume

Nagasaki University, Nagasaki, Japan

Elasmobranch Fauna in Ariake Bay, Japan

The study area-Ariake Bay-is recognized as an estuary, which has the largest tidal flat in Japan. This study aims to elucidate the species composition, abundance, and habitat of elasmobranchs in Ariake Bay. Samples were collected using small bottom trawlers, set nets, gill nets, and bottom long-lines from almost all areas of Ariake Bay. A total of 255 fish species including 21 elasmobranchs (9 sharks and 12 skates and rays) were identified, of which at least 59 species (5 elasmobranch species) were recorded for the first time in the study area. The most abundant elasmobranch genus was *Dasyatis*, which comprised at least 6 species (*D. akajei*, *D. laevigata*, *D. zugei*, *D. izuensis*, *D. acutirostra*, and *Dasyatis* sp.). From the central region of the bay, we could collect samples quantitatively: we found that elasmobranchs (especially rays) were more abundant than the teleostean species. The most abundant species was the fanray, *Platyrhina sinensis*. Some species such as *P. sinensis* and guitarfish *Rhinobatos hynnicephalus* were not found in the inner part of the bay. On the other hand, Myliobatiforme such as stingrays (Dasyatidae) and eagle rays (Myliobatidae) were distributed widely throughout the bay. At least 11 elasmobranch species, including Myliobatiforme and scalloped hammerhead shark *Sphyrna lewini*, use the rivers, which flow into the innermost area of the bay, and the tidal flat areas in the inner part of the bay as their nursery ground.

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687 Cypriniformes Tree of Life, Pavilion East, Sunday 26 July 2009; ASIH STOYE AWARD GENERAL ICHTHYOLOGY

Lei Yang

Saint Louis University, Saint Louis, MO, United States

Cypriniformes Tree of Life: Phylogenetic Relationships of the Cyprinid Subfamily Cyprininae (Ostariophysi: Cypriniformes) Inferred from Mitochondrial and Nuclear Sequence Data

As the largest subfamily of the Cypriniformes, Cyprininae currently contains roughly 100 genera and 1,300 species, and many undescribed species still exist in the tropical waters of the world. This group contains barbins (e.g. *Barbus*), labeonins (e.g. *Labeo* and *Garra*), cyprinins (e.g. common carp and goldfish), and schizothoracins (snow trouts). Many of these species are important as food fish, aquarium species, and in biological research. Despite the diversity and importance of cyprinines, the phylogenetic relationships of this clade have never been investigated using a large number of taxa from most of the range of the clade and a large number of characters. For this study, more than 150 taxa, representing over 60 genera of all four tribes of the Cyprininae were sampled for sequence data. Our analyses are based on five mitochondrial genes (COI, cytochrome b, 16S, ND4 and ND5) and four nuclear genes (RAG1, Rhodopsin, EGR2B and IRBP) evaluated using maximum parsimony, partitioned maximum likelihood, and partitioned Bayesian methods. The subfamily Cyprininae was revealed as a monophyletic group. The tribe Labeonini was also robustly resolved as monophyletic. None of the other three tribes (Barbini, Schizothoracini, and Cyprinini) were monophyletic. The phylogenetic relationships within each tribe will be discussed.

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410 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Shao-Min Yang[1], Szu-Lung Chen[2], Yu-Teh Lin[1]

[1]Institute of Ecology and Evolutionary Biology, National Taiwan University, Taipei, Taiwan, [2]Animal Department, Taipei Zoo, Taipei, Taiwan

Coexistence Mechanism of Two Agamid Lizards in Northern Taiwan

The geographic distribution of *Japalura swinhonis* and *Japalura polygonata xanthostoma* overlap in northern Taiwan. The two species coexist in some localities, but not others. We investigated whether differences in morphology (standardized for overall sizes) occurred between sympatric and allopatric populations (a precondition for character displacement). We found morphological differences in head height and head dimensions, and limb shapes, including right hindlimb. Since head dimensions may

affect bite force and fighting ability, and limb shapes may affect motion performance, it suggested a trade-off between fighting and motion ability in the two species.

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299 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Huang Yong Cheng, Lue Guang Yang

National Taiwan Normal University, Taipei, Taiwan

Resource Partition and Habitat Preference of *Japalura luei* in Taiwan

Japalura luei is a rare and endemic agamidae lizard in Taiwan. The distribution range, population size and information about its ecological requirements of this lizard are limited. In this study, we tried to investigate morphological difference between sexes, habitat preference, distribution range, population age structure and resource partition of them in Taiwan. Our survey indicated that *J. luei* was mainly found near the mixed forest in Northern Taiwan with red false-cypress and Japanese Cedar in Nanao. The estimated population size by mark-recapture method was about 485 individuals. The SVL of males is 65.95 mm, females is 62.71 mm. The male lizards mainly were found on the conifers (73%). As for the forest layer preference, male lizards prefer to stay on the main trunk (95%), following by on the branch (5%). While the females, choose to stay on different parts of the tree, mainly on the clump (67%). On the average, the male lizards stay at the height of 115.4 cm above the ground, while the females prefer at the height of 87.9 cm above the ground. As for diurnal activities, mainly from ten in the morning to two in the afternoon. During the night, *J. luei* used the ferns 87%, branches of the tree 9% and the brushes 4% as resting places. We know the different microhabitat preference between different sexes, and the information about to ecological requirements of this rare species, this can provide information for the conservation and management strategy in the future for this endemic lizards in Taiwan.

