

ABSTRACTS - 2008

JOINT MEETING OF ICHTHYOLOGISTS & HERPETOLOGISTS COMPILED BY M.A. DONNELLY

(for co-authored abstracts, the underlined name indicates the presenter)

0469 General Herpetology I, Salons 4&5, Sunday July 27, 2008

Dean Adams, James Church

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Community Organization in *Plethodon* Salamanders: Categorical but Not Continuous Patterns of Body Size Assortment

A long-standing goal in evolutionary ecology is to determine whether the organization of communities is reflective of underlying deterministic processes. Research on *Plethodon* salamanders has revealed that species interactions are important drivers of phenotypic evolution within communities, and that these interactions play a role in community composition. Specifically, at both a regional and continental scale, the number of large and small *Plethodon* that co-occur at individual localities is highly non-random, suggesting that body size plays an important role in community membership. However, whether these processes generate regular patterns of body size dispersion has not been investigated. In this study, we measured 96,996 adult *Plethodon* from 3,154 geographic localities, and used several null model approaches to determine whether *Plethodon* communities exhibited body size assortment (i.e. community-wide character displacement). We found that only 2-species communities exhibited greater body size dispersion than was expected from chance, whereas communities containing, 3, 4, or 5 species did not. Further, these results are largely explained by the presence of a single large and a single small *Plethodon* at particular localities. Our results suggest that competitive interactions shape communities at a 'categorical' level (i.e. how many large and how many small *Plethodon* can co-exist), but do not further drive the evolution of body size within particular communities.

0294 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

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Biting for Blood: A Novel Jaw Mechanism in Haematophagous Candirú Catfish (*Vandellia* sp.)

Teleostean evolution is characterised by specialisations of the trophic apparatus, where oral and pharyngeal jaw mechanisms have enabled an efficient and highly diverse prey capturing and manipulating behaviour. Oral jaws with immovable premaxillaries being ancestral, many teleostean lineages exhibit an increasing trend towards premaxillary mobility and protrusion, especially extensive in suction

feeding fishes. Immovable premaxillaries are found at least in four lineages of basal teleosts (Osteoglossomorpha, Anguilliformes, Ostariophysi and Protacanthopterygii). The basal condition in catfish (Siluriformes), within the Ostariophysi, also involves plate-like premaxillaries that are strongly connected immovably to the ethmoid. This condition is found in nematogenyids and diplomystids, both considered basal (depending on molecular or morphological evidence, respectively). However, as is the case in many other teleostean lineages, specialised feeding habits in some catfishes have also been linked to premaxillary mobility, as for example in some algae scraping loricariids. A not so distinct relative of these loricariids also comprise taxa showing an extremely unusual feeding habit for a fish, *i.e.* blood sucking. Within the Trichomycteridae, the clade Tridentinae-Stegophilinae-Vandelliinae seems to reflect an evolutionary history towards improved parasitic behaviour, with haematophagy making the candirú vandelliinecatfish notorious. Vandelliines are known to exhibit unusual upper and lower jaws, with specialised teeth on the premaxillaries, assumed to be an adaptation for slashing gill filaments of their hosts. However, the morphology of the jaws (strange shape of ethmoid and premaxillaries, lower jaws without a symphysis) also suggest that the whole mechanism of 'biting' in vandelliines is distinct from that of other catfish, and even other teleosts. This includes novel joints and novel muscles. A detailed morphological analysis of the musculo-skeletal system of the oral jaw apparatus in *Vandellia* sp. and allied trichomycterids, including 3D-modelling, is performed to unravel this apparent novel jaw mechanism.

0416 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Frog Life Below Zero: Oxygen And Antioxidants

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Winter presents a series of challenges for wildlife and, in turn, animals have adapted in their own unique ways to survive multiple stresses on animal physiology and biochemistry. The wood frog, *Rana sylvatica*, uses a remarkable strategy of winter survival - freeze tolerance - and these frogs have been extensively used as a vertebrate model for studying the mechanisms of cryoprotection. During freezing, frogs must endure a variety of stresses including cell dehydration, anoxia/ischemia, and potential tissue damage by ice crystals growing in extracellular fluid spaces. One aspect of survival is a profound suppression of physiological and metabolic processes that leaves cells in a state of low activity. Transitions to and from a hypometabolic state is a closely regulated process which includes selected changes in gene expression under the regulation of a series of transcription factors. FOXO transcription factors have recently been shown to be involved in regulating many cell functions such as cell cycle arrest, apoptosis, and coping with oxidative stress. Oxidative stress can derive from a variety of external and internal sources and it is essential that cells have protective antioxidant defenses that defend against damage caused by reactive oxygen species (ROS). In the case of frozen frogs this can include contributing to long term cell viability over days/weeks in the frozen state and dealing with a surge of ROS production when oxygen is reintroduced to tissues after

thawing. The effect of freeze/thaw on protein levels of FOXO1 and FOXO3 were assessed in wood frog organs using immunoblotting. Transcript levels of *foxo1*, *foxo3*, *catalase* and *MnSOD* were also analyzed by RT-PCR. Catalase and MnSOD (manganese superoxide dismutase) are two key antioxidant enzymes regulated by FOXOs, and show differential expression during freezing. The results demonstrate that regulation of FOXOs and their target genes is important for cellular defense during freeze/thaw.

0084 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008; GRUBER

Age, Growth and Reproduction of the Bering Skate, *Bathyraja interrupta* (Gill & Townsend, 1897), from Alaskan Waters

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Life history traits of a common commercial bycatch species from the Gulf of Alaska were examined. Collections of *Bathyraja interrupta* were obtained from annual surveys, port sampling of commercial catch and observer collections from 2005 to 2007 in the Gulf of Alaska. Observed total lengths for males ranged from 19-82 cm and females from 20-87 cm. There was no difference in mean MIRs amongst months ($n = 131$, $F = 0.903$, $p = 0.481$) using samples from 6 consecutive months. No significant difference was found in *B. interrupta* growth parameters between sexes ($F = 0.8259$, $p = 0.4804$). *B. interrupta* has a relatively short life span with growth parameters comparable to other skates of a similar size ($L_{inf} = 126.40$, $k = 0.07$, $t_0 = -2.32$). Age estimates show a minimum longevity of 12 years for males and 13 for females. Total lengths at 50% maturity were approximately 68 cm for males and 70 cm for females (Males: $r^2 = 0.8836$, $p < 0.0001$, $n = 40$; Females: $r^2 = 0.9947$, $p < 0.0001$, $n = 43$), which corresponds to 7 years and 7.5 years respectively (Males: $r^2 = 0.9937$, $p < 0.0001$, $n = 12$; Females: $r^2 = 0.9969$, $p < 0.0001$, $n = 14$). Gravid females were found in all months between April and September.

0277 Poster Session III, Sunday July 27, 2008

Species Richness and Cladal Diversity in Freshwater Fishes of the Americas

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Species-richness is not distributed evenly among taxa. Most species are members of a few, highly diverse clades, whereas most taxa are species-poor. This sort of distribution with the shape of “hollow curve” is well described by a power function with an exponent close to -1. Power laws describe empirical scaling relationships in a broad range of natural phenomena and are widely used to explain the ecological mechanisms that constrain biodiversity. However, the relationships between species richness and cladal diversity remain poorly understood, and the mechanisms that promote differential net diversification among clades are almost entirely unknown. Here we report species-richness profiles for the two largest freshwater faunas of the Americas; the 'Amazon superbasin' (ASB) and 'Mississippi superbasin' (MSB), with regional boundaries delineated by hydrogeographic and ichthyofaunal criteria. ASB fishes from tropical South and Middle America include 5,738 species in 65 clades, and MSB fishes from temperate and subtropical eastern North America include 954 species in 88 clades. Species-richness was assessed among clades (*i.e.*, species or higher taxa) with evolutionary origins in freshwater, rather than among taxa of a given Linnaean rank (*e.g.*, family). Biogeographic age calibration was used to estimate minimum clade ages from the geological dates of vicariant events that isolated sister taxa. We find strong associations of species richness with two clade-level properties, phylogenetic age and geographic range, and with an organismal property, mean body size. We also report for the first time an inverse relationship between species-richness and the power function exponent of dominance-diversity curves, suggesting that the rate of cladal diversification is dependent on species-richness. Neotropical freshwaters retain a relatively intact Gondwanan diversity, in comparison with the depauperate ichthyofaunas of other continents due to Neogene cooling and aridification; *i.e.*, the exceptional Neotropical species-richness is a relict of the Late Cretaceous-Early Tertiary global greenhouse.

0492 Poster Session I, Friday July 25, 2008

Target-Training in the Brownbanded Bamboo Shark (*Chiloscyllium punctatum*) and Nurse Shark (*Ginglymostoma cirratum*)

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The capability of sharks learning repetitive tasks was undertaken in this experiment. One male bamboo shark *Chiloscyllium punctatum* (63 cm TL) and one male nurse shark *Ginglymostoma cirratum* (110 cm TL) held in captivity since the beginning of 2007, were used in this experiment. Between September 2007 and April 2008, 61

trials were conducted to determine if these sharks could distinguish between colors (black square vs. white square targets), and shapes (white circle vs. white square targets). The sharks were trained to correctly identify with the targets using a reward system. The rewards were obtained when the sharks correctly hit their snout against the white square target for distinguishing between color and shape. The bamboo shark could obtain a maximum of eight pieces of fish, whereas the nurse shark was allowed a maximum of three, consistent of a normal regimen used by the aquarium. The bamboo shark correctly identified both the color and shape targets 437 out of 488 opportunities (89.5%), the nurse shark had a success rate of 167 out of 183 (91.2%). The assumption that some species of sharks rely on their barbels: as a means of identifying objects, rather than sight was also investigated. Initial response time varied, but decreased over time. The sharks appear to rely more on their eyesight for color distinction than on tactile behavior for shape discrimination. (Supported funding Ripley's Aquarium, South Carolina, Advisor Dr. Dan Abel)

0213 Herp Reproduction, Salons 4&5, Sunday July 27, 2008

The Relationship Between Mating Season and Vitellogenesis in the Colubrid Snakes of North America

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Snakes in the family Colubridae are diverse and widespread. In temperate North America, the reproductive cycles of the three subfamilies considered here, Colubrinae, Natricinae and Xenodontinae, are similar in both sexes. Females begin vitellogenesis in the spring and ovulate in late spring to early summer. In both oviparous and viviparous species, the young are hatched/born in the summer. Estrus, the period of time when females are sexually attractive and receptive, occurs in the spring (unimodal) in all species and in the summer/fall (bimodal) in some species. The age of the sperm at fertilization is identical in both mating patterns. The major difference between snakes with the unimodal and bimodal patterns is where the sperm are stored during the winter; in the vas deferens in unimodal snakes and in the oviduct in bimodal snakes. A phylogenetic analysis of the occurrence of the unimodal and bimodal patterns suggests that these traits are phylogenetically plastic, however, the bimodal pattern is more prevalent in small semifossorial species. Elevated plasma testosterone levels coincide or immediately precede the mating seasons. In most colubrids spermatogenesis begins after the spring mating season, a pattern described as post-nuptial spermatogenesis. There are, however, several species of snakes in which spermatogenesis begins before mating, a pattern termed pre-nuptial spermatogenesis.

0146 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Manta Rays, *Manta birostris*, in the Maldives: Seasonal Distribution and Economic Value

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The Republic of Maldives in the central Indian Ocean is home to large numbers (many '000s) of Manta Rays, *Manta birostris*. They are an important component of the nearshore pelagic ecosystem, and a significant attraction for tourist divers and snorkellers. The aims of this study were to map the seasonal distribution of manta rays within the Maldives, and to assess their economic value for tourism. Seasonal distribution and economic value were determined from personal observations, interviews with experienced divers and a national survey of fishermen. The distribution of Mantas is strongly influenced by the seasonally alternating monsoon currents. Mantas occur on the (seasonally alternating) downstream sides of the atolls, and are rare on the upstream sides, switching sides biannually with changing currents. Manta presence is correlated with turbidity and ocean colour, both proxies for zooplankton abundance. Diving and snorkelling with Mantas is estimated to be worth about US\$ XX million per year. Tourism is the largest sector of the Maldivian economy; appreciation of the value of marine-life, and particularly of the charismatic mega fauna, can play a major role in its conservation.

0209 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

Egg Morphology of Species in the Tribe Gobiosomatini (Teleostei: Gobiidae) Using Scanning Electron Microscopy

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The tribe Gobiosomatini (American seven-spined gobies) comprises 40% of the New World gobiid fauna (Birdsong & Robins, 1995). They occupy diverse habitats for which an adaptive radiation pattern has been hypothesized (Ruber et al., 2003). Scanning electron microscopy was used to examine morphological egg characters, which were then mapped on a known phylogeny to elucidate relationships and examine character congruence between and within genera in Gobiosomatini. The resulting tree was examined for patterns relating to phylogeny, habitat and environmental stimuli. Egg differences among genera were noted with respect to: shape, distance between eggs, length of long and short axes, zona radiata thickness, width of and pattern surrounding micropylar region, length of filament region attached to the substrate, filament base width and egg-to-substrate distance. The zona radiata thicknesses varied greatly from 0.7µm (*Coryphopterus dicrus*) to 6µm (*Bathygobius soporator*). Interesting vegetal pole protuberances were noted in both

Elacatinus oceanops and *Tigrigobius macrodon*. Morphological egg plasticity and dispersal pattern of *Bathygobius soporator* were examined, and the characters were not found to vary significantly when altering the microhabitat substrate. Egg characters did not vary significantly when laid on natural or unnatural substrate in *Gobiosoma ginsburgi*. Other relationships among these parameters were considered and will be discussed.

0381 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Temperature Insensitivity Of Chameleon Tongue Projection: Maintaining Performance At Low Temperature Via An Elastic Power Amplifier

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Ectotherms such as lizards are constrained in their activity by the impact of environmental factors on their physiology, for example, the effect of temperature on muscle contraction velocity. Low temperatures are expected to hinder the ability of many lizards to pursue prey by impacting performance of muscle-powered movements such as locomotion and tongue protraction. Chameleons are unusual among lizards in that they do not pursue prey by chasing and lunging, but instead use ballistic tongue projection to ambush prey. We hypothesize that chameleons are able to maintain tongue projection performance at low temperatures—despite the strong influence of temperature on muscle dynamics—by virtue of their tongue projection mechanism, which uses rapid elastic recoil of collagenous sheaths within the tongue. We further hypothesize that tongue retraction performance, which relies on the retractor muscle doing work directly on the tongue and prey, is affected strongly by temperature. To test our hypotheses, we imaged *Chamaeleo calypttratus* at 3000 Hz feeding on crickets at 15-35°C. For each feeding event, we calculated average and instantaneous velocity, acceleration and power of the tongue and calculated Q_{10} values for both projection and retraction. In accord with our hypothesis, our results reveal that *C. calypttratus* is able to maintain tongue projection performance over the examined temperature range and that velocity of elastically powered projection is far less sensitive to temperature ($Q_{10}=1.03$) than muscle-powered retraction ($Q_{10}=1.65$). The temperature insensitivity of tongue projection, combined with the ambush hunting strategy of chameleons, may ease temperature limitations on their activity patterns and may explain observations of chameleon activity over a wider temperature range than sympatric lizard species. Other elastically powered movements, such as frog jumping and salamander tongue projection are expected to show a similar pattern, which may be a general mechanism by which ectotherms can maintain performance at a range of temperatures.

0581 Poster Session II, Saturday July 26, 2008

Seasonality Syndrome and Proliferating Pythons

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Population growth of exotic Burmese pythons in Florida has raised concerns about range expansion. Rodda et al. (2008) and Barker and Barker (2008) recently estimated the native range. A conspicuous distributional gap exists in the Thai/Malay peninsula, Borneo, and Sumatra. A somewhat similar gap is known for *Calloselasma*, *Daboia*, and *Varanus bengalensis* (cf. Tweedie, Wuster et al., and Auffenberg), and was noted previously for *Python molurus* (see O'Shea). Numerous avifaunal transitions occur in this region, at the boundary between deciduous and rainforest. The recurrent pattern is best explained by specialization for distinctly seasonal environments. I suggest that *P. molurus* exhibits an adaptive syndrome of traits for seasonality: preference for open deciduous forest, gregarious occupation of subterranean retreats in the cool/dry season, the formation of dominance hierarchies, and mating within retreats. One implication for population control is that artificial burrows may be effective attractants in some environments. If natural retreats are used repeatedly, spoor tracking may also prove useful. Burrow usage suggests that physiological tolerances limit distributions. I take a simplistic approach to the limited question of whether Burmese pythons can spread beyond the Florida peninsula. I compare Florida to the Chinese subtropics. A mean January minimum of 2.5 °C tracks the Chinese range of *P. molurus*, and highlights the thermally unique Sichuan Basin; anthropogenic introduction to this region is possible. By this cold hardiness criterion, pythons can clearly expand beyond peninsular Florida. Frost free periods >250-300 d/yr also encompass the Chinese range; expansion beyond FL depends on which value is the better estimate. The metabolic time for female nutrient acquisition (conditions averaging ≥ 20 °C) also indicates that spread out of FL is possible. The model of Rodda et al. may overestimate the northern extent of climatic suitability, but their call for vigilance should be heeded below the Fall Line.

0623 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Cottonmouth Feeding: Jack of All Prey, Master of the Dead

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Cottonmouths are predator/scavengers of aquatic and hydrophilic prey. They hunt on land and in water, but concentrate their efforts in very shallow water. Ambush sites near objects (e.g. woody debris) that detain or channel prey are often used, as are sites that afford some overhead cover. Beaver dams are a favored foraging environment. Cottonmouths sometimes hunt at quite low temperatures (15 °C). Cottonmouths mainly use ambush tactics, but they may change ambush sites more

frequently than other viperids. In the laboratory, foraging cottonmouths were actually more active than watersnakes. Foraging cottonmouths rely more on chemosensory input than do rattlesnakes. Cottonmouths appear to deposit chemical cues by head-rubbing objects near sites of prey encounters. Foraging individuals often come into contact with one another. Cottonmouths are euryphagous, taking all vertebrate groups and some arthropods. Some evidence suggests a coevolutionary arms race between cottonmouths and frogs. Ambush posture and attack mode are variable, and differ ontogenetically. Juvenile cottonmouths attract prey by caudal luring. Nonmammalian prey are held until subdued; fish are often eaten alive. Mammals are released after being struck, and typical SICS retrieval is used. Cottonmouths lack the proficiency of specialized piscivores for capturing and handling fishes, rarely handling or consuming prey underwater. Scavenging of carrion is species-typical, probably reflecting the hydric cycles and attendant die-offs of aquatic prey in the swamps they favor. Juveniles rarely take dead fish, whereas adults prefer them. Location of carrion may rely on nasolfaction. An annual "boom-or-bust" pattern of food intake is the norm. Fruitful topics for future investigation include mechanisms yielding dietary generality, sensory control of various stages of feeding, ontogeny of foraging tactics, spatial memory in a water-land mosaic, interaction of foraging behavior and sociality, roles of venom for feeding on different prey, and correlates of extreme variation in food intake.

0762 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Appraising Neotropical Amphibian Diversity: Current Trends and Inferences from the Global Amphibian Assessment

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The Global Amphibian Assessment (GAA) has become a landmark reference in global amphibian conservation and amphibian biology since its official launch in 2004. In order for it to continue to provide current information, however, regular updates must be undertaken, in this way allowing for further assessment or reassessment of amphibian-related patterns. The Neotropics host roughly half of all known amphibian species (2915 of 5915 species as of December 2005), and are also thought to contain a large undescribed amphibian fauna, making this an important region to monitor in terms of species richness, habitat associations and conservation. We provide an update to the existing GAA and examine the patterns that emerge both within the 2008 Neotropical update and in relation to the 2006 update and 2004 complete assessment. Species accounts, maps and preliminary conservation status (based on the IUCN Red List Categories and Criteria) were generated for all new and revalidated Neotropical species. These materials were then assessed by the authors or reviewers of each species, where possible. Since the last (2006) update and up to December 2007, 183 new and revalidated (including elevation of subspecies to species category) Neotropical species have been added to the GAA database, bringing the total number of described Neotropical species to 3091 (including the

removal of junior synonyms). Anurans comprise 97% of these 183 species; the remaining 3% is comprised of salamanders. The new species are distributed among 17 families, with Strabomantidae reporting the highest number of species (57 spp.), followed by Hylidae (27 spp.). The latter, however, reports the highest number of genera (12). The countries with the greatest number of newly described/revalidated species are Peru and Brazil, with 49 and 48 species, respectively, followed by Bolivia (23 spp.). We will further discuss habitat associations and the conservation status of these new species.

0286 Poster Session II, Saturday July 26, 2008

Ecological Separation of Striped and Unstriped Forms of *Plethodon cinereus*

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When studying speciation, researchers commonly examine reproductive isolation in recently diverged populations. Polymorphic species provide an opportunity to examine the role of reproductive isolation in populations that may be in the process of divergence. We examined a polymorphic population of red-backed salamanders (*Plethodon cinereus*) for evidence of sympatric ecological separation by color morphology. Recent studies have correlated temperature and climate with color morphology in this species, but no studies have looked at differences in diet or mate choice between color morphs. We used artificial cover objects to monitor salamander diet, mating preference and surface activity over a two year period at a field site in northeastern Ohio. We detected differences in diet and mate preference between two color morphs, striped and unstriped. The diets of striped individuals were significantly more diverse and were made up of more profitable prey than the diets of unstriped salamanders. Opposite sex pairs were more likely to be made up of individuals of the same color morph and striped males were more likely to occur with larger females than were unstriped males. We corroborate findings of earlier studies suggesting that the unstriped form is adapted to warmer conditions. Unstriped individuals were the first to withdraw from the forest floor as temperatures fell in the late fall. We found no evidence that the color morphs responded differently to abiotic factors such as soil moisture and relative humidity, but in the late summer and fall, unstriped salamanders tended to be found at warmer temperatures than did striped salamanders. Individuals of *P. cinereus* make up over 98% of salamanders observed at our study site. Thus, we speculate that ecological separation in this population may result from niche expansion in a species-poor salamander community.

0125 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Identifying Canadian Freshwater Fishes through DNA Barcodes

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Fish identification can be problematic, especially when phenotypic variations overlap between species and when morphological character have been degraded or express differentially during ontogeny. Furthermore, even for a well-studied fauna such as the freshwater fishes of North America, there is still some undescribed cryptic diversity remaining. In this context, and following the commitment of the Canadian Barcode of Life Network to barcode the freshwater resources of our nation, we developed a molecular tool to identify the Canadian freshwater fishes. A total of 652-bp have been obtained for 1360 individuals belonging to 191 species including 86 genera and 28 families. The nearest-neighbour distance between species averaged 7.5%, which was 30-fold higher than the mean within species distance of around 0.3% and 13-fold higher than the mean maximum intraspecific distance of around 0.6%. Among the set of 191 species, nine species (5%) included several distinct clusters and 15 species (8%) exhibited barcode sequences and lineages that were shared or overlapped with those of other species. This study has shown the efficacy of COI barcodes for diagnosing North American freshwater fishes since most species examined here corresponded to a single, cohesive array of barcode sequences that were distinct from those of any other species.

0113 Poster Session I, Friday July 25, 2008

The Brain of *Mobula japonica* (Spinetail Devilray, Myliobatiformes, Elasmobranchii) in Gross Morphological and Ecological Perspectives

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The difference in brain mass among different taxonomic radiations is one important measure of brain evolution. In the present study the brain mass to body mass ratio and external morphological features of *Mobula japonica*'s (spinetail devilray) brain are described. *M. japonica* extended the upper boundary of the minimum convex polygon described earlier by other authors for batoids, which is plotted on a double logarithmic scale of brain to body mass. The new data had high leverage to the regression, compared to other batoids, causing some change in the allometric

coefficient. The encephalization quotient was higher than unity, therefore it can be concluded that the actual brain mass is greater than expected by the given body mass. The most prominent brain parts were the huge and high telencephalon, giving 61 % of the total brain mass and the convoluted, strongly foliated cerebellum, with 19 %. *M. japonica* had the highest percentage of telencephalic mass from all batoids studied so far, while squalomorph sharks are represented by 24-31 %, galeomorph sharks 35-66 %, and batoids 33-51.1 %. The cerebellum of the *Mobula* was most similar to that of lamniform and advanced carcharhiniform sharks, which had extremely high foliation, and the cerebellum could be divided into 3 lobes with deep sulci. A structural dimorphism of cerebellar foliation was detected between genders, albeit with a small sample size. No such gender-related dimorphism was detected in brain mass/body mass ratio. Other brain parts were similar to those of other elasmobranch species. The data are discussed in terms of their systematic or evolutionary significance.

**0748 Fish Systematics II, Salons A&B, Friday July 25, 2008; STOYE
GENERAL ICHTHYOLOGY**

**Resolving the Phylogeny of Frogfishes (Lophiiformes: Antennariidae):
Evidence from mtDNA and Ovarian Morphology**

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Phylogenetic relationships among members of the family Antennariidae (Order Lophiiformes) were inferred from partial sequences of the ribosomal 16S and cytochrome C oxidase subunit I (COI) mitochondrial genes. Sequences were aligned and analyzed using parsimony and likelihood methods of phylogenetic inference. Nineteen species were included, representing ten of the twelve described genera and five of the six recognized species-groups, as well as an unidentified species, possibly representing a new genus. Results indicate that the genus *Antennarius* is not monophyletic, forming two clades basal to all other antennariids. *Antennatus* and *Histrio* also nest within a clade of *Antennarius*. Ovarian structure and molecular characters support the monophyly of a clade that includes *Phyllophryne*, *Kuiterichthys*, *Echinophryne*, *Tathicarpus*, *Rhycherus*, *Lophiocharon*, and *Histiophryne*.

0729 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT SYSTEMATICS/EVOLUTION

Phylogenetic Relationships among Australian Agamid Lizards Using Nuclear and Mitochondrial DNA Data

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Australian agamid dragon lizards include notable species such as the frill-neck lizard and thorny devil. Previous molecular phylogenetic hypotheses using mitochondrial DNA loci provided support for monophyly of some genera but found strong support for nonmonophyly of others. Nuclear DNA is known to be less variable than mtDNA but may provide support for deep relationships among species that are poorly resolved using mtDNA. However, only one phylogenetic analysis has used nuclear DNA. We perform combined and separate analyses of mtDNA and nuclear DNA from the potassium voltage-gated channels (KCNA4 and KCNA10) for about 90% of Australian agamid lizard species. Our results are entirely congruent with previous mtDNA analyses.

0569 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

Phylogeny of Skates, Rays, and Allies (Chondrichthyes: Batoidea) Using RAG-1 and Complete Mitochondrial Genomes: Preliminary Results

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Skates, rays and their allies (Batoidea) are a prominent but under-studied clade of stem vertebrates that exhibit broad morphological diversity. Batoids include forms as varied as ragged-snouted sawfishes, circular torpedo rays and seven-meter-wide mantas. How did this diversity in form arise from a shark-like ancestor? The lack of a reliable phylogenetic hypothesis has impeded an understanding of the changes in body form affecting the diversification of this group. The most taxon-rich batoid phylogenies are morphological and have been important in identifying suites of characters that appear constrained and/or convergent. Even so, the lack of confidence in any one topology has led to ambiguity about the way in which putatively convergent changes were brought about. Previous molecular phylogenies have included very few taxa and limited sequence data. We generated both nuclear DNA sequence data (RAG-1, ~60 taxa) and the complete protein-coding component of the mitochondrial genome (~25 taxa), sampling broadly across Batoidea. Data were analyzed under Maximum Likelihood and Bayesian approaches, and a number of well-supported clades were recovered. Some are novel, while others are anticipated by morphology.

0156 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Artificially Constructed Wetland Habitat as a Recovery Action for Species at Risk Amphibians, South Okanagan Valley, BC

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The Okanagan valley is under intensive urbanization and agricultural development, where 85% of the natural wetlands and riparian areas have been drained or altered. Surveys of amphibian Species at Risk have been conducted in the south Okanagan since 2003. Of 108 ponds inventoried, approximately 88% experience at least one harmful impact resulting from human actions. Our project goal is to establish a mosaic of fishless, non-contaminated wetlands while securing conservation agreements between private landowners and Ducks Unlimited Canada. Project objectives include: 1) habitat restoration and enhancement to increase the quality and quantity of habitats, 2) increase knowledge and participation in recovery actions of the species among the public and stakeholders, and 3) monitor amphibian populations to evaluate recovery actions. Restoration and enhancement of sites were selected using three main criteria: close proximity (< 500 m) to known breeding populations of the Threatened Great Basin Spadefoot (*Spea intermontana*) or the Endangered Tiger Salamander (*Ambystoma tigrinum*), close proximity to waterways (< 500 m), and a minimum distance from roadways (> 100 m). In fall 2006 and 2007 we constructed six ponds and enhanced six wetlands. In Spring 2007, amphibians were detected at three of the six project sites; Spadefoots successfully metamorphosed at one site. In 2008, the sites and surrounding wetlands will be monitored for calling frogs, the presence of eggs, and metamorph emergence. In 2008, three additional wetland sites will be enhanced, including predatory fish removal. The impact of upland habitat modification (i.e. agricultural soil compaction) and the availability of sandy soil required by burrowing amphibian species will be examined. The project aims to increase the quality and quantity of amphibian breeding habitat and the connecting upland habitat corridors.

0218 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Framework for the Establishment of a Global Conservation Program for Manta and Modula Rays

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Since the year 2002, the 501(c)(3) non-profit organization, The Manta Network (TMN), has been establishing a global framework for the conservation, protection and management of manta and modula rays. Aspects of this framework include a Manta Science Advisory Board, Manta Research Affiliates Program, Global Manta Database and resources library, sponsored field research, educational programs and a manta awareness program that includes the scientific community, conservation groups, the dive industry, underwater photographers, the media and the general public. Results of these programs will be discussed including the development of an online global database, automated spot identification software, manta research and expeditions and the use of a uniquely designed, underwater, live IP video camera system for research and education.

0644 Poster Session III, Sunday July 27, 2008

Genetic Estimates of Population Structure of the Endangered Okaloosa Darter

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Effective management of listed species requires an understanding of the threats and status of target populations. The Okaloosa darter (*Etheostoma okaloosae*) has been listed as Endangered since 1973 due to its limited distribution and presumed threats posed by invasive species and habitat loss or perturbation. The Okaloosa darter is restricted to six streams draining into the Choctawhatchee Bay, Florida. Little is known about population histories and levels of isolation of these stream populations. Analysis of complete cytochrome b sequences from >200 darters fin-clipped from all six streams has identified three lineages (net divergence 0.6-0.9%) that are geographically restricted and reflect past isolation. Data on nuclear divergence (microsatellite loci) are being examined to contrast with mtDNA (to be presented). Although most immediate challenges for endangered fish are ecological, consideration of evolutionary processes can broaden options for management. In the case of the Okaloosa darter, the identification of distinct evolutionary lineages may influence management and recovery actions for the species.

**0397 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008;
STOYE GENETICS, DEVELOPMENT & MORPHOLOGY**

Taxonomy, Population Genetics, and Body Shape Variation of Alabama Spotted Bass *Micropterus punctulatus henshalli*

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Alabama spotted bass (*Micropterus punctulatus henshalli*) are found in the Mobile River basin above the Fall Line in Alabama and northwest Georgia and are sympatric with redeye bass (*M. coosae*). We tested (i) the uniqueness of *M. p. henshalli* relative to Northern spotted bass (*M. p. punctulatus*) and *M. coosae*, (ii) the validity of Bailey's zone of intergradation, and (iii) for population structure in spotted bass by analyzing variation among five nuclear microsatellite DNA loci, mitochondrial cytochrome *b* sequences, and body shape for fish from the Mobile River basin and other drainages. Results indicated population genetic differentiation, microsatellite deviation from Hardy-Weinberg equilibrium, and admixture among populations, which swamped phylogenetic signal. STRUCTURE analyses consistently grouped individuals into nine to twelve populations, with fish from the Alabama plus Tallapoosa Rivers and Ohio River forming the most distinctive clusters. Phylogenetic analyses of *cyt b* sequences recovered a clade containing Alabama spotted bass and redeye bass haplotypes, suggesting potential hybridization between these taxa. Microsatellite DNA variation tends to support this hypothesis for some, but not all, populations. Body shape analyses are inconclusive with respect to hybridization among these taxa.

0741 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Yolk and Integumentary Carotenoids are Not Mobilized to Supplement the Antioxidant Capacity of Hatchling Western Painted Turtles (*Chrysemys picta bellii*) during Hypoxic Stress

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Hatchlings of the painted turtle, *Chrysemys picta*, hibernate terrestrially and can survive subfreezing temperatures by supercooling or by tolerating the freezing of their tissues. An ischemic hypoxia develops when tissue perfusion is limited by low temperature and/or freezing. Damage by reactive oxygen species is minimized because hatchlings of *C. picta* have high constitutive antioxidant defenses. Although preliminary research indicates that antioxidant enzymes are an important component of the antioxidant defenses of turtles during hypoxia exposure, little is known about the contribution of non-enzymatic antioxidants to total antioxidant capacity. Carotenoids are lipid-soluble antioxidant pigments that can be incorporated into the integument to produce colorful ornamentation. Western painted turtles, *C. p. bellii* are distinguished from the other *C. picta* subspecies by their orange-red plastron. Because they cannot synthesize carotenoids and they do not

feed, the pigments in a hibernating hatchling's shell are derived and maintained from their yolk. Under stressful conditions, reallocation of carotenoids from bodily sinks towards physiological functions (antioxidant defense, immune function) has been observed in other vertebrate taxa. We examined whether *C. p. bellii* hatchlings, in response to 8-d hypoxia treatment, mobilize carotenoids to the plasma from yolk, and/or from the plastron. Plastron redness, lipid-soluble antioxidant capacity, and carotenoid content of yolk and plasma did not differ between the hypoxia treatment and normoxic controls. Our results indicate that stored carotenoids are not mobilized by *C. p. bellii* in response to hypoxia.

0711 Poster Session III, Sunday July 27, 2008

***Sparus aurata* (Perciformes: Sparidae): A New Potential Harmful Invader in the Gulf of California**

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The gilthead sea bream *Sparus aurata* Linnaeus, 1758 is a Mediterranean fish reaching 70-cm total length and 6-kg weight. It is described as an opportunistic predator though more specialized toward gastropods and bivalves. The introduction of commercial cultures of the gilt-head sea bream in different coastal areas and bays may cause ecological problems such as an increase of eutrophication, introduction of diseases, and even the ecological disruption of local ecosystems. In September 2005, a transnational company introduced juvenile individuals of *Sparus aurata* in cages in Bahia de La Paz, Gulf of California. The Mexican environmental authorities forced the company to remove all the gilt-head sea bream during July 2007 from the bay. However, on 3 October 2007 an individual female *S. aurata* was captured in the wild during experimental fishing work, swimming freely in the bay. Until 27 December 2007 fifteen specimens 290-335 mm TL had been captured. In order to evaluate the potential success to establish in the area the specimens were analyzed for feeding habits and reproductive stage. The analysis of stomach contents showed 19 different items. Mollusks were the most important food item (IRI: 57.27%) and among them the gastropods were the preferred (39.11%). Secondarily food items were macroalgae (7.53%) and crustacean (2.39%), including also uncommon prey-item as legs of grasshoppers and echinoderms. The analysis of histological sections of gonads stained with hematoxylin-eosin indicated the majority sea breams were hermaphrodites with ovary tissue in stage I and II. Only one specimen showed ripe ovary tissue with hydrated oocytes. We concluded that the escapee of *S. aurata* are able to survive in the bay invading different habitats since the origin of the food is from sandy, reef and mangrove areas; they are maturing as described for the Mediterranean and probably they will be able to reproduce during 2008.

0105 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

From Larvae to Lineages: Investigations of Shorefish Diversity in the Tropical Atlantic

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The identities of pelagic larval stages constitute the largest gap in our knowledge of the coral-reef fish fauna of the tropical Atlantic. This fundamental taxonomic information is necessary before larvae can be used in studies of, for example, evolution, fisheries biology, and ecology. Over the past 15 years, we have identified larvae of numerous Belizean fishes by rearing net-collected larvae at the Smithsonian's marine station at Carrie Bow Cay. More recently, we have begun matching larvae to adults using mitochondrial cytochrome oxidase 1 sequences (DNA Barcodes). As well as greatly enhancing our ability to provide species identifications of larvae, the molecular data from Belizean fishes reveal more species diversity in many genera than our present classifications suggest. Because much of the Belizean fish fauna is believed to occur throughout the Caribbean and other areas of the tropical Atlantic, we are expanding our DNA barcoding efforts to other geographical areas. In addition to re-analyzing species diversity of cryptic reef fishes throughout the tropical Atlantic, the ultimate goals of our work include reconstructing species-level phylogenies of a diversity of tropical Atlantic shorefish genera, from which we can investigate patterns of morphological divergence and speciation.

0619 Poster Session II, Saturday July 26, 2008

Assessing the Use of Artificial Structure in a Fragmented Landscape: Herpetofauna as a case study

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As habitat fragmentation increases due to urbanization and/or agriculture, the likelihood of remaining habitat patches being able to support viable animal populations decreases. Herpetofauna are model organisms for studying the impact of habitat fragmentation on animal populations, as they are relatively easy to sample and often rely on more than one habitat type for population persistence. We discovered an abandoned homestead on our campus and completely encircled the homestead with a drift fence. Our objectives with the drift fence study were to (1) inventory and monitor local herpetofauna, (2) assess the use of the homestead as a rookery site and (3) assess the use of the homestead as a hibernaculum. Between 4/25/07 and 11/15/07 we captured 473 animals, representing 9 reptile species and 7 amphibian species. Interestingly, the *Agkistrodon contortrix* (Copperhead) and *Thamnophis sirtalis* (Garter Snake) we captured during the summer were all gravid and entering the homestead site. Thus, data we collected this summer supported our

hypothesis that artificial structure provided by the homestead may be used as a rookery area for some herpetofaunal species. In addition, 8 of 10 snakes captured in late fall (9/26 - 10/26/07; represented the last month of snake activity at the fence) were entering the homestead site. Thus, data collected during the fall supported our hypothesis that artificial structure provided by the homestead may be used as a hibernaculum area for some snake species.

0521 AES Age & Growth/Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Determination of Age in Atlantic Angel Sharks: What Does it All Mean?

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Species-specific age and growth estimates, while necessary for age-structured population dynamic models, are often difficult to obtain for elasmobranch species. Although angel sharks (Squatinae) are highly exploited and considered 'endangered' in many parts of their range, very few studies have examined the age and growth of species in this family, likely due to difficulties associated with traditional ageing techniques. Investigation of Pacific angel shark *Squatina californica* vertebrae found band deposition to be related to somatic growth, but temporally unpredictable. Atlantic angel sharks *Squatina dumeril* were collected for age and growth analysis (n=343) from fishery-independent and dependent sources from January 2001 through June 2007. Vertebral samples were collected from the area of the spinal column located dorsally to the abdominal cavity, and band counts were obtained from whole, halved, and sectioned (0.6 mm) vertebral centra. Several methods were employed in order to investigate the age and growth of the Atlantic angel shark, including traditional growth models using band counts (e.g. von Bertalanffy Growth Model and Gompertz Growth Model), and newer Bayesian methods that estimate L_{∞} (asymptotic size) using only length data.

0051 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008;
GRUBER

**Maturity, Fecundity, and Reproductive Cycle of the Spotted Ratfish,
Hydrolagus colliei (Lay and Bennett, 1839)**

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Size at maturity, fecundity, and reproductive periodicity of the spotted ratfish, *Hydrolagus colliei*, were estimated from off the coast of California, Oregon, and Washington. Maximum body size and size at median maturity were greater for females than males. Skeletal muscle concentrations of the steroid hormones testosterone (T) and estradiol (E₂) predicted similar, but slightly smaller sizes at maturity than morphological criteria. Stage of maturity for males was estimated identically using either internal organs or external secondary sexual characters, facilitating non-lethal maturity assessments. Latitudinal differences in sizes at median maturity were observed, with greater values north of Point Conception for females, and north of Cape Mendocino for males. Peak parturition occurred from May through October, with elevated skeletal muscle concentrations of E₂ in females correlating with ovarian recrudescence during November through February. No significant seasonal trends in female T were apparent, but mean female 11-ketotestosterone (11KT) was 300% greater in April than any other month during the parturition season. There was marginal evidence for increased number and size of ova with maternal size. Extrapolation of the hypothesized 6-8 month egg-laying season to observed mean parturition rates of captive specimens yielded an estimated annual fecundity of 19.5-28.9 egg cases. Differences in fecundity among higher taxonomic classifications of chondrichthyans were detected, with chimaeriform fishes being more fecund than myliobatiform, squaliform, and rhinobatiform fishes.

0379 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT
ECOLOGY

**Seasonal Habitat Use and Movement of Cascades Frogs (*Rana cascadae*) in
Washington**

April Barreca, Jason T. Irwin

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Cascades frogs (*Rana cascadae*) are endemic to montane ecosystems in the Pacific Northwest and are declining in the southern part of their range. They are considered "near threatened" by the World Conservation Union and are a "species of concern" in Washington by USFW. There are few studies that track amphibian movement after they leave their breeding pools. This project will track a population of Cascades frogs in the foothills of the North Cascades throughout the year using radio-telemetry. Since there have been no studies on the overwintering strategies of the Cascades frog this study will focus on how this species survives half the year in

extreme winter conditions. Physiological data on energy storage will be gathered before and after hibernation and compared to a lower elevation site. Baseline data will be gathered on population size and correlated with temperatures and dissolved oxygen at hibernation sites measured near the frogs in both aquatic and terrestrial habitats. Frog movement will be tracked between hibernation, breeding and summer foraging sites. Preliminary data indicate that *R. cascadae* are not freeze tolerant like the Wood frog (*Rana sylvatica*), and require specific micro-habitats during hibernation.

0453 Poster Session III, Sunday July 27, 2008

Osteological Description of Fish Species from the Family Carangidae

Angélica Barrera-García, Felipe Galván-Magaña, Andrés Abitia-Cárdenas, Carlos Polo-Silva

Centro Interdisciplinario de Ciencias Marinas, La Paz, B.C.S., Mexico

A wide study in trophic biology of top predators demonstrates that family Carangidae constitutes an important prey in their diets. However the advanced digestion state of the prey and a few comparative osteological information of these species, their identification is not possible to lower taxa. Thus the present research aims the comparative study of some carangid fishes from the Eastern Pacific Ocean, mainly with the neurocranium, jaw bones, hyomandibular and axial skeleton to know interspecific differences in these bones to recognize the characters which facilitate the carangid species identification in the stomach contents of top predators. The fishes were identified in fresh, and their skeleton preparation was using the softening in warm water and the dermestid beetles methods. We found that the family has their own characters that allow separate between other families like the presence of lateral laminate in the neurocranium between the sphenotic-pterotic and parietal-epiotic bones, the high crest formed by the frontal and supraoccipital, and a total of 24 vertebrae in the axial skeleton. The neurocranium and hyomandibular are different from each species. Also, *Selene peruviana* is distinguished by the elevation of the supraoccipital crest and the ascending and the nasal process are joined in the premaxilla; *Decapterus macarellus* by the position and form of sphenotic. The nasal process in *Seriola rivoliana* is triangular and flattened; however in *Selar crumenophthalmus* is shorter than the ascending process, and in *Trachinotus rhodopus* is thin and extended. Also more characteristics are shown in the pictures to identify species.