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736 Poster Session III, Exhibit Hall, Sunday 26 July 2009

Laurel Young, Richard Mayden

Saint Louis University, Saint Louis, MO, United States

Cypriniformes Tree of Life: Reanalyzing Reproductive Behaviors in North American Minnows

North American minnows (Family: Cyprinidae) display diverse spawning behaviors which are usually combined into categories such as broadcasting, crevice spawning, egg clustering, and mound-building. Each group has a collection of similar behaviors but within each category there is much variation between different species. In addition,

when these spawning modes are overlain on a phylogenetic tree, it appears that each reproductive type has evolved multiple times. To search for a more parsimonious explanation, individual reproductive morphological characteristics and actions for each species of Cyprinidae were collected. The particular characters were coded in binary states and entered into the computer program MacClade in which to conduct a parsimony analysis. After comparing this new phylogeny to a current tree based on molecular data, preliminary data points to the likelihood that discrete characters have evolved once or a small number of times. Each extant species, therefore, displays a unique assortment of behaviors. Although the collective breeding actions in each species may resemble each other, the evolutionary history of reproduction in minnows is best explained through the evolution of discrete characters. From this analysis we can more fully understand the evolution of these minnows and clarify some misleading classifications of breeding behaviors.

1000 General Ichthyology I, Pavilion East, Saturday 25 July 2009

Shawn Young[1], Jeff Isely[2], Tim Grabowski[3], Patrick Ely[4]

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Age, Growth and Reproductive Biology of Catostomids from the Apalachicola River, Florida, USA

We collected Grayfin Redhorse *Moxostoma* n. sp. cf. *poecilurum* (n = 134), Spotted Sucker *Minetryma melanops* (n = 102), and Quillback *Carpiodes cyprinus* (n = 102) to determine age, growth and reproductive biology of spawning catostomids in the Apalachicola River. The information provided herein for grayfin redhorse is the first detailed description of life history parameters for this undescribed, endemic species. Scales and otoliths revealed the maximum ages of grayfin redhorse and spotted suckers were 9-10 years. Quillback ages were 13-30 years. Scales underestimated ages of quillback. Grayfin redhorse aggregated and spawned from mid-February to mid-April over main-channel gravel-bar habitat, overlapping spatially and temporally with spotted sucker spawning. Quillback spawned later over a sand-gravel substrates frequently in close proximity to riverbank habitat and were usually captured in smaller groups of 4-10 individuals. Quillback was the smallest in total length at age; longest-lived; most fecund; and produced the smallest eggs. Grayfin redhorse was the largest in body size; had an intermediate life span; and produced the fewest yet largest eggs. Spotted sucker was more similar to grayfin redhorse in most characteristics. Several highfin carpsuckers *Carpiodes velifer* were also captured, signifying a range extension for the species.

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107 AES Functional Morphology Symposium, Grand Ballroom II, Friday 24 July 2009

Kara Yopak, Lawrence Frank

University of California San Diego, San Diego, CA, United States

Defying Evolutionary Expectations: Analysis of the Brain of the Whale Shark, *Rhincodon typus*, using Magnetic Resonance Imaging

Very little is known about the brain organization of the suction filter feeder, *Rhincodon typus*, and how it compares to other orectolobiforms, despite its specialized lifestyle. Brain size and overall brain organization was assessed in *R. typus* in relation to both phylogeny and ecology, using magnetic resonance imaging (MRI). In comparison to 60+ chondrichthyan species, *R. typus* demonstrates a relatively small brain for its body size, similar to lamniforms *Carcharodon carcharias* and *Cetorhinus maximus*. *R. typus* possesses a relatively small telencephalon, with some development of the dorsal pallium (suggestive of moderate social behavior), a relatively enlarged diencephalon, and a relatively reduced mesencephalon. The most notable characteristic of the brain of *Rhincodon* is a large, highly foliated cerebellum, one of the largest within the chondrichthyan clade. Enlargement and increased complexity of the cerebellum has been previously seen in active, pelagic species such as *Alopias vulpinus* and *Sphyrna lewini;* potential adaptive pressures for this neural characteristic will be discussed. Early development of the brain was qualitatively assessed from *in situ* MRI images of the brain and chondrocranium of a neonate specimen of *R. typus*. There was evidence that folding of the corpus appears in early development, although depth and number of folds may vary ontogenetically. Hierarchical cluster analysis shows evidence of convergent evolution with the large-bodied, filter feeding shark, *C. maximus*, supporting the claim that organization of the brain is more similar in species with analogous but independently evolved lifestyles than those that share taxonomic classification.