0092 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Examining the Relative Role of Ectotherms and Endotherms in Food Webs

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I present a hypothesis for understanding the important differences between the roles that ectothermic and endothermic organisms play in food webs. Ectotherms devote comparatively little of the energy they consume to maintenance of body heat or other activities beyond growth and reproduction; therefore, ectotherms are able to convert a greater proportion of consumed resources into biomass than endotherms. Such an allocation strategy means ectotherms can achieve extremely high densities in many habitats. As a result, ectotherm-dominated food webs may have predator foraging behavior, food web length, and food web stability that differ from food webs or chains with a large endotherm component. Specifically, I outline support for the idea that ectotherm-based food chains are longer than endotherm-based counterparts. I also suggest reasons why the fields of conservation biology and ecology should pursue further clarification on the roles ectotherms and endotherms play at the community and ecosystem level.

0638 Fish Systematics I, Salons A&B, Friday July 25, 2008

Utility of the Nuclear Growth Hormone Gene for Inferring Phylogenetic Relationships among Actinopterygian Fishes

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Previous work on the nuclear growth hormone gene (GH) suggests that it is an excellent locus for estimating phylogenetic relationships among rayfin fishes. In this study, we used an expanded alignment of coding region sequences comprising 654 nucleotide characters to infer phylogenetic relationships among 235 actinopterygian taxa, including 157 ostariophysans and 78 non-ostariophysans, plus sarcopterygian outgroups, produced in this study or obtained from Genbank. The final dataset comprised 600 variable sites of which 401 were phylogenetically informative at the actinopterygian level. The data set was subjected to phylogenetic analysis partitioned by codon with R-Y coding at the third codon position. We translated the nucleotides to amino acid sequences to understand character state changes across the resulting phylogeny. (Bayesian consensus tree), Teleosts (elopomorphs to acanthomorphs) are resolved with strong posterior-probability support (27 unambiguous amino acid changes including 13 synapomorphies). Ostariophysans (Cypriniforms, Siluriformes + Characiforms) are well supported (9 unambiguous amino acids changes; 3 derived) and sister to another well-supported group comprising protacanthopterygians (Salmoniformes plus Esociformes) plus acanthopterygians (13 unambiguous changes; 5 derived). The lone osmeriform included in the study (*Plecoglossus altivelis*) is sister to remaining Euteleosts. The

large number of amino acid changes and changes in certain amino acids that affect protein folding (e.g., cysteine residues) suggest that changes in GH protein structure have occurred over the course of actinopterygian evolution.

0300 Poster Session III, Sunday July 27, 2008

Genetic Differentiation of Spotted Salamanders (*Ambystoma maculatum*) in a Fragmented Landscape in Southwest Ohio

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The fragmentation of suitable habitat for amphibians is occurring at an alarming rate across the US. This puts populations already stressed in further peril. Genetic exchange across populations is curtailed by fragmentation. This affects some species more than others, depending on several factors including a particular species ability to cross inhospitable terrain. Lack of species specific knowledge makes conservation decisions difficult. Loss of genetic diversity through loss of genetic exchange can increase the probability of local extinctions through inbreeding and stochastic events. Spotted salamanders inhabit forested areas with access to vernal pools for breeding. Contiguous forest should allow genetic exchange between subpopulations maintaining genetic diversity. In southwest Ohio much of the remaining land available for development is forested wetlands that were unsuitable for agriculture.

Molecular genetic methods (microsatellites) were used to sample three populations of Spotted Salamanders (*Ambystoma maculatum*) located in isolated forests in southwest Ohio for genetic diversity. Populations from 40 to 103 kilometers apart were compared. Each forested area had a single breeding pond in which Spotted Salamanders had been observed. F_{st} values were high indicating isolation of the three populations from each other. Values were similar ranging from 0.1487 to 0.1746 (mean = 0.1647, SD = 0.0140). None of the populations were in Hardy-Weinberg Equilibrium with a deficit of heterozygotes.

0261 Fish Ecology I, Drummond, Thursday July 24, 2008

Is Prey Detection Mediated by the Widened Lateral Line Canal System in the Lake Malawi cichlid, *Aulonocara hansbaenchi*?

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The peacock cichlids of Lake Malawi (*Aulonocara* spp.) are characterized by widened lateral line canals, a morphology that has been shown to enhance sensitivity to local water flows such as those generated by infaunal invertebrate prey. We tested the hypothesis that 1) search behavior and prey detection behavior in *Aulonocara hansbaenchi* are different in light (day) and dark (night) conditions, and that 2) live prey (that generate hydrodynamic stimuli capable of stimulating the lateral line) would be preferred over dead prey. Six live and six dead brine shrimp were tethered in pairs in six petri dishes randomly placed among 12 petri dishes in the sandy substrate of an experimental tank. Standard digital video was used to characterize search and prey detection behavior of individual fish. At night, prey detection was generally preceded by a glide (no acceleration or fin movements), and then a pause and 180 degree swimming reversal re-positioning the prey under the mandible prior to strike. During the day, prey detection tended to be preceded by a glide, and a change in orientation. Furthermore, a significantly higher number of live prey were eaten at night, but during the day high numbers of both live and dead prey were eaten. These data suggest that the lateral line is used to detect prey at night, while vision and lateral line are important for prey detection during the day. The widened lateral line canal morphology in *Aulonocara* is convergent with that in taxa in more than a dozen families (e.g., some *Notropis*, *Glyptocephalus*, *Melamphaeidae*), some of which are known to feed on infaunal prey or in midwater. *Aulonocara hansbaenchi* is easily reared and crossed with other Lake Malawi cichlids and will be used to understand the developmental and genetic bases for functional evolution of the lateral line system among fishes.

0757 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Snake Abundance and Species Richness in Managed Riparian Forests Along the Middle Rio Grande in New Mexico

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To understand the effects of removal of non-native plants and fuels on wildlife in the riparian forest of the Middle Rio Grande in New Mexico, we monitored snakes from 2000 to 2006 using trap arrays of drift fences, pitfalls, and funnel traps. We used a non-parametric Wilcoxon signed rank test to compare trapping methods. We used a

repeated measures analysis of variance (ANOVA) to compare capture rates in treated and untreated riparian forest. We recorded 158 captures of 13 species of snakes from 12 study sites. We captured more snakes in funnel traps than in pitfalls. The most frequently captured species included Common Kingsnake (*Lampropeltis getula*), Gophersnake (*Pituophis catenifer*), Plains Black-headed Snake (*Tantilla nigriceps*), and Plains Hog-nosed Snake (*Heterodon nasicus*). We did not detect an effect of non-native plants and fuels removal on the rate of captures; however, we recommend using other trapping and survey techniques to monitor snakes to better determine the impact of plant removal on the snake community. Compared to historical records, we did not report any new species but we did not capture all snakes previously recorded. Black-necked Gartersnakes (*Thamnophis cyrtopsis*), which are closely tied to aquatic habitats, were not captured during our study – possibly indicating the loss of off-channel semi-aquatic habitats along the Middle Rio Grande.

0285 Herp Systematics, Drummond, Friday July 25, 2008

Phylogeny of the Gekkotan Lizards of the World

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Gekkotan lizards constitute one of the most diverse and species-rich clades of squamates and are among the most ecologically important groups of all nocturnal vertebrate insectivores. Geckos should be an ideal group for asking a diversity of biological questions, but this has been prevented by the lack of an appropriate phylogenetic framework. We used DNA sequence data derived from a combination of five nuclear genes and five mitochondrial genes to investigate relationships among ~525 species of geckos representing 105 genera under maximum parsimony, maximum likelihood, and Bayesian inference. Living gekkotans are divided into seven major clades, here recognized as family level units. Southwest Pacific geckos (Carphodactylidae, Diplodactylidae and Pygopodidae) form a monophyletic group that split from other gekkotans no later than the mid-Cretaceous. Two other families, Sphaerodactylidae and Phyllodactylidae, account for most New World geckos, but have trans-Atlantic distributions. Gekkonids *sensu stricto* are the most diverse clade and include several major monophyletic subgroups (Afro-Malagasy geckos, the *Gekko* group, *Hemidactylus* + *Cyrtodactylus*) as well as some unanticipated groupings (e.g., *Nactus* + *Heteronotia* + *Dixonius*). Although at odds with earlier hypotheses of relationship, our results are largely consistent with morphological data. However, they suggest that many characters previously regarded as phylogenetically informative are, in reality, highly homoplastic – at least at more hierarchically inclusive levels.

0589 Poster Session III, Sunday July 27, 2008

On the Absence of a Plethodontid from the Northern Great Plains of Manitoba with Comments on Our Description of a New Species, *Plethodon prairiensis* sp. nov., that is Based on No Specimens or Data

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In 1926, E.R. Dunn published his monograph on the salamander family Plethodontidae, thus setting the stage for research on this group, a productive area that bears fruit even today. One of the authors (CKB) has extensive experience with working with almost no data, and we take this form of analysis to the next appropriate level: the description of a phenomenon with no evidence for it except a dot on a range map showing the world-wide distribution of plethodontids. Whereas some may argue that the dot merely represents a stray splash of ink from Dunn's quill pen, we contend that the locality could actually be real and that Dunn just forgot to include an account of the strange plethodontid that inhabits the Great Plains of Manitoba. We argue that an undiscovered population in this strategic area helps to explain the migration of plethodontids from Korea into the western and eastern American clades during the late Mesozoic, and elucidates plethodontid relationships much more clearly than shadowy evidence from DNA analyses. We propose that *Plethodon prairiensis* is the sister taxon of all North American plethodontids, and we speculate that it looked a lot like *Hemidactylium*, but had five toes.

0648 Fish Systematics IV, Salons A&B, Monday July 28, 2008

A New Character for the Taxonomy of Lamprey

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Papillae along the posterior margin of the gill pore and a mid-lateral central process were examined for 33 of 34 recognized species of northern and southern hemisphere lamprey. The number, size, shape and arrangement of the papillae are diagnostic for all genera and most species. Anadromous parasitic lampreys have the largest number of papillae and freshwater, non-parasitic species have the smallest number and the largest papillae. The central process is a hollow structure that is completely absent from all species in the Genera *Ichthyomyzon* and *Mordacia*, but present in all other genera. Gill pore papillae and the central process also distinguish forms of lamprey. For example, the anadromous parasitic Pacific lamprey have approximately 65 to 75 pigmented, pencil shaped papillae, throughout their distribution from off the east coast of Russia to off the west coast of California. However, a freshwater parasitic form in California that has not been distinguished from the Pacific lamprey has approximately 15 papillae that form unpigmented, fleshy bars. To date, 49 distinct gill pore and central process structures have been

identified, some of which when combined with standard morphological measurements indicate the possible existence of new species. Thus, gill pore papillae may be as useful in lamprey taxonomy as gill raker structure has been for bony fishes.

0098 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

An Invasive Frog Affects Ecosystem Processes Through Nutrient Recycling as Opposed to Trophic Cascades

Karen Beard

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A frog endemic to Puerto Rico, *Eleutherodactylus coqui*, invaded Hawaii in the late 1980s likely via the floriculture trade. This species is regarded as a pest because of its loud mating call and economic impacts on private property values and the nursery industry. Because *E. coqui* is a generalist insectivore that can attain extremely high densities (up to 89,000 individuals/ha), the invasion is also of ecological concern as *E. coqui* may negatively impact endemic species, especially invertebrates, through both direct and indirect effects. *E. coqui* has been the focus of a \$4 million/year control effort on all four main Hawaii Islands and is now largely restricted to the Island of Hawaii. The impacts of *E. coqui* on flying, phytophagous, and leaf litter invertebrates; herbivory, plant growth, and leaf litter decomposition rates; and leaf litter and throughfall chemistry were studied at two sites on the Island of Hawaii. *E. coqui* significantly reduced invertebrate abundance at only one of the two study sites. *E. coqui* decreased herbivory rates, and increased plant growth rates, leaf litter decomposition rates, and nutrient availability in decomposing litter and throughfall across both study sites. Path analyses suggested that *E. coqui* increased plant growth rates and leaf litter decomposition rates more through associated increases in nutrient availability (nutrient recycling) than through changes in the invertebrate community (trophic cascades). This is the first study I know of identifying the importance of a nutrient recycling mechanism using a terrestrial, vertebrate predator. A previously conducted experiment in Puerto Rico, using similar methods, determined the effects of *E. coqui* on the invertebrate community and ecosystem processes in its native range. Across its native and introduced ranges, the effects of *E. coqui* on invertebrates varied by study site, but the effects of *E. coqui* on ecosystem processes were similar.

0197 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR

Mitochondrial Evidence of Pleistocene Range Fluctuations in Blanchard's Cricket Frog (*Acris crepitans blanchardi*) across the Mid-western United States

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Cricket frogs (*Acris*) are highly aquatic members of the treefrog family Hylidae, and occur exclusively in North America. The genus consists of two species and five subspecies, with Blanchard's cricket frog (*A. crepitans blanchardi*) as the most northern and western form. Reported declines in northern populations of this subspecies prompted the investigation of its genetic structure to further understand its biology, historical biogeography, and to evaluate potential conservation actions. Mitochondrial control region sequences of 479 individuals from 107 sites across its range were determined. One hundred one haplotypes were found, giving a haplotype diversity of 0.77. However, overall nucleotide diversity was relatively low (0.0089), as was genetic differentiation (sequence divergence = 3.6%). A combination of phylogenetic, spatial, and demographic analyses identified several groups within this subspecies, and demonstrated that its present structure has likely been primarily shaped by climatic fluctuations that occurred during the Pleistocene. Maximum likelihood phylogenetic analysis distinguished two main clades that roughly correspond to the northeast and southwest portion of the range. The southwest region was likely a refugium for Blanchard's cricket frog during the unstable climatic conditions of the Pleistocene, as it possesses high genetic diversity and has been at demographic equilibrium throughout much of its history. In contrast, the northeast region appears to have experienced multiple range expansions and contractions in response to the repeated advance and retreat of glacial ice. This is supported by several signatures in the mitochondrial data, including low genetic diversity, star phylogenies, and unimodal pairwise mismatch distributions. The retreat of the last ice sheets approximately 20 000 BP allowed Blanchard's cricket frog to colonize as far north as southern South Dakota and Michigan, resulting in a gradient of decreasing mitochondrial diversity to near-monomorphism in the most northern part of its range. The exclusion of the southwest clade from the region north of Kansas and east of Missouri indicates that a northern-adapted form may exist in this area. This possibility should be considered when evaluating recovery strategies for northern populations of Blanchard's cricket frog.

0198 Poster Session II, Saturday July 26, 2008

Conservation Genetics of the Highly Endangered Puerto Rican Crested Toad (*Peltophryne lemur*)

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The Puerto Rican crested toad (*Peltophryne lemur*) is the only bufonid endemic to Puerto Rico. Historically found at nine scattered locations around Puerto Rico and on Virgin Gorda, it is currently represented by a single wild and two captive populations. The main factors contributing to its decline are habitat alteration, inundation of coastal breeding ponds during tropical storms, and, potentially, predation and competition by the introduced marine toad (*Bufo marinus*). Recovery efforts for this species have been extensive, including captive breeding of both northern and southern populations, reintroduction of >90 000 tadpoles, habitat restoration and construction of breeding ponds, and public outreach and education. To guide future conservation efforts, genetic variation and differentiation was assessed by profiling individuals from the three groups at the mitochondrial control region and six microsatellite loci developed for this study. Only two mitochondrial haplotypes were found (sequence divergence = 1.66%), with one localized to each of the southern and northern populations. Moderate genetic variation exists at microsatellite loci in all three groups, with no evidence of inbreeding as assessed by heterozygote deficiency. The captive southern population has not diverged substantially from the only remaining wild population on the south coast of Puerto Rico at either mitochondrial or nuclear loci ($F_{ST} = 0.028$). In contrast, qualitative and quantitative analyses of the microsatellite data suggest that northern and southern populations have been separated for some time, with little overlap in alleles at five of six loci ($F_{ST} = 0.313-0.340$). Despite this strong differentiation, the two lineages are no more divergent than many populations of other amphibian species. As the northern breeding colony is on the verge of extirpation, it is recommended that a third colony be established in which northern and southern individuals are bred together, in order to preserve any northern adaptive traits that may exist.

0402 Herp Stressors/Snake Conservation, Salons 6&7, Monday July28, 2008

Food as a Conservation Tool: Lessons From Field Studies of Snake Bioenergetics

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Basic science is most valuable when it informs and directs applied science. Studies of field bioenergetics have demonstrated a tight coupling between food resources and fundamental life-history responses of pit vipers and many other snakes. Pit vipers in particular are extreme examples of low-energy adapted organisms and they exhibit high sensitivity to changes in resource abundance. Geographic patterns of growth, body size and sexual size dimorphism have been linked to variation in resource abundance or primary productivity. Likewise, snakes generally respond to experimental or natural resource augmentation with corresponding increases in growth rate, body size and body condition. I discuss several well-documented examples of increased growth, body size, or population density of snakes in response to uniquely abundant food resources. These published studies, coupled with information from experimental studies suggest that manipulation of food resources may be an extremely valuable technique for remediation of snake populations. Indeed, efforts to conserve snake populations often stop at preservation of suitable habitat and reduction of obvious sources of mortality (e.g., road-kill, collecting). Habitat manipulations designed to improve prey densities may complement these more traditional conservation techniques.

0328 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Multiple Speciation Events in Amazonian Lowland Forest Fishes Driven by Andean Tectonics

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The richest biota in the world is found in the lowland rainforests of Amazonia. Despite its enormous importance as source of biodiversity, little is known about the evolutionary processes that generate diversification in Amazonia. Here we present the results of a comparative multigene and multispecies study aimed at elucidating the history of diversification of forest-dependent fishes from the Rio Negro basin, central Amazonia. We conducted extensive field expeditions along the Rio Negro basin and amassed samples of four fish groups (cardinal tetras, pencilfish, hatchetfish and rummy nose tetras) from 25 tributaries – an effort that corresponds to over 100 co-distributed populations and 2,000 individuals. Data from mitochondrial DNA and newly developed microsatellite DNA markers were obtained for all individuals. Our analyses unravelled extremely localized population structures and cryptic speciation. Inferred patterns of reproductive isolation and evolutionary

distinctiveness are consistent with the existence of several cryptic (but deeply divergent) species. A comparative phylogeographic analysis clarified the histories of these fish populations and disclosed a remarkable result that has implications to understand biotic diversification in Amazonia: all speciation events in the lowland forests can be accounted by geomorphologic processes related to the uplifting of the Andes Mountains. We detected high concordance between the formation of tectonic arches and sub-arches in the Rio Negro and the distribution and history of cryptic species. This is the first multispecies and multigene study to present strong support for the palaeogeographic model of speciation in Amazonia. We also discuss on the implications of our comparative approach to evaluate the relative contribution of ecological and geographic processes underlying population differentiation and speciation in Amazonia.

0657 Poster Session I, Friday July 25, 2008

Reproductive Biology of Hammerhead Shark *Sphyrna lewini* in Salina Cruz, Oaxaca, Mexico

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The hammerhead shark *Sphyrna lewini* was the most caught shark in Oaxaca. However the reproductive aspects of the specie in this area of Mexico are unknown. Samples and data were collected every week at the artisanal fishing between September 2004 and June 2006. A total of 991 hammerhead sharks (342 females and 649 males) also juveniles (45 to 160 cm TL) and adults (170 - 288 cm TL) were sampled. Sex ratio in adults was 1F:2M. The hammerhead shark was present all year but the biggest abundance was in May to July, this is the season when the pregnant females appear. Size of first maturity for females was 220 cm TL (increase in diameter of the oocyte, width of the oviductal gland). The histological analysis showed that males have diametric testes, sperm in epididymis, ductus deferens and compound spermatozeugmata in seminal vesicle, which suggests a size of first maturity for males at 180 cm TL. We don't found sperm storage in the oviductal glands of females but this condition has been confirm for the specie. We recorded 40 pregnant females with an interval of 6 to 40 embryos. Births were in July to August and the birth size was between 41 to 51 cm TL. We propose Salina Cruz, Oaxaca as a nursery area for hammerhead shark *Sphyrna lewini*.

0501 Poster Session II, Saturday July 26, 2008

Thermal Effects on Strike-induced Chemosensory Searching in the Cottonmouth, *Agkistrodon piscivorus*

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Cottonmouths exhibit Strike-Induced Chemosensory Searching (SICS) after striking and releasing prey. SICS is characterized by sustained, rapid tongue flicks as the snake attempts to locate the chemical trail left by fleeing prey, which is then trailed and eventually swallowed. This trailing behavior presumably results from selective pressure to balance foraging success with avoidance of injury from retaliatory bites. SICS, which integrates a variety of snake behaviors, is affected by many proximate factors such as prey type, relative prey size, the reaction of the prey during or following the strike, the number of prey previously struck, and various others. The purpose of this study was to test the effects of ecologically-relevant temperature variation on SICS in the cottonmouth using three temperature treatments of 14-16°C, 20-22°C, and 28-30°C. Although snakes foraged successfully at all three temperatures, cottonmouths at warmer temperatures tended to release prey more often, and then relocate and swallow prey sooner, than snakes at lower body temperatures. These data suggest that environmental temperatures have the potential to influence foraging success in cottonmouths via thermal dependencies of SICS components.

0298 Poster Session III, Sunday July 27, 2008

Evaluating the Success of Timber Rattlesnake Relocation Efforts in Eastern Kansas

Rebecca Benjamin, Sean Kimbrell, William Donovan, Mindy Walker

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There has never before been a documented experiment that attempted to permanently relocate a population of *Crotalus horridus* (Timber Rattlesnakes). This project is of interest because it is both a conservation effort on the behalf of a threatened species of venomous reptiles and an unprecedented research opportunity to examine the consequences of their relocation. A disjunct population of Timber Rattlesnakes ($n \approx 200$) in eastern Kansas was under threat of development. Twenty-nine snakes were removed from this den site and relocated to a safe habitat. All individuals were weighed, measured and implanted with microchips for identification. Scale clippings were taken for further identification and genetic analysis. Seven of these individuals had radio-transmitters with unique frequencies surgically implanted in their abdominal cavities for future telemetry tracking. These snakes were tracked every third day of their active season of 2007 to document their foraging routes and examine their general health. Prey density and diversity were also assessed. One of the seven radio-implanted snakes was lost to predation, while the remaining six survived the first active season and successfully entered a den. Upon recapture in 2008 the snakes will be reweighed and remeasured for comparison to the initial capture data. Blood samples will be collected from each snake for genetic analysis. Morphologic and genetic results obtained from the 2008 tracking season will indicate the success of the relocation. Thus far, our results indicate that the relocation of a population to an appropriate habitat may be a promising conservation technique.

**0204 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR**

**The Effects of Habitat Barriers on Movements and Gene Flow in Northern
Map Turtles (*Graptemys geographica*)**

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Habitat loss and fragmentation are considered to be the leading causes of turtle declines worldwide. 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. This listing is based primarily on perceived threats and general turtle life-history characteristics, rather than on actual published data about the species' biology in Ontario. 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 and control structures. We hypothesized that the locks and dams on the TSW are acting as barriers to movements and gene flow in Northern Map Turtles, and predicted that Map Turtles would have significantly reduced movements and genetic diversity in areas of high lock density. Radio transmitters were attached to turtles in high lock density (N=8) and a low lock density (N=12) areas and movements were followed. Tissue samples were collected from turtles (N=105) in reaches separated by locks and dams along the waterway. Turtles in the high lock density area had significantly shorter daily and seasonal movements than those in the low lock density site, indicating that the locks and dams are acting as barriers to movements. Anecdotal evidence suggests that these barriers are not impenetrable, as turtles may move through the locks with boat traffic, or climb around the locks during nesting migrations. Genetic analyses, using microsatellite markers, will elucidate gene flow, and allow us to determine whether the locks and dams are isolating genetically distinct populations. The ultimate goal of this project is to gather information relevant to the creation of viable management strategies and conservation initiatives for Northern Map Turtles.

0046 Poster Session I, Friday July 25, 2008

The Reproductive Ecology of *Manta birostris* off Southern Mozambique

Michael Bennett, Andrea Marshall

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Manta birostris is common in southern Mozambican coastal waters with 450 individual rays identified, based on their unique dorsal and ventral markings, in the area around Inhambane since 2003. Manta rays are present year-round and use many inshore reefs as cleaning stations. Observation of this population over five years has revealed previously unreported aspects of their reproductive biology and behaviour. The study population in southern Mozambique is sexually segregated, with a female to male sex bias of 3.5:1. Sexual dimorphism in size is apparent between the sexes. The high re-sighting rate (40%) of individuals infers a semi-resident local population

that has allowed the reproductive condition of known individuals to be regularly assessed. Male rays appear to transition from immaturity to maturity around a disc width (DW) of 3 meters, whereas females mature at about 4 m DW based on observed pregnancies and reproductive pectoral fin scarring. Pregnancies have been observed in over 60 individuals. Courtship and mating behavior typically occurs between October and January, but appears to be punctuated. Parturition occurs in the summer months, from late November to early February. Typically a single pup is born per litter. The smallest free-swimming individual accurately measured in the field was 1.5 m DW, while a 1.3 m DW pup was extracted in early October from a dead specimen. Preliminary data suggests that the gestation period in this population is 12-13 months. While at least four females were seen to be pregnant in consecutive years, the majority of individuals had a biennial or even triennial reproductive cycle.

0477 Poster Session III, Sunday July 27, 2008

Tools for Planning and Designing Conservation Buffers

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Conservation buffers can benefit aquatic and riparian biodiversity by creating habitat, protecting water quality, enhancing the microclimate, and providing opportunities for species movement. Buffers can also provide other environmental and socio-economic benefits such as soil protection and landowner economic diversification. Balancing these benefits can be a challenging task of determining what opportunities, limitations, and trade-offs exist in each situation, and of designing a buffer system that achieves the best balance among them. To meet this challenge, the USDA National Agroforestry Center is developing a suite of buffer planning and design tools to accommodate a range of landscape considerations in combination with each landowner's unique decision-making process. These tools can be used individually or in combination to plan and design buffer systems that satisfy landowner needs and goals while protecting and enhancing ecological functions and values. Some of the tools being developed include: 1) Multi-scale Suitability Assessments Techniques: GIS-based assessments to determine where buffers can achieve biodiversity, water quality, soil, and economic diversification goals. 2) Buffer Width Design Tool: An empirical-based graph for estimating buffer width to achieve a desired level of water quality protection. 3) Planning and Design Guidelines: Illustrated field guide for designing conservation buffers for multiple objectives. Synthesized from over 1,400 peer-reviewed journal articles. 4) CanVis: Image-editing software for creating photo-realistic simulations of buffer design alternatives. 5) Buffer\$: An analysis spreadsheet tool for evaluating the economic costs and benefits of converting a crop field to a conservation buffer.

0474 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Biodiversity in Agricultural Landscapes: Creating a Shared Vision

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Agricultural lands must provide numerous services these days from food, feed, fiber and fuel production to biodiversity protection. Unfortunately many of these services are sometimes at odds with other, such as the current expansion of biofuel production and its impacts on aquatic and riparian habitat. Conservation buffers, both riparian and upland, are an effective strategy for protecting and enhancing riparian and aquatic biodiversity in agricultural landscapes. They create and safeguard habitat, protect water quality, enhance the microclimate, and restore habitat connectivity for species movement. Planning and design of these systems however must be tackled at both the landscape scale where many of these ecological functions are expressed and at the site-level where landowner needs and objectives are addressed. At the USDA National Agroforestry Center, we've developed a planning framework and a suite of tools for designing multi-functional conservation buffers. The multi-scale framework incorporates a regional reconnaissance, landscape assessments, and site-scale buffer plans; providing context for the planning effort and identifying locations for buffers to more effectively achieve biodiversity, water quality, soil protection, and economic diversification objectives - either individually or simultaneously. Site-scale buffer planning is supported by several tools that help 1) determine the physical design of the buffer, including width, configuration, and plant species selection, 2) evaluate the cost-benefits of different buffer scenarios, and 3) landowners to visualize buffer design alternatives on their property. Through planning, landowner and community stakeholder goals can be brought together into a shared vision necessary for supporting aquatic and riparian biodiversity.

0307 Fish Ecology I, Drummond, Thursday July 24, 2008

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

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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.

0244 Poster Session II, Saturday July 26, 2008

The Role of Prescribed Burn on *Pinus palustris* (Longleaf Pine) Community Composition And Structure: A Multiple Taxa Approach to Adaptive Management

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Rapid development, commercial timber practices, and fire suppression have relegated the once dominant matrix community, *Pinus palustris* (longleaf pine) savannah, to scattered isolated remnants on protected lands. While current management practices use prescribed burning to mimic natural fire regimen, few studies have assessed community response to such activities beyond the focal species approach. We present ongoing research that quantifies changes in longleaf pine community composition and structure across a range of taxa (i.e., plants, herpetofauna, invertebrates, and microbes) that utilize longleaf pine uplands, and associated isolated wetlands, on a large riverine island. In six paired sites (i.e., burned v. control) a nested sampling design was used to assess vegetation (i.e., overstory, shrub, herbaceous, and longleaf seedling regeneration) as well as abiotic

factors (e.g., soil nutrients, litter depth) known to constrain plants and herpetofauna. Direct (i.e., drift fence array) and indirect (e.g., call surveys) herpetofaunal sampling occurred proximate vegetation plots, quantifying species occurrence, diversity and richness. Microbial and invertebrate sampling efforts are ongoing with completion anticipated in summer 2008. Of the taxonomic groups sampled, plant community (and associated edaphic conditions) exhibited the greatest statistical differences between treatments with increased longleaf pine seedling density ($p < 0.001$), reduced litter depth ($p < 0.001$), and reduced herbaceous cover ($p = 0.047$) occurring on burned sites. A total of 179 herpetofauna, representing 21 species, were captured in 1164 array nights. While no overall differences occurred in herpetofaunal richness and diversity between burned and unburned sites, several species exhibited treatment preferences including *Notophthalmus viridescens dorsalis* (unburned; $p = 0.076$), *Hyla femoralis* and *Storeria occipitomaculata* (burned; $p = 0.069$ and $p = 0.042$, respectively). Large bodied snakes occupied unburned sites more ($p = 0.07$), but sample size precludes definitive conclusion. Extensive drought influenced results as species of interest responded differently to drought-related stress (e.g., migration, aestivation), affecting observed distributions. Our research suggests that for fire management to be successful, quantifiable parameters specific to species of interest must be assigned a priori and monitored concurrently with management application.

0646 Poster Session I, Friday July 25, 2008

***In-vivo* Muscle Dynamics of Thresher Sharks During Sustained Swimming**

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This study presents the first phase of a collaborative research project that investigates several aspects of locomotor muscle function and design in the thresher sharks (Alopiidae). Threshers are a group of large, pelagic sharks easily recognized by their elongate upper caudal lobe. The alopiids represent the only genus to contain species with both lateral and medial positions of the red aerobic locomotor muscle (RM). Thus, the alopiids provide the ideal system in which to test the hypothesis that the medial RM position in the common thresher shark (*Alopias vulpinus*) provides the basis for a propulsion mechanism similar to that found in the lamnid sharks and different from sharks with lateral RM. Field studies captured common thresher sharks and used sonomicrometry to quantify the *in-vivo* muscle dynamics of the red and white muscle (WM) during sustained swimming. Preliminary data on RM strain (at first dorsal fin), at a tailbeat frequency of 0.5Hz, was consistently greater than that of the WM and decreased significantly during simulated swimming movements (when the RM was not stimulated; i.e., passive swimming). By contrast WM strain did not differ between active and passive swimming. A comparison of RM and WM 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.

0377 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Defining Management Units of a Migratory Species: the Global Genetic Population Structure of the Tiger Shark (*Galeocerdo cuvier*)

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The tiger shark (*Galeocerdo cuvier*) is a migratory and globally distributed species, inhabiting warm-temperate and tropical waters. This species likely plays a key role in marine ecosystems and recent evidence of its over-exploitation and population decline in some regions underscores the need for accurate delineation of its population structure worldwide to inform management efforts. We analyzed the global population structure of tiger sharks (n = 289) using 11 nuclear microsatellite loci and sequences of the entire mitochondrial control region (n = 201). Population-level microsatellite analyses revealed strong genetic differentiation among tiger sharks from Atlantic and Indo-Pacific waters ($F_{ST} > 0.102$), and between samples from South Africa and the Southwestern Atlantic ($F_{ST} = 0.185$). There was relatively weak differentiation among sample sites within basins ($F_{ST} < 0.026$). Although individual-level analyses using the software STRUCTURE and BAPS found significant within-basin differentiation, these groupings did not correspond to geographic capture locations, suggesting extensive mixing of adult populations within basins. Preliminary mitochondrial sequence analysis revealed high congruence with nuclear markers, showing strong division of the Atlantic and Indo-Pacific groups. Collectively, these findings imply a strong barrier to dispersal across the South Atlantic, and between ocean basins. In contrast, open ocean expanses appear not to inhibit dispersal across the Indo-Pacific, suggesting an absence of barriers to gene flow across this basin. The detection of mainly basin-wide management units emphasizes that managing and conserving large, migratory species will require collaborative, multi-national and global-scale approaches.

0005 Fish Ecology I, Drummond, Thursday July 24, 2008

Reproductive Anatomy, Gonad Development and Spawning Seasonality of Nurseryfish, *Kurtus gulliveri* (Perciformes: Kurtidae)

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The nurseryfish, *Kurtus gulliveri* of northern Australia, is remarkable for the fact that the males carry the egg mass on a supraoccipital hook on their forehead. Plankton samples of larval nurseryfish indicate a prolonged spawning season (June-November) that more or less corresponds with the Dry Season in the Northern Territory. The paired, elongate testes are located in the posterior position of the body cavity suspended by the mesorchium. The Gonadosomatic Index (GSI) of males was small and highly variable (mean 0.14, 0.01-0.27) from June-November. The histological structure of testicular lobes showed maturing and mature stages that contained spermatocytes, spermatids, and spermatozoa. The paired, bean-shaped ovaries contained about 5000 oocytes (1176-9783) and were located in the rear of the abdominal cavity. GSI averaged 1.58 (0.36-4.48). Ovarian histology revealed primary growth, cortical alveolar oocytes, vitellogenic oocytes, coalesced yolk, and atresia. The occurrence of postovulatory follicles and late vitellogenic oocytes in the ovaries clearly indicate that nurseryfish females are batch spawners. Maturing testes showed signs of previous spawnings indicating that males are capable of spawning several times throughout the spawning season. We speculate that nurseryfish may spawn in a manner similar to their closest relatives, cardinalfishes (Apogonidae), with eggs carried on the male's hook instead of orally.

0481 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

MtDNA Phylogeography of *Barbus intermedius* (Pisces: Cyprinidae) from Ethiopia

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Barbus intermedius, a large and hexaploid East African freshwater minnow, is well known for its morphological plasticity. Two subspecies of *Barbus intermedius* are recognized: *B. intermedius intermedius*, from Ethiopia and northern Kenya, and *B. intermedius australis*, from Lake Baringo, Kenya. Since the species description in 1835 there have been few attempts to examine geographic variation in this species in order to resolve its complex taxonomic history. We analyzed sequence variation in mtDNA cytochrome *b* gene sequences in 82 specimens representing *B. intermedius*, *B. bynni*, *B. paludinosus*, *B. gananensis*, and outgroup taxa from *Garra*, *Labeo*, and *Varicorhynchus*. Fourteen populations of *B. intermedius* in four major drainage systems in Ethiopia were analyzed. Phylogenetic analyses revealed two mitochondrial lineages, corresponding to a north-south split in the drainages. The northern lineage

included specimens from the Blue Nile (including Lake Tana) and Awash drainages, and northern Rift Valley lakes. The southern lineage consisted of specimens from the Omo-Gibe drainage system and southern Rift Valley lakes and rivers. These divergent mtDNA lineages are indicative of potentially long independent histories. Splitting *B. intermedius* into two species requires additional assessment of morphological character variation.

0463 AES Food & Feeding, Kafka/Lamartine, Saturday July 26, 2008

Diet of the Roundel Skate, *Raja texana*, from the Northern Gulf of Mexico

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To evaluate the trophic role of skates in benthic marine ecosystems, diet and feeding habits of the roundel skate, *Raja texana*, have been examined from offshore waters in the northern Gulf of Mexico. Diet was assessed by life-stage (immature and mature) and quantified using several relative measures of prey quantity: percent by number (%N), percent by weight (%W), frequency of occurrence (%O), the index of relative importance (IRI), IRI expressed on a percent basis (%IRI), %IRI based on prey category (%IRI_{PC}), and the geometric index of important based on prey category (%GII_{PC}). Analysis of stomachs from 222 immature individuals (195 non-empty; mean) and 191 mature individuals (167 non-empty) indicate shrimp make up 90.7 %IRI_{PC} (69.6 %GII_{PC}) of immature skate diet, with decapod shrimp and euphausiids the most important identifiable type present. Although in smaller amounts, fishes were found in the diet of immature skates (7.9 %IRI_{PC}, 18.8 %GII_{PC}), with *Bregmaceros* spp. the most important identifiable species present. Mature skate diet was also predominantly shrimp (64.8 %IRI_{PC}, 46.6 %GII_{PC}); however, fishes made up a much larger percentage by prey category (24.8 %IRI_{PC}, 26.9 %GII_{PC}). Crabs and other crustaceans were also relatively important in the diet of mature animals (4.4 %IRI_{PC}, 12.1 %GII_{PC} and 2.7 %IRI_{PC}, 9.5 %GII_{PC}, respectively).

0371 Fish Ecology I, Drummond, Thursday July 24, 2008

Fish and Invertebrate Assemblages in Seasonal Headwater Streams

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Channelization of streams results in modifications of the meandering of streams. Changes in natural stream meandering affects erosional and depositional patterns and subsequent pool-riffle development where there is a diversity of substrate sizes. Channelized streams experience higher rates of drying in late summer and early fall due to efficient water movement and higher water temperatures. Approximately 70 % of east-central Indiana landuse is rowcrop agriculture and stream channelization is common. For this study we defined streams that dry in late summer and early fall as seasonal, and perennial streams maintain flow throughout the year. We sampled 14 sites for fishes and invertebrates in seven headwater streams within the Buck Creek watershed. We predicted that alterations in natural channel structure, which change the seasonal drying of the streams, would also change the fish and invertebrate assemblages. Abundances of invertebrates and fishes were analyzed in separate Detrended Correspondence Analyses (DCA) ordinations in PC-ORD. Subsequent invertebrate DCA axes were tested for significant correlations with habitat scores, water quality variables, and abundance of fishes. Fish DCA axes were tested for significant correlations with habitat and water quality variables. No significant differences in fish and invertebrate assemblages were found in comparisons of seasonal vs. perennial streams. However we did find significant correlations with habitat and water quality variables.

0145 Poster Session II, Saturday July 26, 2008

The Effect of Parasite Infection on Phonotactic Response in the Mink Frog, *Rana septentrionalis*

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Parasites are typically detrimental to their hosts, and effects include modulation of behaviors important to host fitness. The mink frog, *Rana septentrionalis*, is the final host of the digenean flatworm, *Halipegus eccentricus*, which inhabits the eustachian tube. Extreme infection results in complete occlusion of the eustachian tubes, and could adversely affect a frog's hearing. The tympanic membranes are coupled internally through the buccal cavity via open eustachian tubes, thus vulnerable to pressure changes induced by the presence of *H. eccentricus*. I tested phonotactic response in mink frogs to determine if hearing is affected by infection of *H. eccentricus*, reflected in a lower frequency of positive responses, or a longer latency to response. Male and female frogs were placed one at a time in a floating choice arena, given 10 min to acclimate, and 10 min to respond to a conspecific advertisement call broadcast from a speaker. Positive phonotaxis was recorded if the frog approached

the broadcast speaker. Individuals were then measured, checked noninvasively by looking down the eustachian tubes from the open oral cavity, then released at the capture site. Infection rates were relatively high: 44.6% of males had at least one *H. eccentricus* in one or both sides, and 37% of females were infected. Infected and uninfected males differed significantly in responses, with uninfected males responding more frequently than infected males. There was no difference in latency of the response. For females, infected and uninfected individuals exhibited similar response rates, and there was no significant difference in the latency to response. For both males and females, though, infected individuals took slightly longer to score a phonotactic response. Therefore, infection by flatworm parasites in the eustachian tube of mink frogs may indeed affect a frog's response to a conspecific call.

0362 Fish Systematics III, Drummond, Saturday July 26, 2008

Morphological Diversity of Gas bladders in Thorny Catfishes (Siluriformes: Doradidae)

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The thorny catfish family Doradidae (Siluriformes) exhibits great morphological diversity in gas bladder anatomy associated in part with the modified elastic spring apparatus. Although ichthyologists have long appreciated the complexity of these structures, few studies have examined variation within the whole family. The present contribution describes, categorizes and illustrates gas bladder morphology in all known species of doradids, noting inter- and intra-specific variation and ontogenetic changes where they occur. The most basal doradids exhibit a simple cordiform gas bladder, whereas in some derived taxa it becomes abbreviated anteroposteriorly and acorn-shaped. The gas bladder walls may be smooth or have few to many simple or branched diverticulae restricted to specific areas or liberally distributed around its periphery and sometimes on dorsal and ventral surfaces. In some taxa, a secondary bladder is formed by elongation of both or just one of the posterior chambers and a narrow constriction between primary and secondary bladders. In large-size species the gas bladder exhibits internal trabeculae, and in two non-related genera the gas bladder is reduced with thick walls and reduced posterior chambers. Intra-specific differences are relatively minor, and most often reflect ontogenetic changes especially in some large-size species. Comments on the utility of this character complex for phylogenetic analysis of doradid relationships are provided.

0360 Poster Session I, Friday July 25, 2008

New Species of *Leporinus* Spix (Characiformes: Anostomidae) from Rio Curuá, Iriri-Xingu Basin, at Serra do Cachimbo, Brazil

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A new species of the genus *Leporinus* Spix (Characiformes, Anostomidae) is presented from the rio Curuá, a tributary of the rio Iriri, Xingu basin, at Serra do Cachimbo, Pará State, Brazil. The new species can be diagnosed by its unique coloration, which consists of round dark spots widespread over the body, and by the following combination of inferior mouth, dental formula 3/4, 37 to 38 scales in lateral line, 4/3-4 transversal series of scales, and 12 circumpeduncular scale series. The new species most closely resembles *L. reticulatus* from upper Tapajós basin, by having widespread dark spots. The new species is apparent endemic to the rio Curuá, above the great waterfalls near Cachoeira da Serra at Serra do Cachimbo. Comments on the endemism of upper rio Curuá are provided.