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273 Lizard Ecology, Pavilion East, Friday 24 July 2009

Peter Zani

Lafayette College, Easton, PA, United States

The Effects of Temperature and Body Size on Winter Survival of Side-blotched lizards, *Uta stansburiana*: Results from the Laboratory, Semi-natural Enclosures, and a Natural Population from Eastern Oregon

Winter is typically considered a period of unfavorable conditions that organisms must endure. Yet, recent studies suggest that winter cold can actually benefit organisms in terms of survival and subsequent reproduction. For example, in 2004 Wilson and Cooke

(Ecology 85:3406-17) showed that winter survival of lizards increased with latitude. To further clarify this pattern I conducted experiments on lab, enclosed, and natural populations of side-blotched lizards (*Uta stansburiana*). Laboratory experiments revealed that animals in colder winter environments survived longer and that size was correlated with survival regardless of temperature. In nature, larger adult lizards have a survival advantage over multiple years. However, these data were collected over an entire year and other sources of variation (e.g., predation) cannot be excluded. Thus, I created replicate experimental enclosures in eastern Oregon that contained appropriate hibernacula (cliffs) for overwintering. Just prior to the end of the growing season (mid-October) each enclosure was stocked with eight animals of known size ranging from young-of-the-year to multi-year-old adults. By recapturing survivors in the spring I was able to estimate the effect of body size on survival in semi-natural conditions. Results from multiple years indicate that larger lizards survive winter better in the enclosures. The similarity of the size-survival advantage in the lab, enclosed, and natural populations suggests that the relationship between size and survival represents a consistent selective filter from year to year. This filter may be responsible for certain life-history patterns in organisms, such as the size-number offspring trade-off across the breeding season.

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260 Poster Session II, Exhibit Hall, Saturday 25 July 2009

Yong-Pu Zhang[2], Wei-Guo Du[1], Jian-Wei Shen[1], Lin Shu[3]

[1]Hangzhou Normal Univeristy, Hangzhou, China, [2]Wenzhou University, Wenzhou, China, [3]Quzhou College, Quzhou, China

Low Optimal Temperatures for Food Conversion and Growth in the Big-headed Turtle, *Platysternon megacephalum*

We conducted a feeding trial in juvenile big-headed turtles, *Platysternon megacephalum*, from eastern China at a range of temperatures from 20 ˚C to 29.4 ˚C to determine the effects of body temperature on food digestion, specific growth rate and food conversion, and thus the optimal range of temperatures for aquaculture. Food and energy intake increased significantly from 20 ˚C to 22.4 ˚C, remained at a high level until 27.1 ˚C, and then decreased dramatically to 29.4 ˚C. Similarly, lipid and protein intakes were significantly less at the lowest (20 ˚C) and highest (29.4 ˚C) temperatures than at intermediate temperatures. The digestive efficiency of energy decreased as temperature increased, whereas the digestive efficiency of protein increased from 20 ˚C to 25 ˚C, and decreased at higher temperatures. The relationship between body temperature (T) and specific growth rate (SGR) or food conversion coefficient (C_c) was curvilinear, and could be described by quadratic equations: $SGR = -0.0099T^2 + 0.4708T - 5.2387$ or $C_c = -0.3708T^2 + 17.1983T - 181.8546$. The maximum growth was estimated to occur at 23.9 ˚C, and over 90% of maximal growth rate occurred in the temperature range from 21.9 ˚C to 25.8 ˚C; maximal food conversion coefficient was estimated to occur at 23.2 ˚C, with above 90% of the maximum from 21.0 ˚C to 25.4 ˚C. Taken together, the optimal range of

temperatures for digestive physiology and growth in juvenile *P. megacephalum* was found to be 22-25 °C, which is much lower than those in most freshwater turtles.

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486 Live-Bearing Fish Symposium, Grand Ballroom I, Sunday 26 July 2009

J. Jaime Zuniga-Vega[1], Jerald B. Johnson[2]

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Reviewing the Causal Hypothesis for the Evolution of Superfetation in Livebearing Fishes

Superfetation is the ability of females to carry simultaneously more than one brood at different developmental stages. In poeciliid fishes this interesting reproductive feature has evolved independently several times. We review the phylogenetic distribution of superfetater species within the family Poeciliidae as well as the different hypotheses proposed to explain the evolution of superfetation in this group of livebearing fishes. 1) The resource availability hypothesis claims that superfetation should be favored in low resource environments, as it reduces the peak reproductive demand by partitioning the brood into subsets. 2) The set of demographic hypotheses argue that this reproductive trait could have arisen as a response to either unpredictable juvenile survival, high adult female life expectancy, or low and uncertain adult survival probabilities. 3) The morphological constraint hypothesis aims to explain superfetation as a result of external pressures upon the body shape which in turn restrict the space that females can devote to offspring production. Particularly, in high stream velocity environments or in habitats where fish must swim fast to escape predators, superfetation may allow fish to produce a relatively high number of offspring with a streamlined phenotype. We also review the evidence that supports these main hypothesis as well as the ecological and evolutionary implications of superfetation upon other key life-history traits such as reproductive allotment, level of maternal provisioning, and offspring size.

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