0387 Herp Stressors/Snake Conservation, Salons 6&7, Monday July 28, 2008

Western Rattlesnake Conservation in the south Okanagan Valley, British Columbia

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¹University of Guelph, Guelph, Ontario, Canada, ²Environment Canada, Vancouver, BC, Canada, ³Nk'Mip Desert Cultural Centre, Osoyoos, BC, Canada, ⁴BC Ministry of Environment, Victoria, BC, Canada

Radio-telemetry was used on male Western Rattlesnakes (*Crotalus oreganus*) to assess the value of short distance translocation (SDT) and snake fencing as management tools for protecting snake populations. Between April 2004 and October 2005, we evaluated the effectiveness of SDT by investigating how 500m SDT affected the spatial ecology, body condition, and behaviour of Western Rattlesnakes in a field study near Osoyoos, BC, Canada. Twelve of 14 (85.7%) rattlesnakes managed with SDT returned to the general area they were removed from on one or more occasion (range 1-7 times). Rattlesnakes managed with SDT showed a significant increase in total distance moved over an active season when compared to non-translocated snakes, but there was no evidence to suggest SDT had an effect on activity range size, body condition, behaviour, or mortality rates. SDT to high quality undisturbed habitats was not successful as a long-term solution to snake-human conflict because most translocated snakes returned to conflict areas within a short time (mean 19.9 ± 8.7 days). In 2006, a 5km snake fence was erected to reduce snake-human interactions in a campground in the same study area as the SDT work. There were no known mortalities found along or near the fencing and no observations were made of any snakes in distress. Of the nine snakes tracked in the fence treatment area, only two

were observed in association with the fence (i.e. closer than 2m) throughout the season and only one was able to escape the fenced area.

0489 Herp Stressors/Snake Conservation, Salons 6&7, Monday July28, 2008

Pesticide Exposure And Reproductive Effects In Native Amphibian Species Living in Agricultural Habitats, South Okanagan Valley, British Columbia (2003-2005)

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Egg mortality was assessed in four species in ponds in an intensive fruit growing area of the south Okanagan valley, BC, Canada. Species tested were the Great basin spadefoot (*Spea intermontana*) (federally listed as threatened), western toad (*Bufo boreas*) (special concern in Canada), and two species that are not at risk: pacific tree frog (*Pseudacris regilla*) and Columbia spotted frog (*Rana luteiventris*). Enclosures with eggs were placed in ponds in non-agricultural reference ponds located 500 to 1000 m from sprayed sites, conventionally sprayed orchards, and organic orchards. Current-use pesticides occurred at concentrations as high as 1410 ng/l for diazinon; 57 ng/l endosulphan-sulphate in sprayed sites and the highest single day sum total of pesticides was 1519.8 ng/l among sites. Reference ponds contained up to 411.6 ng/l sum total of pesticides demonstrating that as in other agricultural landscapes ponds in conservation areas are exposed to pesticide drift. For all species and years, hatching success was lowest at sprayed sites with sites regularly having 0% hatching success for all species. Hatching success was highest (72 to 96%) at the non-agricultural reference sites, but in organic orchard sites egg mortality was as low as 62%. There were significant correlations among water chemistry, pesticides and hatching success. Nine pesticides correlated negatively with Great basin spadefoot hatching success. Concentrations of nitrate, total dissolved phosphorus, and total phosphorus also correlated with hatching. For Pacific Tree Frog there were no significant correlations with pesticide concentrations however hatching success correlated negatively with water chemistry as well. When the toxicity of three of these pesticides was tested in a laboratory setting, spadefoot eggs were consistently more sensitive than tree frogs but individual pesticides induced less than 20% mortality of eggs of either species.

0138 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008; GRUBER

Reproductive Biology of the Banded Guitarfish, *Zapteryx exasperata*, from the Gulf of California México

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The banded guitarfish, *Zapteryx exasperata*, is an important target specie in the artisanal elasmobranch fishery into the Gulf of California during spring and early summer. Males and females banded guitarfish have two functional testes and ovaries, respectively. Using the logistic model median size at maturity (L50%) was estimated 64 cm total length (TL) for males and 69 cm TL for females. Average length of pregnant females was 78.8 ± 3.8 cm TL. Histological analysis showed sperm clumps in the epididymis and no evidence of sperm storage in the oviducal gland was observed. Embryos development starts in February and ends in June or early July when embryos average size (149.1 ± 17.8 cm TL) reach the reported birth size (15-22cmTL). Oocyte development is concurrent with the embryonic growth with largest oocyte diameter of 25 mm in July. Mean fecundity was estimated at 7 pups (range 1-13, s.d. = 2.92) with a 1:1 embryos sex ratio. Reproductive cycle in banded guitarfish from the Gulf of California seems to be 1 year long. Differences of the reproductive pattern with the population of the Mexican Pacific are discussed.

0139 Poster Session I, Friday July 25, 2008; CARRIER

Description of the Banded Guitarfish Reproductive Tract and Embryos Development

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No information is known about the reproductive tract anatomy in the banded guitarfish. Males possess two functional compound-type lobulate testes. In immature individuals, testes appear as a small pink structure attached in the anterior portion of the epigonal organ ranging in length between 10 to 80 mm. Testes of mature individuals range from 40 to 100 mm. Microscopic examination of testes indicate that banded guitarfish possess multiple germinal zones located on the dorsal surface. Females possess two functional external type ovaries. Immature females have

undeveloped ovaries with small, clear, yolkless oocytes less than 5 mm in diameter, the uterus appear narrow and the oviducal gland is difficult to distinguish from the rest of the oviduct. In mature females vitelogenic oocytes range from 5 to 25 mm. Embryos were found to be equally distributed in each uterus. At the beginning of the gestation, all fertilized oocytes in each uterus are contained in a single, thin, amber colored envelope that remain until the embryos complete their development. At the second month of development (April) embryos start to be distinguishable with a mean total length of 26 mm and without coloration; three months later, embryos reach the birth size 186 mm TL and the yolk was completely absorbed.

0074 Fish Systematics I, Salons A&B, Friday July 25, 2008

Phylogeography and Systematics of the Slender Madtom, *Noturus exilis*

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The Slender Madtom, *Noturus exilis*, is disjunctly distributed in the eastern and interior highlands with additional isolated populations in glaciated regions in Wisconsin, Illinois and Iowa. A previous phylogeographic study of *N. exilis* found high levels of genetic structure among populations and deep phylogenetic splits among several geographically defined clades. Variation in fin pigmentation also has been noted. These features suggest unrecognized taxonomic diversity in *N. exilis*. We explored this possibility using mitochondrial and nuclear markers to further assess genetic structure and phylogeographic relationships. High levels of population structure throughout the range of *N. exilis* were observed, and identical haplotypes were only found within river systems and not shared at large distances or among drainages. Three deep phylogenetic divisions (4.8-6.2% sequence divergence) were found: (A) the Red River (White River), (B) the Arkansas and Neosho rivers, and (C) the remainder of the interior and eastern highlands. Within clade C, several geographically defined clades were recovered including: (1) upper White River, (2) Black River (White River), (3) Strawberry River (White River), (4) middle Cumberland and Tennessee rivers, (5) lower Cumberland River, and (6) Missouri, Kansas, St. Francis, Illinois, and lower Ohio rivers. Interestingly, the White River is comprised of four genetically divergent units that are not closest relatives. Examination of morphological variation is underway to see if populations from the exclusive, geographically-concordant clades are diagnostic morphologically.

0682 General Ichthyology III, Drummond, Sunday July 27, 2008

The Genus *Symphysodon* Heckel, 1840 (Perciformes: Cichlidae) and how its Three Species can be Defined from Their Habitat and Chemical Water Parameters, Better than from Their Molecular or Morphological Characters

Heiko Bleher

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The systematics of the cichlid genus *Symphysodon* has been revised recently twice and the molecular results were similar in both papers (Ready, Ferreira & Kullander 2006; Bleher, Stölting, Salzburger & Meyer 2007). In both publications three clades within the genus and three species were recognized. Without going into the details of the nomenclature of each MS, it is worth mentioning that Bleher et al. proved, by analyzing the distribution and the habitats of each one of the three species, that each species lives in its own habitat with its own chemical water parameter and nowhere else. That they live allopatric and normally never meet, and if they occasionally do, like during extreme floods in Amazonia where they live, natural hybridization may take place. In the present study the chemical parameters of each species are shown (from more than 250 parameters taken), the distribution limits of each species and where natural hybridization has occurred. This study is a result of more than 300 field trips during the last 43 years throughout most of the central and lower Amazon rivers and lakes. The result may prove that chemical water parameters are not only for the *Symphysodon* species the main factor of isolation during evolution, but probably for many other fish species as well. This study also shows that the chemical water parameters, which have never been taken in consideration for fish species taxonomy, should be used more frequently by researchers. In addition, in this study some results from breeding *Symphysodon* species in different water parameters in captivity, as well as results from hybridizing in aquaria during the last four decades are shown.

0086 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Stingray Swimming: Three-dimensional Kinematics of Pectoral Fin Locomotion

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Batoids swim using distinctive undulations and oscillations of expanded, flexible pectoral fins. Previous work has described fin motion in two dimensions, placing species along a continuum from undulatory to oscillatory locomotion. However, the flexible fins of stingrays allow complex deformations, in addition to the traditionally described anterior-posterior propulsive wave. A three-dimensional analysis of pectoral fin motion is needed to fully describe batoid locomotion, including changes in kinematics with swimming speed, and to generate hypotheses about fluid flow around the flexing fin. In this study we characterize the pectoral fin motion of freshwater stingray *Potamotrygon hystrix* in three dimensions. Three synchronized,

one megapixel high speed video cameras (250 frames/s) were calibrated using direct linear transformation and used to film three individuals (mean disc length=13 cm) swimming at two speeds (1.5 and 2.5 disc lengths/s). Multiple finbeats per individual, per speed, were analyzed to create a three-dimensional model of the moving fin, with approximately thirty points describing surface deformations. Kinematic variables including wave speed, frequency and amplitude were determined for the propulsive wave, and combined with angular variables to quantify fin motion in other planes, based on x, y and z excursions of points across the fin surface. This three-dimensional analysis of batoid locomotion reveals fin postures with significant hydrodynamic implications, including a “cupping” of the distal margin. Future experiments using particle image velocimetry will explore these implications and characterize flow patterns around the fin.

0212 Herp Conservation, Salons 4&5, Sunday July 27, 2008; STOYE CONSERVATION

Forest Management Alters Multi-scale Habitat Selection and Breeding Success of Wood Frogs (*Rana sylvatica*)

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Animals select habitats that maximize their individual lifetime fitness, and the fitness potential of a habitat is the effect of this habitat on an individual's survival and reproduction. We used radio-telemetry data collected on 72 adult frogs and logistic regression modeling to assess habitat selection at three scales (seasonal home range, weekly activity center, daily microhabitat) in multiple seasons in response to an unharvested control and three forest management strategies: clearcutting (with removal of all merchantable timber > 10 cm diameter), clearcutting with coarse woody debris retention, and partial harvesting with removal of < 25% canopy cover. We also used observations of adults in two populations and a logistic regression model to assess the breeding success of individuals captured in each treatment in this managed forest. Over the course of two tracking periods, radio-transmitted frogs selected the partially harvested treatment, tended to select unharvested treatment, and spent 5 ± 2 days longer in these forested treatments than in the clearcut treatments (with and without coarse woody debris retained). The best supported model indicated frogs were more likely to occupy weekly activity centers with more complex ground structure. Frogs selected daily microhabitats with higher canopy cover, more complex ground structure, and moist but not wet substrates. Of the 180 frogs that we captured entering two breeding ponds, 61 bred successfully, and larger frogs and frogs from the forested treatments were more likely to breed. Our data suggest that the fitness potential of the clearcut treatments is lower than that of the forested treatments. Furthermore, coarse woody debris retention, especially in clearcuts, should ameliorate some of the effects of harvesting, and partial harvesting with removal of < 25% canopy cover is a forest management strategy that may not adversely influence the abundance or fitness of *R. sylvatica*.

0221 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Phylogenetics and Evolution of New World Anchovies (Engraulidae)

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Anchovies (Engraulidae) are highly abundant clupeomorph fishes that provide a vital component of local ecosystems and constitute one of the most heavily commercially harvested fisheries worldwide. However, there is currently no explicit hypothesis of phylogenetic relationships available for these ecologically and economically important fishes. Here we provide an initial phylogenetic analysis of the putatively monophyletic New World anchovy clade, composed of approximately 80 species. This clade is interesting because it includes both marine and freshwater species, and shows a case of extreme miniaturization (in the South American genus *Amazonsprattus*). We present a preliminary phylogenetic analysis of New World anchovies including 7 of the 9 genera, based on both mitochondrial and nuclear DNA sequence data. Using the resulting phylogeny, we consider the evolution of miniaturization and biogeographic transitions between marine and freshwater habitats.

0115 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Habitat Use is Linked to Components of Fitness Through the Temperature-Dependence of Performance in Ratsnakes and Map Turtles

Gabriel Blouin-Demers

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For ectothermic reptiles, habitat selection is mechanistically linked to fitness through the temperature-dependence of performance. Many reptiles occupy thermally heterogeneous environments and regulate their body temperature through selective use of habitats within their environments, making reptiles ideal subjects to understand the fitness consequences of habitat use. Our goal here was to investigate the link between habitat selection, thermoregulation, and fitness by comparing the expected distribution of performance for real ratsnakes and map turtles that thermoregulate through selective use of habitat with the performance of hypothetical snakes and turtles that are assumed to use habitats randomly. Thermal data for real snakes and turtles were obtained using temperature-sensitive radio-transmitters implanted in free-living individuals, whereas thermal data for hypothetical animals were obtained by sampling environmental temperatures that a randomly moving individual would encounter. Thermal data were then transformed into performance using experimentally derived equations relating performance (swimming speed) to temperature. Habitat selection allowed snakes and turtles to avoid lethal temperatures and resulted in an average improvement of 18% in locomotor performance. A more exact measure of the fitness improvement accrued through habitat selection will have to await data relating body temperature to ultimate

measures of fitness and a deeper understanding of the contribution of different performances to fitness.

0683 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Life-history of a Population of Cottonmouths (*Agkistrodon piscivorus*) in East-central Alabama

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We conducted a capture-mark-recapture study of a Cottonmouth (*Agkistrodon piscivorus*) population at Tuskegee National Forest, in east-central Alabama over 4 years (2001-2004). During this time period we made a total of 391 observations on 198 marked individuals. This population is characterized by relatively small adults (mean male SVL = 67.9 ± 9.0 cm, mean female SVL = 62.6 ± 5.0 cm) with a significantly female-biased sex ratio (0.39 males/female) that was evident across seasons and years. Reproductive data indicate the frequency of reproduction is highly variable across years and that, on average, females invested 26.2 ± 0.093 % of their body mass into relatively small (4.1 ± 1.5) litters. Growth in free-ranging individuals was significantly lower than lab-reared individuals and may be attributed to variable resource levels. Using the Cormack-Jolly-Seber (CJS) model we obtained an estimate of annual survival (0.79) that is among the highest reported for snakes. Although we did not detect an effect of body size on survival, the probability of recapturing individuals increased with body size up to a snout-vent-length of 82 cm, after which it remained approximately constant. Our findings provide new information about Cottonmouth life history and, in combination with similar Cottonmouth datasets across its range, will enhance our knowledge of Cottonmouth demography and population dynamics.

0278 General Herpetology I, Salons 4&5, Sunday July 27, 2008

Sex in Unisexual Salamanders: Discovery of a New Sperm Donor with Ancient Affinities

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Although bisexual reproduction has considerable evolutionary benefits, several populations of unisexual all-female vertebrates are known to exist. Unisexual salamanders in the genus *Ambystoma* are common around the Great Lakes region in eastern North America. Based on mitochondrial DNA sequences, they originated from a hybridization event that involved a female that shared a common ancestor with *A. barbouri* 2.4 to 3.9 million years ago but, unexpectedly, *A. barbouri* nuclear genomes are unknown in unisexuals. Unisexual salamanders steal sperm from donors of normally bisexual species so their reproductive mode is described as kleptogenesis. Most known unisexuals are polyploid and they all possess at least one *A. laterale* genome. One or more genomes are taken from other sperm donors that may include *A. jeffersonianum*, *A. texanum* and *A. tigrinum*. We examined unisexual adults and larvae in a southern Ohio pond where unisexual individuals exist with male *A. barbouri*. This population provided a unique opportunity to test hypotheses pertaining to the role of *A. barbouri* in the co-evolution of the disparate cytoplasmic and nuclear components in unisexual salamanders. Microsatellite DNA loci, mitochondrial DNA sequences, and genomic *in situ* hybridization (GISH) were used to identify the genomic constitution of individuals. *Ambystoma barbouri* was found to be an acceptable sperm donor for unisexuals but only contributed genomes in ploidy elevated individuals. There was no evidence for contemporary genome replacement with an *A. barbouri* genome. In the absence of *A. jeffersonianum*, this Ohio population is likely experiencing a recent switch in sperm donors from *A. jeffersonianum* to *A. barbouri* and demonstrates the evolutionary flexibility and dynamics of kleptogenesis.

0705 Poster Session I, Friday July 25, 2008; CARRIER

Identification by Video Surveillance of Species-specific Bait Manipulation by Lemon Sharks, *Negaprion brevirostris* and its Influence on Capture Susceptibility

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Anyone familiar with shark fishing knows that some species can successfully remove bait from a hook without getting caught. This ability whether through species-specific mouthing techniques or individual differences in bait manipulation has potentially significant implications for fisheries management. If catch rate is affected

by behavioural differences in bait handling this can lead to a species-specific bias with regard to, abundance estimates and CPUE., This could erroneously imply that there are greater or fewer numbers of a particular species. We investigated the question of capture susceptibility in the field using a 30 m long section of long line with a single baited gangion. An underwater video camera placed near the rig enabled us to record the behaviour of each lemon shark approaching and interacting with the baited hook. Analysis of the video records provided materials to identify inter- and intraspecific variations in bait handling behaviour which in turn influenced whether a shark became hooked or not. One objective of the study was to examine whether the negative stimulus of capture could result in rapid learning whereby a shark would actively avoid a baited hook as a result of being hooked. We investigated this by first marking juvenile lemon sharks with colour-coded dart tags at the study site (Bimini lagoon). Their interactions with baited hook were also observed and videotaped from a 16ft tower. Data collected included approach duration, number of approaches, as well as a number of bait-handling behaviours. We thus determined if a shark that was previously caught (i.e. negatively conditioned), actively avoided the baited hook or displayed caution (slower approach time) on subsequent trials over a period of months. Supported by grants from the Hoover Foundation, BBFS, National Science Foundation and Leverhulme Foundation.

0636 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Does Paedomorphosis Drive Morphological Divergence in the Oklahoma Salamander?

Ronald Bonett

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Paedomorphosis is widespread in salamanders and may be the impetus for much of the morphological variation seen among different forms. In the most extreme cases paedomorphosis includes a series of correlated developmental truncations that result in adults with an almost completely larval morphology and aquatic ecology. Developmental mode (paedomorphosis vs. metamorphosis) is highly labile among populations of the Oklahoma salamander, *Eurycea tynerensis*, with most populations exhibiting only a single strategy. Paedomorphosis is common in porous chert bottom streams where *E. tynerensis* has constant access to subsurface water, while metamorphosis is required in locations where streambeds are highly compact and surface streams dry-up completely during summer months. The existence of multiple independent replicates of isolated paedomorphic and metamorphic populations across the distribution of *E. tynerensis* in the western Ozarks provides a unique system for studying the role of paedomorphosis and subsequent life history shifts in patterns of morphological evolution. Here I present a morphological examination of *E. tynerensis* to test if paedomorphosis and long term associations with aquatic habitats is driving subsequent morphological evolution at the population level.

0364 Herp Stressors/Snake Conservation, Salons 6&7, Monday July 28, 2008

Evaluating How Nutrient Input Influences Insecticide Exposure on Larval Amphibians

Michelle Boone, Neal Sullivan, Emmette Boone

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Chemical contamination is widespread and represents a realistic environmental factor in most systems. Understanding how presence of nutrients in aquatic system may influence the effects of contaminants is necessary to have general predictive power and to properly guide chemical regulation and management. In this study, I examined effects of an insecticide across varying amounts of leaf litter input on tadpoles of American toads (*Bufo americanus*) reared from hatching through metamorphosis and on green frogs (*Rana clamitans*) reared from hatching through onset of cold weather in outdoor mesocosm ponds. These studies suggest contaminants nutrient input can alter the effect of the insecticide. While low nutrient input generally had negative impacts on growth and survival of tadpoles, insecticide exposure generally had positive effects on metamorphosis resulting from a trophic cascade. However, tadpoles exposed to low nutrient conditions and the insecticide showed the lowest growth and development. These results suggest that environmental conditions (and conditions in mesocosm studies) can influence the impact of a contaminant and change its effect on amphibian metamorphosis from positive to negative.

0110 Fish Systematics II, Salons A&B, Friday July 25, 2008

Classical And Molecular Cytogenetics of the Species from Superfamily Cobitoidea (Teleostei, Cypriniformes) - a Review

Alicja Boron, Anna Grabowska

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Superfamily Cobitoidea is composed of four families (Gyrinochilidae, Catostomidae, Cobitidae, Balitoridae), 99 genera and 842 species. Most of so far published data contain the chromosome number and karyotype. Majority of the taxa belonging here characterized by diploid ($2n = 50$ or $2n = 48$) or polyploid ($2n = 100$) chromosome number. Some of species, especially from family Cobitidae, via hybridization processes followed by genome duplication during meiosis, produce polyploidy. Naturally occurring allopolyploid cobitids and their parental species are the most cytogenetically investigated among Cobitoidea. Hybridizing species of loaches possess $2n = 50$ or $2n = 48$ chromosomes and karyotypes characterized by domination of biarmed elements. Most of the cytogenetically investigated species characterized by multiple, from two to three, NOR bearing chromosome pairs and location of 'major' rRNA corresponded with GC rich DNA sites. Cytogenetic features of Cobitoidea taxa such as number and location of AgNORs, 28S rRNA and chromatin composition by different banding patterns are compared and discussed.

0719 Fish Conservation, Drummond, Sunday July 27, 2008

Establishing Fish as *in situ* Bioindicators of Extreme Events and Natural Hazards

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Extreme Events and Natural hazards are inevitable, although unpredictable - both spatially and temporally. Because of their ubiquitous distribution in aquatic ecosystems, fish and their associated fisheries could potentially serve as important *in situ* bioindicators of the effects of both extreme events and natural hazards. Many fish attributes suit this purpose, including response variables at individual, species and community levels of organization. Given that resources for investigations are limited, some attributes are more efficient, effective, and biologically meaningful than others. To help establish research plans to investigate the potential for fish to serve as bioindicators, a decision matrix was created with regard to space, time, and variable-response potential. In addition, a decision tree is presented that facilitates choices of species, stocks, populations, and communities appropriate for investigation. More subjective criteria, such as the presence of historical, species-specific databases, are also used in the variable inclusion process as well as the economic and social value as viewed by the public. Lastly, it is advocated that a national/international network of research facilities become established that is multi-jurisdictional and multi-disciplinary to evaluate the spatial and temporal effects of natural hazards on fishery ecosystems. Integration of long-term species-response data will allow a full evaluation of fish interactions with extreme events and natural hazards.

0409 Poster Session III, Sunday July 27, 2008

Raccoon Predation on a Northern Wood Turtle Population - a New Event at the Limit of its Range

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Mortality by predation in adult Wood turtles (*Glyptemys insculpta*) is largely unknown. We documented a mortality event linked to mammalian predation that reduced the number of adults, especially female breeders, in a northerly population.

The objective of this study is to describe predation events by Raccoons (*Procyon lotor*) on adult females during the laying season and its impacts on the Shawinigan river population (Québec), one of the most important known population in Canada. Between 1996 and 2003, the population appeared stable and adult mortality was low (7 cases out of 500 adults handled). None of the breeding females annually monitored (avg. =35,8 females/yr) was ever found dead on, or near, the main breeding site. However, in 2004, a minimum of 9 breeding females, i.e. 25% of females using the nesting site, were killed. Visual observations and necropsies on carcasses confirmed that the raccoon was the predator. Subsequent capture, marking and recapture activities (in 2005) confirmed that a predation level of almost 50 % on the adult population had occurred. In the absence of these observations, the decrease in adult numbers could have been attributed to other factors such as illegal harvesting. We are concerned about this high rate of mortality as the rate of predation exceeds the 5% threshold known to cause a decline in turtle populations.

0766 Fish Conservation, Drummond, Sunday July 27, 2008

Population Viability of Australian Grey Nurse Sharks Under Fishing Mitigation and Climate Change

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Increasing rates of biodiversity loss require biologically realistic approaches to identify the most threatened taxa that may benefit from efficient intervention. This is particularly so for the marine environment where only recently have we begun to appreciate the magnitude of the destruction. The worldwide decline in apex marine predatory sharks is particularly disconcerting because we still understand little of their basic demography, and even less about how threatened populations will fare under rapid climate change. We developed a series of stochastic, density-dependent population viability models for the Critically Endangered grey nurse shark (*Carcharias taurus*) from eastern Australia to predict medium- (3 generations) and long-term (40 generations) extinction risk. Models were constructed using measured and inferred demographic rates, estimates of shark meshing and fishing mortality, and predictions of range shift under climate change. We found that under current reported rates of recreational, commercial and mesh fishing mortality, the estimated population of *C. taurus* (148 – 766 individuals) has a > 40 % chance of becoming quasi-extinct (< 50 females) within 3 generations (~ 50 years). If fishing mortality rates are under-reported, the probability of extinction rises to nearly 100 % over the same interval. For the population to persist for at least 3 generations, at least 3 to 4 times the estimated population size is required. The effects of various management interventions were modelled. The greatest reduction in extinction risk was achieved through a reduction in fishing-related mortality by using non-offset circle hooks. A shift from meshing nets to drumlines for beach protection and an increase in the enforcement and extent of sanctuary zones also reduced extinction risk, but only marginally. Our models predict that range expansion southwards within warming of surface waters is likely to reduce extinction risk if the western and eastern

populations begin to exchange individuals. Our results demonstrate the necessity of including all major sources of uncertainty into stochastic population viability analyses – including the predicted effects of climate change – and the utility of contrasting different management interventions to maximise a threatened population’s probability of persistence over the foreseeable future, even when detailed life history information is missing.

0439 Poster Session III, Sunday July 27, 2008

Amphibian Reproduction in a Suburban Landscape: The Value of Manmade Habitats

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The installation and maintenance of stormwater ponds to detain and treat runoff from impervious surfaces is a common method of stormwater control in developed areas. However, the function of these ponds to capture pollutants is of concern for wildlife species that use the ponds, particularly pond-breeding amphibians. In this study, we aim to describe the use of these stormwater ponds by pond-breeding amphibians relative to other available habitats in suburban areas. We chose three landscapes in the Red Run watershed of Baltimore County, Maryland; landscapes consisted of a stream segment, the surrounding forest buffer, and any adjacent stormwater ponds that would be accessible to pond-breeding amphibians. We also chose three rural landscapes in Oregon Ridge Park in Baltimore County, Maryland, where no stormwater ponds were available. We used preliminary surveys during late winter 2007 to identify all possible breeding habitats for amphibians and then performed call, egg mass and larval surveys to measure breeding effort at each habitat in spring and summer 2007. Across the suburban landscapes, we found calling males or egg masses in only 34% of available habitats and larvae in only 15%. Moreover, of the habitats that had breeding activity, 50% were stormwater ponds, and the rest were a result of past human activity such as road construction. This pattern was reinforced in the rural landscapes, where amphibians were primarily found breeding in human-created habitats. More importantly, late-stage larvae were found only in manmade ponds in all study areas. The results of this study indicate that, at least in human-dominated landscapes, manmade habitats may be as important to amphibian conservation as natural wetlands or pools, and that management strategies for such habitats could greatly benefit amphibian conservation in urban settings.

0558 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

The Cost of Being Sexy: Effect of Host Lizard Sex on Ectoparasite Feeding Success

Amber Branske

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According to the immunocompetence handicap hypothesis, sex differences in ectoparasite loads observed in field studies may be due to costs associated with testosterone production. In order for secondary sex characters related to testosterone to be accurate fitness predictors, there should be costs associated with the production of these characters. This concept was examined in a study of Western Fence lizards (*Sceloporus occidentalis*) and a common ectoparasite, larvae of Western Black-legged ticks (*Ixodes pacificus*). Tests conducted in the laboratory examined the relationship between host sex and tick feeding success and duration. A gravid female *I. pacificus* was obtained, and its eggs were maintained in the laboratory until they hatched. Tick larvae were applied to adult male and female *S. occidentalis* and allowed to attach. Lizards were kept in mesh cages suspended over pans of water in environmental chambers. As ticks detached from the lizards, they fell into the water and floated, facilitating quantification of feeding success. Each day, the water was examined for the presence of shriveled, dead ticks (indicating unsuccessful feeding) or healthy, engorged ticks (indicating successful feeding). Ticks that fed on male lizards had a significantly higher feeding success (number of ticks that successfully fed) and shorter feeding duration than ticks that fed on female lizards, suggesting that the immune response of male lizards to ticks was not as robust as that of female lizards. Future studies will include examination of specific components of the immune response, as well as testosterone manipulations in males to determine whether testosterone is responsible for the host sex difference in tick feeding parameters.

0763 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Arroyo Toads (*Bufo californicus*) in Southern California; Trends from Five Years of Population Monitoring using Proportion Area Occupied (PAO) of Tadpoles and 10 Years of Adult Counts

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In 2003, we implemented a new monitoring program for the endangered arroyo toad (*Bufo californicus*) on Marine Corps Base Camp Pendleton (MCBCP). To address the problems associated with large variations in adult toad activity, we employed a spatial and temporal monitoring approach that tracks the presence of arroyo toad breeding populations by documenting presence of eggs and larvae. Sites are surveyed up to four times per year to calculate and account for imperfect detection probabilities. We also continued to conduct nighttime counts of adult toads from a transect monitoring program implemented in 1996. In this presentation, we review the major trends and findings of the first five years of the spatial monitoring program and over a decade of adult count transects. These include the findings that 1) toad activity has been highly variable among years, but relatively stable over the last decade, 2) associations between activity and rainfall are dependant upon hydroperiod, 3) proportion of wet area occupied appears to be the most stable monitoring metric, and 4) both proportion area occupied (PAO) and probability of detecting arroyo toads are negatively associated with the presence of non-native aquatic species. Direct and indirect associations with bullfrogs (*Rana catesbiana*) and crayfish (*Procambarus clarkia*) and are discussed.

0666 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

Environmental Transmission: A Mechanism of Disease-induced Amphibian Extinctions

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Pathogens that are highly transmissible, infect multiple hosts, and have reservoirs are those most likely to cause extinction of host populations. *Batrachochytrium dendrobatidis* (*Bd*) is an aquatic fungal pathogen of amphibians that has contributed to declines and local extinctions of some host species, but little is known of how it moves through populations. Given that *Bd* can survive outside an amphibian host, and that it has been detected on habitat surfaces during an epizootic, it is likely that *Bd* may have other means of enhancing transmissibility aside from direct contact. However, it is unknown whether free-living zoospores are infective, and thus far transmission has been assumed to be direct. I tested the hypothesis that *Bd* can be transmitted indirectly by means of free-living zoospores that are encountered by a naïve host, and that transmission would be higher in wet versus dry habitats. I

infected lab reared *Rana sphenoccephala* juveniles, placed then in constant temperature chambers, and applied different seasonal moisture regimes. Chambers are 5 gal buckets with 6 cm of pea gravel substrate and sealed Plexiglas tops fitted with a misting mechanism to control moisture levels. Chambers of saturated treatments (tropical wet-season or temperate spring and fall) are sealed to prevent evaporation and drying treatments (tropical dry season or temperate summer) are vented to promote lower moisture. After four weeks, I removed the infected frogs and introduced naïve frogs to test whether they would become infected, and if a difference in the frequency of indirect transmission exists among the moisture treatments. Additionally, if environmental transmission occurs, the efficacy of an infected host indirectly transmitting the pathogen should be a function of its zoospore discharge rate. We tested for differences in zoospore discharge rates among juvenile frogs of different size classes by placing infected animals in a small chamber with a Millipore filter in the bottom for 24 hours. All samples were assayed for infection or quantitative differences in zoospore discharge rate using qPCR. A standard dilution curve using known quantities of zoospores for reference was developed. Infection status, pathogen load, and / or zoospore discharge samples are currently being analyzed via qPCR, and results will be presented. By knowing driving force behind the spread of *Bd* we can focus on factors that are critical to infecting new hosts.

0445 AES Management, Jarry/Joyce, Sunday July 27, 2008

Status of Atlantic Shark Management in the United States

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The Highly Migratory Species (HMS) Management Division of the National Marine Fisheries Service (NMFS) is responsible for the management of the Federal Atlantic shark fisheries including the Gulf of Mexico and Caribbean Sea. In late 2006, NMFS revised the stock status of several large coastal sharks (LCS), including sandbar, dusky, blacktip, and porbeagle sharks, based on the findings of recent stock assessments. Since then, the HMS Management Division has been developing management measures that will change the regulations for all commercial and recreational fishermen, as well as scientists and aquarium collectors. Implementation of this rule is expected in early Summer 2008. In addition to these measures, the HMS Management Division will be beginning the rulemaking process to change regulations on small coastal sharks (SCS) based on the 2007 stock assessment. This process is anticipated to begin in early Summer 2008. The alternatives initially considered in this rulemaking will be based on the findings of the 2007 stock assessment, as well as comments received during upcoming public scoping meetings.

0237 Poster Session III, Sunday July 27, 2008

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

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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, sand skinks are listed as threatened under the Endangered Species Act. The scrub habitat 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 scrub habitat 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 6 years, 7 to 19 years, and 20 to 40 years. During the spring of 2008 we also fitted enclosures with cover boards to find a relationship between sand skink density and presence of sinusoidal tracks left by the movement of sand skinks. We present the results from two years (Spring 2007, Fall 2007 and Spring 2008) of surveying sand skink population densities. We observed higher sand skink densities in areas that have not been burned for 20 years or longer, and found many environmental variables to vary along with time since fire. The relationship between prescribed fire and sand skink population abundance, along with the use of cover boards to standardize survey techniques should provide land managers with additional information helpful to the conservation of this species.

0727 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Geographic and Temporal Patterns of Diversification in *Sebastes* Rockfishes

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The latitudinal biodiversity gradient is one of the most well documented geographic patterns seen in life on earth (Hillebrand 2004; Mittelbach et al. 2007). Despite this, the underlying processes responsible for this pattern remain poorly understood. One potential explanation for the biodiversity gradient is that lineages inhabiting lower latitudes have higher rates of net diversification (speciation rate - extinction rate) potentially due to factors such as higher rates of molecular evolution (Rohde 1978; 1992), increased importance of biotic interactions (Wallace 1878; Dobzhansky 1950; Fischer 1960), increased opportunities for species formation (Moritz et al. 2001; Gentry 1989), or larger geographic areas over which to diversify (Rosenzweig 1995) at lower latitudes. To date, however, few studies have investigated with statistical rigor whether net rates of diversification are elevated at lower latitudes (But see Wiens et al. 2006; Wiens 2007; Weir and Schluter 2007). Furthermore, none, to our knowledge, have investigated this pattern in marine fishes. Therefore we

investigated the latitudinal pattern of diversification in rockfishes of the genus *Sebastes*. The program BEAST v1.4.7 (Drummond and Rambaut 2007) along with two fossil calibrations was used to reconstruct a chronogram using seven mitochondrial and two nuclear genes. The midpoint of the latitudinal distribution of each species was collected from the literature and using these tip values midpoint latitude was calculated for each node in the tree. Rates of net diversification were estimated for each node in the tree using the equations of Magallon and Sanderson (2001). Mesquite v2.01 (Maddison and Maddison 2007) was used to estimate independent contrasts for both midpoint latitude and net rate of diversification across the tree. Regression analyses of contrasts showed a significant negative correlation between diversification rate and latitude ($p < 0.01$). These results provide evidence that latitudinal patterns of diversification rates parallel those for species diversity in *Sebastes* rockfishes. We discuss these results within the context of previous research and supplement them with an investigation of the temporal patterns of diversification in *Sebastes*.

0027 Poster Session III, Sunday July 27, 2008

The Importance of Natural History, Landscape Factors, and Management Practices, in Conserving Pond-breeding Salamander Diversity

Bob Brodman

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I have analyzed presence, abundance and patterns of coexistence of 11 species of pond-breeding salamanders from 178 managed sites in Ohio, Indiana, Illinois and Michigan. These sites include 17 that have been monitored for 11-14 years and 10 sites that have been monitored from 4-7 years. The two most abundant species, *Ambystoma tigrinum* and *A. texanum*, use open habitats such as grasslands and savanna, and are found in single species communities significantly more often than expected by a null model. Several other species were more likely to coexist with certain species in assemblages and communities of 4 or more species occurred significantly more often than predicted by null models. All of these sites have fishless seasonal or semi-permanent wetlands and forested upland habitat. Among populations with long-term data, five species declined at some sites and two species increased at some sites. The declining species all prefer mature forest upland habitat and typically breed in fishless seasonal wetlands, whereas the increasing species use more open upland habitats and semi-permanent to permanent wetlands. Regression and General Linear Models indicate that the timing of prescribe burns was the most important factor in determining the relative abundance of pond-breeding salamander larvae. Most species were negatively affected by springtime prescribed burns. It took a mean of 4.6 years for populations of these species to recover to pre-burn levels. *A. tigrinum* was also negatively affected by prescribed burns, however their mean time to recover was just 1.6 years and this was typically followed by an increase that exceeded pre-burn abundance. *A. texanum* was not significantly affected by spring burns. Conservation oriented management practices should avoid springtime prescribed burning of wetlands and surrounding upland habitats that are used by pond-breeding salamanders.

0039 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

A 14-year Study of Amphibian Populations and Metacommunities in Rural Northwest Indiana

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I used data from 14 years of surveying the amphibian fauna (14 species) of Jasper County, Indiana, USA, to detect population and diversity trends, and to test hypotheses regarding the influence of landscape, climatic, and biotic factors on amphibians abundance and diversity. There were a number of species associations within the amphibian community. Most species associations were positive, except Chorus frogs were negatively associated with Tiger Salamanders. Precipitation in November, January, February, April, and May, and temperature in September through July had the greatest influence on annual variation in amphibian breeding activity, abundance, and species richness. There was support for the hypothesis that the degree of wetland isolation and hydroperiod heterogeneity influence amphibian abundance. The number of wetlands in a cluster was correlated with species richness, amphibian abundance, and the number of years with amphibian populations. Wetland clusters with 15 or more wetlands had significantly more species, abundance, and number of years with breeding activity, than smaller wetland clusters and isolated wetlands. Wetland clusters with wetlands of two or three types of hydrology had significantly more species, abundance and number of years supporting amphibian populations than wetlands with just one hydrology type or isolated wetlands. At the landscape level, large amphibian metacommunities were associated with large wetland clusters that have hydroperiod heterogeneity, upland habitat with native vegetation, and upland habitats capable of supporting umbrella species of wildlife.

0375 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Is Harvest of the Snapping Turtle Sustainable: When is a Whale Not a Fish?

Ronald Brooks

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Snapping Turtles are still widespread across North America and have been introduced successfully outside their historic range. An established view of the species is that it is common and, at best, a nuisance that needs to be kept in check. A recent view is that *Chelydra* is a valuable component of wetland ecosystems and at risk of serious declines in abundance and distribution because of a diversity of anthropogenic threats. The species' long-lived life history may even put the *Chelydra* at risk of extinction. Despite the plethora of data and models supporting the claim that chronic increased juvenile and adult mortality rates can not be sustained by turtles and other long-lived species, application of this view often meets resistance from stakeholders (e.g. fisheries), particularly with respect to the snapping turtle. The clash between the traditional views of those who kill the turtle for food or to protect other wildlife and the more recent environmentalist views represent a classic confrontation. Here I will summarize data and models that suggest snapping turtles are not different from sturgeon, sea turtles, or sharks and that their abundance will continue to decline in the face of harvest especially when harvest mortality is added to road mortality, persecution, and other factors. I also discuss whether there is an impact on ecosystems when turtles are reduced to fragments of historic populations. However, this issue is much broader than a debate over *Chelydra* and I have portrayed the opposing sides as exploitation versus conservation though other terms could be substituted. To some extent, the debate is reminiscent of the great courtroom battle over whether whales are fish or mammals in that although there is science to support both sides, there is also a lot of self-interest and emotion on both sides.

0378 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Is Global Warming Creating Giant Canadian Turtle Hatchlings And Reducing Fitness?

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Climate change is an ubiquitous topic and it is interesting to consider its potential effects on reptiles at the northern limits of their distribution. Seasonal temperature variations are known to affect follicular development in a wide range of ectotherms, and it is also well known that turtles often show significant annual variations in egg size, an irritating deviation from theories of optimal egg size. In our long-term studies of reproduction in 3 turtle species (*Chelydra serpentina*(1977-2006), *Glyptemys insculpta*(1991-2004), *Chrysemys picta*(1990-2006)) in south-central Ontario, we observed that average summer and fall, but not spring, temperatures and egg size have been increasing over the past 30 years. We tested the hypothesis that

temperature accounted for annual variations in egg size. Summer and fall temperatures were positively correlated with egg size the following year in all 3 species. In *C. serpentina* and *G. insculpta*, temperature appeared to be increasing egg size by acting directly on patterns of follicular development, and by moderating rates of resource acquisition; conversely, only the direct effects of temperature on follicular development, moderated changes in egg size of *C. picta*. Furthermore, removal of temperature effects (*C. picta*) and/or nutritional effects (*C. serpentina* and *G. insculpta*) from the data led to disappearance of annual variation in egg size. The fitness consequences of 'involuntary' increases in egg size and clutch size are apparent in *C. picta*, in which females, but not males, exhibited a decrease in body condition between 1990 and 2006. *C. serpentina* did not exhibit a consistent change in body condition over time. Our study underscores the importance of assessing the effects of climate change on a species-specific basis, as even taxa with close common ancestry can vary in their response to climate change.

0717 Fish Systematics I, Salons A&B, Friday July 25, 2008

Nucleotide Bias, Codon Usage, Selection, and Phylogenetic Analysis - Investigations Based on Hundreds of Fish Mitochondrial Genomes

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The availability of many complete mitochondrial genome sequences from fishes allows for the broad-scale characterization of the ways in which these genomes evolve. A phylogenetic hypothesis for 230 actinopterygian species was used as an evolutionary framework for investigating the relationship between nucleotide composition and codon usage. Maximum likelihood estimates of the rates of synonymous and nonsynonymous substitutions were used to assess the effects positive (directional) and negative (functional constraint) selection acting on mitochondrial genomes. We show that directional mutation pressure has a major influence on synonymous codon usage and that the intensity of bias varies with position in the genome. In addition, the rate of nonsynonymous substitution is more strongly correlated with genomic position than with specific genes. This suggests that rates of amino acid substitutions in mitochondrial proteins are controlled more by variable mutation pressure than by natural selection acting on protein function. These findings are discussed in terms of their potential effects on molecular phylogenetic analysis and how phylogenetic inaccuracy might be identified and minimized.

0353 Poster Session I, Friday July 25, 2008

Assembling the Euteleost Tree of Life

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The "Assembling the Euteleost Tree of Life" (EToL) project aims to produce a robust hypothesis of relationships among the diverse assemblage of fish lineages that comprise the euteleost radiation. With nearly 18,000 species, monophyly and relationships of some orders and many suborders and families have proven phylogenetically intractable. The EToL collaboration will produce the largest and most taxonomically extensive dataset of morphological and molecular character states from which to develop and test evolutionary hypotheses in this group. Although EToL is designed with a strong emphasis on the generation and analysis of data from DNA sequences, it also promises to shed new insight on morphological character homology and character state variation across the Euteleostei. To generate hypotheses of homology of morphological characters in the group, the development and variability of target traits will be examined along ontogenetic series of 50 strategically selected taxa. These observations will focus primarily on characters that have been previously used to infer relationships in subsets of euteleosts. EToL activities will generate a morphological character state matrix from 300 euteleost taxa for up to 450 traits that have been shown informative in previous phylogenetic studies. EToL activities will also result in a dataset encompassing nearly 20,000 nucleotide sites from approximately 1,500 euteleost species. Target genes have been partially identified through a genomic database mining routine. Mining more reliable gene markers from public sequence databases is underway. The taxonomic sets used in this collaborative effort are designed to provide the basis for a "backbone" euteleost phylogeny that will guide future, more taxonomically focused investigations. Here we describe the EToL project's organization, data collection strategies, progress to date and expected results. We also identify opportunities to extend the scope of the project's objectives through collaboration with youth groups, members of the general public, and the global community of ichthyologists.

0478 Herp Behavior, Salons A&B, Thursday July 24, 2008

A Key Ecological Trait Drives the Evolution of Monogamy in a Peruvian Poison Frog

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There is considerable debate concerning the ecological and social factors that promote the evolution of monogamy. We report on an unusual example in which a simple change in an ecological trait (phytotelm pool size for tadpole rearing) is correlated with the evolution of monogamy. The Peruvian poison frog *Dendrobates imitator* is a Mullerian mimic of *Dendrobates variabilis* in the central cordillera of northern Peru. Molecular phylogeographic evidence indicates that this species recently colonized the area inhabited by *D. variabilis*. Detailed behavioral observations and ecological surveys revealed that *D. variabilis* uses large phytotelmata for tadpole rearing, has uniparental male care and a promiscuous mating system. In contrast, *D. imitator* uses small phytotelmata for tadpole rearing and exhibits social monogamy, pair-bonding and biparental care with tadpole provisioning. Preliminary molecular genetic analyses support our behavioral observations of monogamy. Reciprocal transplant experiments demonstrate that biparental care is required for tadpole growth and survival in small but not in large phytotelmata. Pool choice experiments demonstrate that these species show opposite size preferences of phytotelm for tadpole deposition. Competition experiments show that *D. variabilis* tadpoles are better adapted for competition and cannibalism than *D. imitator* tadpoles. In summary, our research suggests that the transition to rearing tadpoles in very small phytotelmata drove the evolution of biparental care and monogamy in Peruvian poison frogs.

0190 Poster Session I, Friday July 25, 2008

Diet Composition of Four Abundant Skate Species of the Gulf of Alaska

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Stomach content analysis is being performed on four of the most abundant skate species in the Gulf of Alaska. Through participation on fishery independent trawl surveys (National Marine Fisheries Service and Alaska Department of Fish and Game), stomach samples of *Raja rhina*, *R. binoculata*, *Bathyraja aleutica*, and *B. interrupta* were collected and preserved immediately at sea for high resolution stomach content analysis. Preliminary results suggest commercially important species such as tanner crab (*Chionoecetes bairdi*) and northern pink shrimp (*Pandalus eous*) are a significant dietary component of the larger species (*R. rhina*, *R. binoculata*, and *B. aleutica*), whereas a diversity of smaller-sized prey were found within the stomachs of *B. interrupta*. Future work will focus on intra- and interspecific variation in diet as sample sizes become sufficient for quantitative statistical analyses. The

results of this study will help to determine the trophic interactions of these common demersal predators in the Gulf of Alaska ecosystem.

0023 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Size and Cycle in *Desmognathus* Salamanders: Proximate Contributions to Miniaturization in *D. aeneus* and *D. wrighti*

Richard Bruce

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Desmognathus aeneus and *D. wrighti* are the smallest of the 21 species of the supergenus *Desmognathus* and the subfamily Plethodontinae. Whereas all other species of the genus *Desmognathus* have biphasic life cycles and free-living aquatic larvae, *D. aeneus* and *D. wrighti* have direct development, a trait shared with *Phaeognathus hubrichti*, the only other member of the supergenus. Based on continuing life-history studies in syntopic populations of *D. aeneus*, *D. wrighti*, and the biphasic *D. ocoee*, I offer data on egg/hatchling size, growth, and size/age at sexual maturation, that allow estimation of the contribution of these factors to adult body size. *Desmognathus ocoee* was selected for comparison not because of an especially close relationship with either *D. aeneus* or *D. wrighti*, but because it is the next-smallest species in the assemblage under study, and is presumably subject to the same environmental conditions as *D. aeneus* and *D. wrighti*. An exponential model of growth in standard length ($SL(t) = SL_0e^{rt}$) adequately serves to describe growth rates prior to sexual maturation, which are similar in the three species ($r \approx 0.4$). Miniaturization in both *D. aeneus* and *D. wrighti* appears to be a consequence of (1) smaller egg and hatchling sizes (hatchlings 6.0-7.0 mm SL in *D. aeneus* and *D. wrighti* versus 9.0-9.5 mm in *D. ocoee*), (2) precocious sexual maturation (2-3 years in *D. aeneus* and *D. wrighti* versus 3-4 years in *D. ocoee*), and possibly (3) lower growth rates following maturation, in comparison with *D. ocoee* (and other biphasic desmognathans). The absence of a free-living larva as an outcome of the shortening of the life cycle conforms to a pattern of developmental acceleration that has contributed to miniaturization in *D. aeneus* and *D. wrighti*.

**0542 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008;
GRUBER**

Utilizing DNA Microsatellites to Study Population Structure of Spiny Dogfish, *Squalus acanthias*, in the Western North Atlantic

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In the year 2000, as a result of the declining spiny dogfish stock, the Atlantic States Marine Fisheries Commission implemented an Interstate Fisheries Management Plan that places an annual quota limit on US landings. Thus, this is a timely opportunity to conduct studies that provide updated life history information on this species. Since population structure is an important component of any successful management plan, the objective of the present study is to employ DNA microsatellite markers to determine the population structure of spiny dogfish in the Northwest Atlantic. To assess molecular markers, fin clips were taken from sharks at six locations along the eastern coast of the United States and Canada. Due to evidence suggesting a possible north/south division between spiny dogfish populations in the Western North Atlantic, the six sampling locations were selected with three being north and three being south of Cape Cod, MA. DNA was then extracted from the fin clips and four microsatellite loci were amplified using polymerase chain reaction with fluorescently labeled primer sets specifically developed for spiny dogfish. The products were genotyped and alleles for each locus were scored based on size. Hardy Weinberg Equilibrium was examined as well as statistical analyses using F statistics and pairwise comparisons to determine the presence or absence of any population structure present within spiny dogfish in the Northwest Atlantic. Preliminary results suggest little to no division between northern and southern sampling locations, but more samples are being analyzed as well as comparisons between individual locations. By utilizing this approach to acquire updated knowledge of population structure, it allows for improved accuracy and reliability of the underlying biological information obtained for and incorporated into fisheries models for spiny dogfish in the Atlantic waters off the coasts of Canada and the United States.

0566 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Artificial Night Lighting Affects Anuran Larval Growth and Development

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Artificial night lighting (such as light pollution) in amphibian habitats can alter perceived photoperiod and has the potential to reduce plasma levels of photoperiodic hormones such as melatonin. Melatonin plays an important role in regulating other hormones including many of those involved in growth and development. Although the photoperiodic nature of melatonin expression is well established, it is unclear how much light at night is necessary to disrupt melatonin

production and whether or not such disruption can affect larval growth and development. In a laboratory experiment, we compared the growth and development of African Clawed Frog (*Xenopus laevis*) tadpoles under three different night lighting treatments simulating different levels of light pollution and a dark control. All tadpoles were exposed to 100 lx daytime illuminations on a 12L:12D photoperiod. In the control treatment, tadpoles experienced a normal nocturnal illumination of 0.0001 lx (bright starlight). In the three experimental treatments, tadpoles experienced unnaturally high nocturnal illuminations of 0.01 lx, 1 lx, and 100 lx that correspond to different potential levels of light pollution in larval habitats. In our study, artificial night lighting affected larval size and the proportion of larvae that metamorphosed by the end of the study (approximately 2 months). A greater proportion of larvae metamorphosed in the naturally dark control treatment than in the brighter experimental treatments. Within the experimental treatments, larvae in the brightest treatment were significantly smaller than larvae in the dimmest treatment. Larvae in the control treatment were significantly smaller than larvae in the dimmest experimental treatment but did not differ in size from larvae in the other lighting treatments, probably because of their faster progression to metamorphosis. We conclude that consistent exposure to even small amounts of artificial light at night can affect anuran larval growth and development.

0725 Poster Session I, Friday July 25, 2008

Shape Analysis and Systematic Status of the Blenny Darter, *Etheostoma blennioides*, a Percid Fish from the Tennessee River Drainage

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The Blenny darter, *Etheostoma blennioides*, is comprised of two morphologically distinct subspecies of fish, *Etheostoma blennioides blennioides* and *Etheostoma blennioides sequatchiense*. The purpose of this study was to examine the degree of morphological variation between the two subspecies to determine if a taxonomic revision was needed. The degree of sexual dimorphism that exists within each subspecies was also examined. Preliminary results and a genetic data set suggested that enough visible differences existed for each subspecies to be elevated to species level and that fin lengths would differ between the sexes in each subspecies. Body shape variation was calculated through traditional morphometric methodology and analyzed by performing a sheared principle components analysis. Thirty-seven characters were used to assess the body shape of 100 specimens (50 of each subspecies). The two measurements of snout shape and the caudal peduncle length were found to have significantly high loadings in a sheared PCA. The graph of the principle component II vs. principle component III of the sheared PCA conveyed no overlap between the two polygons putatively representing the subspecies, indicating that *E. b. blennioides* and *E. b. sequatchiense* are distinct species. These results suggest that the two subspecies of *Etheostoma blennioides* are distinguishable based on body shape analysis (primarily snout shape and caudal peduncle length) and should be elevated to species level.

0754 Poster Session III, Sunday July 27, 2008

Genetic Confirmation of Hybridization between *Catostomus fumeiventris* and *Catostomus santaanae* (Cypriniformes: Catostomidae) in the Santa Clara Drainage

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The presence of morphological intermediates has suggested that *Catostomus fumeiventris* and *C.santaanae* hybridize in the Santa Clara drainage where both were introduced many decades ago. We used starch gel electrophoresis of codominant gene products to confirm the genetic interaction between these two species of fishes. Both F₁ and F₂ generations of hybrids were identified, but both parental species still maintained their genetic integrity. Of 160 specimens obtained from Sespe Creek north of Fillmore CA on 15 May 2006, 125 were genetically identified as *C. santaanae*, 11 as *C. fumeiventris*, 10 as F₁ hybrids and 14 as F₂ hybrids. The F₂ hybrids appeared to be the progeny of F₁ x F₁ crosses or backcrosses to *C. santaanae*.

0753 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Skeletochronology of a Paedomorphic Population of Tiger Salamanders (*Ambystoma tigrinum*) in Swalls Pond, Ward County, North Dakota

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Ambystoma tigrinum, the Tiger salamander, is a thoroughly described species. This species has the widest ranging North American distribution within the Ambystomatids. Tiger salamanders live in many different types of habitats and have a diverse life history including the retention of larval characteristics into sexual maturity (paedomorphosis). We report skeletochronology in a population of paedomorphic Tiger Salamanders from Swalls pond North Dakota. Toes were extracted from a random sub-sample of collected salamanders. Salamander toes were processed and prepared using a protocol according to Schneider (2004), modified from a standard protocol developed by Leclair Jr. et al. (2000) and Leclair Jr. and Castenat (1987). Findings indicate that many individuals are in the same cohort (1,2, and 3 years). Length frequencies and assessment of sexual development within this population indicate that females may need to be at least 3 years of age before first reproduction! Males within the same cohort may be reproductively ready after the first summer.

0594 Poster Session III, Sunday July 27, 2008

An Assessment of Heavy Metal Toxicity in Embryonic and Larval Axolotl (*Ambystoma mexicanum*)

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Embryos and 75 day old larvae of the model organism *Ambystoma mexicanum* were treated with differing concentrations of the heavy metals Cadmium (CdCl₂) and Methyl mercury (HgCH₃). Each experiment exposed embryos and larvae to 8 treatment levels including controls. Treatment levels for cadmium were 0ug/L, 15ug/l, 50ug/l, 150ug/l, 1500ug/l, 15,000ug/l, 150,000ug/l and 1.5million ug/l. Treatment levels for methyl mercury were 0ug/l, 1.5ug/l, 5ug/l, 15ug/l, 50ug/l, 150ug/l, 1500ug/l and 15,000ug/l. All treatment groups were observed every 12hrs during the 96hr treatment for mortality, physical anomalies and behavioral anomalies. Tissue samples were collected from deceased individuals and organisms were fixed in 10% formalin and preserved in 70% ethanol for future analysis. Embryos were also scored for developmental progress. We present the embryonic and larval LC-50 values as well as developmental staging and percent survivorship. Toxicologically, cadmium LC-50 concentrations were higher than mercury. Additionally, mercury may have a greater effect on survival beyond exposure period at lower ecologically relevant doses.

0597 Poster Session II, Saturday July 26, 2008; CARCNET/RÉCCAR

The Smooth Green Snake and the Northern Red-bellied Snake: A Comparison of the Ecology of Two Small, Terrestrial, Northern snakes

Nicholas Cairns, Pamela Rutherford

Brandon University, Brandon, Manitoba, Canada

The smooth green snake (*Liochlorophis vernalis*) and the northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*) are small, terrestrial colubrid snakes reaching the extremes of their distributions in southwestern Manitoba. While both species are constrained by short, active seasons they differ substantially in morphology and reproductive mode (*L. vernalis* is oviparous and *S. occipitomaculata* is viviparous). The aim of this study is to compare the ecology of these two species in Manitoba by asking two specific questions. First, do these two northern snakes occupy similar ecological niches? Second, what are the local hibernation characteristics in comparison to their hibernation sites at other localities? We addressed these questions with a mark-recapture study using active searching and searching under artificial cover. Local hibernation patterns were determined using drift fences and trapping, active searching, and implantation of temperature data loggers at the hibernation sites. The study was conducted from spring 2007 to summer 2008 in southwestern Manitoba, Canada. Approximately equal numbers of both species were located, although hibernation characteristics were determined only

for *S. occipitomaculata*. Sexual dimorphism was evident only in *L. vernalis* (females were larger) and gravid females of both species were last captured in mid-July. *S. occipitomaculata* were captured at lower temperatures and tended to be captured in habitat more closely associated with water although in the third week of June there appeared to be a pulse of activity in more xeric prairie and associated habitat. *L. vernalis* were almost always associated with prairie and prairie ecotone habitat types. *S. occipitomaculata* used abandoned ant nests for hibernation sites and were active at these sites until September 25, 2007. Hibernation site characteristics will be determined in spring 2008.

0135 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Juvenile Lemon Sharks (*Negaprion brevirostris*) Around South Caicos, Turks & Caicos Islands: A Nursery Without Neonates?

Marta Calosso, Kristene Parsons, Steve Newman

The School for Field Studies, Center for Marine Resource Studies, South Caicos, Turks and Caicos Islands

Juvenile lemon sharks (*Negaprion brevirostris*) depend on shallow near shore areas as nurseries. These critical habitats may be vulnerable due to their proximity to land and exposure to anthropogenic impacts. This study aimed to assess the use of shallow habitats by immature lemon sharks around South Caicos, Turks & Caicos Islands, an island facing burgeoning coastal development and tourism. Specific objectives were to investigate the abundance of sharks using the area, their size frequency distribution, growth rates, and residency. Sharks were caught with monofilament gillnets at selected sites around South Caicos between August 2006 and present. A total of 100 individuals were captured and tagged with T-bar tags (August to December 2006) and passive integrated transponder tags (January 2007 to present). The area sampled appears to be used predominantly by juveniles of an intermediate size class (mean PCL 63.8 ± 1.02 cm S.E.; range 50.5 - 91.0 cm). No individuals had open umbilical scars and no adults were observed during the study period, suggesting that pupping may occur elsewhere and neonates may use alternative areas until they attain a larger size. Preliminary results indicate a fast growth rate (26 cm yr⁻¹ PCL) compared to other well-studied lemon shark populations. A relatively low recapture rate (15.2%) was recorded which may be attributed to high mortality, size-related emigration, or sampling effort spread across a large open study area. The use of nurseries throughout this species' range could be more complex than originally thought and the details of ontogenetic shifts in habitat use may be location specific. For a more comprehensive understanding of lemon shark life history, further research in alternative locations is required. This would enhance our ability to conserve this species, especially in the face of rapid coastal development occurring worldwide.

0019 AES Management, Jarry/Joyce, Sunday July 27, 2008

Estimation of Discard Mortality in Blue Sharks Using Pop-up Archival Tags, with Implications for the Status of the North Atlantic Population

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A confounding issue in the interpretation of shark population status is the survival rate of sharks discarded at sea. In the Northwest Atlantic, virtually all blue sharks (*Prionace glauca*) caught by the Canadian and U.S. large pelagic longline fleets are discarded after capture, for a total of more than 30,000 mt annually. Observer records of >10,000 blue sharks indicated that ~20% appeared to be dead at the time of discarding, with most of the remainder being injured to varying degrees. To estimate the medium-term survival rate of the discarded blue sharks, we applied pop-up archival transmitting (PAT) tags to more than 45 blue sharks discarded as part of ongoing commercial fishing operations. Tags were programmed to release from the sharks after 3-6 months. Survival rates greatly exceeded expectations, with most of the mortality occurring within 3 days of release. Injured blue sharks appeared to return to what was interpreted as normal behaviour about 3 weeks after release. The implications of delayed discard mortality to population status calculations are substantial.

0171 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Giant Devil Ray Satellite Tagging in the Mediterranean Sea

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ICRAM (Central Institute for Marine Research), ROME, Italy

The giant devil ray (*Mobula mobular*) (Bonnaterre 1788) is the only mobulid species regularly present in the Mediterranean Sea. The distribution, biology and ecology of this species are poorly known and, given its high bycatch mortality, low reproductive capacity and limited range, it is enlisted in the IUCN endangered species list (A4d). The present study describes the diving behavior and movements of three individuals tagged with Pop-up archival satellite tags in the Messina Strait (Central Mediterranean Sea) during summer 2007. Two tags were programmed to detach from the individuals after 120 days and one after 60 days. All tags detached at the pre-established time and far from the tagging positions (156 - 421 km). The data collected show the ability of these individuals to dive extremely deep (up to 700 meters). Despite this, they spend most of their time (81.5 %) between the surface and 50 meters, in waters having temperature between 20° C and 29° C. The preference for warm surface waters exposes this species to threats such as accidental captures in driftnets and surface long lines.

0006 Poster Session III, Sunday July 27, 2008; STORER ICHTHYOLOGY

The Impacts of Armored Catfish (Siluriformes: Loricariidae) on Invaded Freshwater Ecosystems

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Armored catfishes (Siluriformes: Loricariidae) are bottom-dwelling fishes native to Central and South America. They are characterized by having a ventral sucker lips, large bony plates, and novel jaw musculature and tooth morphology. Although Loricariidae is one of the most diverse fish families in the world (>680 species described), little is understood about the trophic ecology of this group. These fishes, also known as “plecos”, are common in the aquarium trade, and are frequently released into freshwater environments. Globally, loricariids are one of the most successful invasive fish families and have an approximate 80% success rate invading new environments. Actively reproductive loricariids have been collected in Texas, Florida, Hawaii, and Nevada and isolated fish have been collected in at least five more states. Populations of these fishes have also been recorded in Mexico, Puerto Rico, Australia, Europe, Indonesia, Taiwan, Singapore, Java, Sumatra, and the Philippines. Loricariid invasion has been linked to native species displacement and increased siltation, and these fishes are considered threats to many rare ecosystems. Although armored catfish introductions are well-documented in the throughout the world, the community and ecosystem-level effects of these fishes in invaded habitats are yet to be determined. In this study, I examined the community and ecosystem-level impacts of loricariid invasion by reviewing published records of introduced populations. I identified the primary threats of exotic loricariids to native communities and ecosystem processes and I determined the regions of the world in which loricariid invasion is having the greatest impact. I also used the loricariid invasion in southern Mexico as a case study to examine the potential impacts of loricariid physiology on nutrient cycling in invaded systems.

0281 Poster Session III, Sunday July 27, 2008

Orientation of Vernal Pool Amphibians in an Industrial Forest Landscape

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Amphibians that breed in vernal pools spend a majority of their lives in adjacent upland habitat. Understanding the migration and dispersal patterns of these amphibians is a critical aspect of effective conservation and land management. We used clearcutting to manipulate buffer widths at 11 vernal pools in northeastern Maine on land managed for timber production. Each pool was completely encircled with a drift fence and pitfall traps. We captured wood frogs (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*) as they entered and exited pools and documented orientation of ingress and egress across three breeding seasons. We examined a total of 4,993 adult and 20,141 metamorph wood frogs; 2,719 adult and

1,992 metamorph spotted salamanders. Orientation at all pools for both species was nonuniform, differed across pools, and was inconsistent among years. The direction of orientation also differed between species as well as between adults and metamorphs. Our results suggest that amphibian migration and dispersal patterns are spatially and temporally complex. This complexity implies that identifying predictable 'corridors' of concentrated amphibian movement for protection would likely be an ineffective approach to managing the upland habitats surrounding these pools.

0466 Herp Behavior, Salons A&B, Thursday July 24, 2008

Preliminary Analysis of the Diet and Foraging Behavior of Mohave Rattlesnakes (*Crotalus scutulatus*)

Michael Cardwell

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The natural behavior of Mohave rattlesnakes (*Crotalus scutulatus*) was investigated in the western Mohave Desert using radiotelemetry from August 2001 through November 2004. This presentation describes a preliminary analysis of the diet and foraging behavior of adult rattlesnakes in this population, based on witnessed events and scat analysis. Data are analyzed in the context of such factors as season, body and air temperatures, time of day, photoperiod, moon phase, precipitation, and microhabitat. These sit-and-wait predators demonstrated a strong preference for rodents, primarily heteromyids such as *Dipodomys*. Other taxa, both endothermic and exothermic, were attacked opportunistically with a range of prey-handling behaviors.

0600 Poster Session II, Saturday July 26, 2008

Techniques for Identification of Prey by Scat Analysis

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While existing literature documents a variety of techniques to identify mammals from their hair morphology, including several dichotomous keys, virtually all previous references are restricted specifically to the use of dorsal guard hairs. There is little written about how to apply these techniques and keys to scat analysis, where all of the hair of a prey animal is mixed together in a tightly compressed bolus. How are dorsal guard hairs identified? What techniques are useful in such analyses? To what taxonomic level can completely digested prey be identified? We present the techniques that have been useful in our efforts to identify prey taxa from rattlesnake feces and make suggestions to improve the efficiency of similar future efforts.

0398 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Latitudinal Variation in Behavioral Thermoregulation by Ratsnakes (*Elaphe Obsoleta*)

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Behavioral thermoregulation by ectotherms is assumed to provide the benefit of improved physiological performance at the cost of increased risk of predation and lost opportunities for foraging and mating. As thermal environments become more challenging, higher benefits would favor increased thermoregulation, but higher costs would favor decreased thermoregulation. Available evidence to date suggests that snakes in thermally challenging environments thermoregulate more (i.e., benefits exceed costs). To determine whether this pattern holds intraspecifically, we compared the thermoregulatory behavior of black ratsnakes, *Elaphe obsoleta* in the center of the species' distribution in Illinois with that at the species' northern limit in Ontario. Although ratsnakes in both populations preferred almost identical temperatures, Illinois ratsnakes maintained temperatures closer to their preferred range through the day and across the season. These superior temperatures were not realized as a result of increased thermoregulation, however, because ratsnakes in Illinois generally thermoregulated less than ratsnakes in Ontario. Our results support the hypothesis that the benefits of thermoregulation have a greater influence than costs on snake thermal strategies. For ratsnakes at their northern range limit thermoregulation may be essential for populations to be viable, whereas at the center of the species' distribution, the principal advantage of thermoregulation may be to allow ratsnakes to extend their active season.

0505 Poster Session III, Sunday July 27, 2008

The IUCN Global Marine Species Assessment - Laying the Foundations for Marine Conservation

Kent Carpenter, Suzanne Livingstone, Beth Polidoro

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The Global Marine Species Assessment (GMSA) is the new initiative of the Biodiversity Assessment Unit (BAU) of the World Conservation Union/ Species Survival Commission and Conservation International/ Center for Applied Biodiversity Science. The growing realization of the seriousness of increasing threats, such as global warming, over-fishing and coastal development, to marine biodiversity has prompted successful BAU methodology to be applied the marine realm. The GMSA programme compiles important baseline information on individual marine species, and using IUCN Red List Criteria, assesses their threat of extinction. This essential species-level information will be used to generate regional and global marine hotspot analyses and identify key marine biodiversity areas, as well as being used for species level conservation efforts. The GMSA is collaborating

with initiatives such as the Census of Marine Life and the Food and Agriculture Organization, together with expert taxonomist and ecologist consultation to determine the Red List status of large clades of marine species. The GMSA aims to assess all boney fishes, primary habitat-producing organisms and selected echinoderms and mollusks (approximately 20,000 species) by 2010.

0230 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008; GRUBER

Movements and Nursery Habitat of Juvenile Thresher Shark (*Alopias vulpinus*) in the Southern California Bight

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The common thresher shark, *Alopias vulpinus*, comprises the largest commercial shark fishery in California waters. However, very little is known about the early life history of this species. We used acoustic telemetry to study the movement patterns and habitat preferences of juvenile common thresher sharks in their nursery habitat along the coast of southern California, between March 2006 and September 2007. Seven juvenile threshers (fork length: 66 to 108 cm) were tagged with temperature and depth sensing acoustic transmitters and tracked for up to 75 h. In contrast to behavior recorded for adults and subadults in an earlier study, juveniles almost exclusively utilized shallow waters of the continental shelf. Juvenile threshers exhibited diel patterns in depth preference, remaining closer to the surface at night and deeper by day, often near bottom depth. The depth and habitat preferences of thresher sharks make them vulnerable to artisanal gillnet fisheries in California and Baja California waters.

0060 Poster Session I, Friday July 25, 2008

Ecology of Three Elasmobranch Species in the Atol das Rocas Biological Reserve, off Northeast Brazil

Felipe Carvalho¹, Paulo Oliveira², Fabio Hazin², Bruno Macena², Andrew Piercy¹, George Burgess¹, Debra Murie¹

¹*University of Florida, Gainesville, FL/Southeast, United States*, ²*Universidade Federal Rural de Pernambuco, Recife, PE/Northeast, Brazil*

Atol das Rocas, a unique atoll in the South Atlantic Ocean, was the first designated marine reserve in Brazilian waters. From August 1999 to December 2007, 28 surveys, averaging 20 days each, were carried out in the Atol das Rocas Biological Reserve aimed at studying the population demographics and behavior of three common

elasmobranch species present in the area. Visual censuses were used to document the use of habitat and population structure of nurse shark (*Ginglymostoma cirratum*) and southern stingray (*Dasyatis americana*). In addition, a tag-recapture study estimated the population size and growth of young lemon sharks (*Negaprion brevirostris*). A total of 73 young lemon sharks were caught, without mortality, ranging in total length (TL) from 60- 70 cm for females and 70- 80 cm for males. The population size of young lemon sharks in the region was estimated at 147 ± 36 individuals. Females and males showed an increase in TL of 12.7 cm/year and 12.4 cm/year, respectively. A total of 184 rays were sighted in the visual censuses. Of these, 85% presented some distinguishing marks that were photographed. The population of southern stingray in the Atol das Rocas, based on the analysis of re-sightings in different surveys, was estimated at 99.2 ± 17.1 individuals. Mean number of nurse sharks sighted in each expedition was 123.34 ± 48.75 , with TL's ranging from 42-293 cm. The extreme tidal regime present in the Atol das Rocas has a significant influence on the behavior of these three elasmobranch species. The area hosts unique populations of these species, underscoring the need to implement proper conservation and management measures.

0062 AES Management, Jarry/Joyce, Sunday July 27, 2008

Fishing Gear Modifications to Reduce Elasmobranch Mortality in Pelagic and Bottom Longline Fisheries off Northeast Brazil

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Terminal gear modifications, particularly the use of circle hooks, are showing promising results in reducing bycatch mortality for teleost fishes, but similar data on elasmobranchs are rare. We conducted two experiments to test the influence of hook type and physical position of the hook in catch composition, catch rates, and mortality of elasmobranchs with longline fishing gear. In the first experiment, a commercial vessel conducted 12 pelagic longline research sets off the coast of Natal, Northeast Brazil. In the second, 1,128 bottom longline research sets were monitored off the coast of Pernambuco, Northeast Brazil. The vertical hook position comparisons in the bottom longline fishery were analyzed by deploying half of the hooks demersally and the other half suspended in midwater using only "J" (size 9/0, 10° offset) hooks. For hook type comparisons, circle (size 18/0, 0° offset) and "J" (size 9/0, 10° offset) hooks were alternated along the mainline for each pelagic or midwater set. Catch rates for blue, night, silky, tiger, shortfin mako, dusky, nurse, and oceanic whitetip sharks were significantly higher for circle hooks in the pelagic longline experiment. However, all shark species caught by circle hooks were hooked significantly more often in the mouth in contrast with "J" hooks, which hooked more often in the throat or gut. Suspending the hooks midwater versus demersally reduced the catches of blacknose sharks (-85%), nurse sharks (-97%), and southern stingrays (-68%), while increasing the catch rates of bull (+20%) and tiger sharks

(+20%). For the midwater sets, the number of tiger, bull, and blacknose sharks and southern stingrays alive at haulback was significantly higher for circle hooks. However, no significant mortality differences between hooks were found for nurse, hammerhead, and blacktip sharks. No significant differences in catch rates between hook types were found for any species in the midwater sets.

0232 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

Developmental Morphology of the Caudal Fin Skeleton of the South American Catfish *Lophosilurus alexandri* Steindachner, 1877 (Siluriformes: Pseudopimelodidae)

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Ontogeny often provides the most compelling evidence for proposing hypotheses of primary homology and is critical to interpreting the origin and transformation of complex structures in a phylogenetic framework. Developmental studies on catfishes (Siluriformes) adopting an evolutionary perspective are scarce in the literature. In an attempt to provide a new anatomical foundation for these studies, we describe the developmental morphology of the caudal fin skeleton of the South American catfish *Lophosilurus alexandri*, the single species of this genus, which is thought to be endemic to the Rio São Francisco basin, Brazil. The present study represents the first treatment on the ontogeny of the caudal skeleton for a species of the family Pseudopimelodidae. The developmental series was obtained through induced spawning in wild specimens; eggs were incubated until hatching, and larvae were reared under laboratory conditions. Specimens were fixed daily and cleared and double-stained for bone and cartilage. The sequence of chondrification and ossification was recorded for each day. The poverty of ontogenetic information about the caudal complex in siluriforms widely precludes an evolutionary interpretation for most of our findings. Presently, however, it is possible to highlight some relevant observations, such as the complex composition of the neural and hemal spines associated with the caudal fin, the early ossification of the second ural centrum, the sudden anterior displacement of the posteriormost basidorsal (associated to the second ural centrum) which obfuscates its delimitation in late stages, and on the nature of the uroneural, which is likely homologous to the neural arch of the second ural centrum.

0144 Fish Systematics I, Salons A&B, Friday July 25, 2008

Taxonomic Review of the Species of *Hisonotus* (Siluriformes: Loriicaridae) from the Rio Uruguay Basin and the Laguna dos Patos System

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Hisonotus belongs to Hypoptopomatinae, a group of loricariids including more than 80 species grouped in 18 genera. *Hisonotus* has about 18 species distributed in southeastern basins of South America. Here, we review the taxonomic composition of the genus in Laguna dos Patos system and in Rio Uruguay basin. Laguna dos Patos system has the species: *H. nigricauda*, *H. laevior* (senior synonym of *H. leptochilus*), *H. taimensis*, plus seven new species. *Hisonotus laevior*, *H. nigricauda*, plus one of the new species are widely distributed and sympatric in most of the Laguna dos Patos system, contrasting to *H. taimensis* and the other new species which have limited distributions. Most of the new taxa are restricted to upper portions of Rio Jacuí drainage where the widely distributed species are not present. *Hisonotus laevior*, *Hisonotus taimensis* plus a new species from the Rio Camaquã drainage share some derived features which are likely synapomorphies of a clade inhabiting almost the entire Laguna dos Patos. Rio Uruguay basin has the species: *H. nigricauda*, *H. ringueleti* (senior synonym of *H. candombe*), *H. aky*, *H. charrua*, plus four new species. *Epactionotus aky* is transferred to the genus *Hisonotus* because it does not have the diagnostic characters of *Epactionotus*, and by sharing derived features with the *Hisonotus* species from upper Rio Uruguay basin. The new species described from Rio Uruguay basin are restricted to its upper portions. The greater diversity in the upper Rio Uruguay compared to the lower portions can be explained by its complex relief. Rapids and waterfalls are dispersal barriers for most *Hisonotus* species, and are likely the cause of allopatric speciation during the process of drainage evolution. A similar aspect is found in the headwaters of Rio Jacuí basin, which possesses several endemic and restrictedly distributed species.

0091 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY

Phylogenetic Relationships among Members of the *Notropis* Subgenus *Hydrophlox*

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The *Notropis* subgenus *Hydrophlox* (Jordan 1878) has contained as many as 33 species since its description. In 1970, Swift redefined the subgenus to include nine taxa: *N. rubellus*, *N. baileyi*, *N. nubilus*, *N. chlorocephalus*, *N. lutipinnis*, *N. chiliticus*, *N. chrosomus*, *N. rubricroceus*, and *N. leuciodus* based primarily on breeding coloration and scale and pectoral fin tuberculation. Since then, *N. rubellus* has been shown to be allied with members of the subgenus *Notropis* and placement of other members of *Hydrophlox* has been questioned. A molecular phylogeny generated from three

markers, (mtDNA: ND2; and nuclear DNA: ITS1 and partial Rhodopsin) reveals a core *Hydrophlox* monophyletic clade comprised of five taxa: *N. rubricroceus*, *N. chiliticus*, *N. chlorocephalus*, *N. lutipinnis*, and *N. chrosomus*. Morphology, distribution and behavior support the conclusion that *Hydrophlox* as it is currently known is polyphyletic and warrants redescription.

0122 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Getting Closer to Reality: Amphibian and Reptile Detection Probabilities for Western Great Lakes Inventory and Monitoring Programs

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Ever search for something, not find it, but wonder if you simply over-looked it? We investigated this problem for amphibian and reptile sampling methods in the western Great Lakes. Effective inventory and monitoring programs are critically important in determining species status, and documenting changes in abundance and geographic distribution. However, data on the effectiveness of various survey methods are scarce. We tested the effectiveness of several herp monitoring methods in the Lake Superior and Lake Michigan basins, over-sampling to develop detection probabilities and minimum sampling requirements for each method and species, for use in proportion of area occupied modelling, which allows the use of less robust data from existing programs for regional analyses (i.e. calling frog surveys). We detected up to 20 species per sampling area. Call surveys, aquatic funnel traps, and casual observations detected the most species, but method success varied with the species present. Detection probabilities greater than 0.3 (recommended for occupancy modelling) were obtained for most species by standard methods, but many species had high variance in detection probabilities, among samples, sites, and season. The minimum number of samples required for 95% confidence in detection was calculated for each species and method. We identify overlaps in sampling methods for maximizing species detection and sampling efficiency. Species with low variance in detection and low sampling requirements are best suited to long term monitoring programs. Species with high variance in detection and/or high sampling requirements are more difficult to inventory, monitor, or manage, and a trade off exists between sampling effort required and confidence in knowing the occupancy of any specific site. Obtaining detection probabilities, understanding the variance in detection probabilities among sites, species, and over time, and correcting for false negatives in data analyses where species are under-sampled, is recommended for developing successful inventory and monitoring programs.

0284 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Phylogenetic Relationships of the *Dactyloa* Clade of *Anolis* Lizards

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The clade *Anolis* is composed of nearly 370 species distributed from southern North America to northern South America, including Central America and the Caribbean islands. Previous phylogenetic studies on *Anolis* have focused on Caribbean and/or Central American species. What little is known of South American anoles is mostly from morphological characters or molecular data from a limited number of species. We present new nucleotide sequence data from one nuclear (RAG-1, ~2900b) and two mitochondrial (ND2, ~1500b; COI, ~700b) genes to resolve phylogenetic relationships of a major subgroup of South American anoles, the *Dactyloa* clade. We included 38 *Dactyloa* species from Colombia, Ecuador, Panama, Venezuela and the Lesser Antilles, as well as 12 outgroup species (4 non-*Anolis* Polychrotinae and 7 non-*Dactyloa Anolis*). Preliminary Bayesian analyses of all three genes combined do not support *Dactyloa* as a monophyletic group, but only because *Anolis occultus* (a non-*Dactyloa Anolis*) is nested within it. In addition, the data provide strong support for the monophyly of the species previously referred to *Phenacosaurus*, and the Lesser Antillean *Dactyloa* species (the *roquet* series). The series *punctatus*, *latifrons* and *aequatorialis* previously circumscribed based on morphological characters appear to be non-monophyletic.

0483 Herp Genetics, Salons A&B, Sunday July 27, 2008

Adaptive Evolution and Functional Redesign of Core Metabolic Proteins in Snakes - Does Broad-Scale Molecular Adaptation Underlie Snake Evolution?

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Adaptive evolutionary episodes in core metabolic proteins are uncommon, and are even more rarely linked to major macroevolutionary shifts. We conducted extensive molecular evolutionary analyses on snake mitochondrial proteins and have discovered compelling evidence suggesting that the proteins at the core of aerobic metabolism in snakes have undergone a process of functional evolutionary redesign. We demonstrate that mitochondrially-encoded oxidative phosphorylation proteins in snakes have endured a remarkable process of accelerated and apparently adaptive evolution, with unprecedented levels of positive selection, coevolution, convergence, and reversion at functionally critical residues. Cytochrome C oxidase subunit I (COI) has experienced extensive modification of normally conserved residues involved in

proton transport and delivery of electrons and oxygen. Thus, the core of snake aerobic metabolism appears to have been selectively reorganized. This presumably adaptive process of evolutionary redesign of snake COI coincided with adaptive bursts in other mitochondrial proteins and substantial changes in mitochondrial genome structure. These also generally coincided with or preceded major shifts in ecological niche and the evolution of extensive physiological adaptations related to lung reduction, large prey consumption, and venom evolution. The parallel timing of these major adaptive events suggests that adaptive redesign of metabolic and mitochondrial function may have substantially contributed to the evolution of snakes, and may underlie the extreme physiological and metabolic efficiency, flexibility, and innovation observed in snakes.

0651 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

The Reproductive Cycles of North American Sharks

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The reproductive cycle of sharks is how often a species breeds and consists of two parts or periods. The first is the vitellogenesis period, when nutrients stored in the liver are transferred to the developing oocytes, and when oocytes accumulate yolk and grow rapidly. The second part consists of the gestation period, or the time of embryonic development from fertilization to birth. These two periods, vitellogenesis and gestation, can run concurrently or consecutively, and the duration of each period is variable. In a given population, the females can be reproductively synchronous or asynchronous. Synchronous females are in the same stage of the reproductive cycle, while in a population of asynchronous females, all are at different stages of the cycle. Different types of reproductive cycles can be discerned: 1. Biennial cycle with concurrent vitellogenesis and gestation, as in the spiny dogfish and other squaloid sharks. 2. Biennial cycle with consecutive vitellogenesis and gestation, the type of reproduction found in many of the sharks of the genus *Carcharhinus* and *Sphyrna mokarran*. The nurse shark (*Ginglymostoma cirratum*) exhibits a similar biennial cycle but with a much shorter gestation period. 3. Annual cycle with concurrent vitellogenesis and gestation, a type cycle found in the more advanced sharks of the genera *Rhizoprionodon* and some *Sphyrna* (e.g., *S. lewini* and *tudes*). 4. Lamnoid annual cycle with discontinuous ovulation, as in the sand tiger shark (*Carcharias taurus*) and probably the mako (*Isurus oxyrinchus*). 5. Lamnoid annual cycle with continuous vitellogenesis, as in thresher sharks (*Alopias*). 6. Triennial cycle with consecutive vitellogenesis and gestation. A triennial cycle with an 18 month gestation period has been postulated for the dusky shark (*Carcharhinus obscurus*) and for the tiger shark (*Galeocerdo cuvier*). Caribbean data shows the tiger shark to have a 12 month gestation period. It is likely that there are many other patterns of reproductive cycles but it may take a long while to elucidate these, given the difficulties of obtaining specimens.

0723 Poster Session I, Friday July 25, 2008

Construction of a Cyprinid Prototype

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The origin of the Cyprinidae remains hidden in a yet to be discovered fossil record. Without this information it might be helpful to construct a hypothetical ancestral form to see what it would look like. It could be assembled using the plesiomorphic character states taken mostly from the skeleton. To attempt such a project a character survey was conducted on a fairly large representation of the family Cyprinidae plus extensive literature review. Comparative specimens were included from the Catostomidae, Cobitidae, Botiidae, Balatoridae and Gyrinocheilidae. Out-group study specimens were drawn from the Characiformes, Siluriformes, Clupeiformes and Salmoniformes. Published information was also relied on for these groups plus the Gonorynchiformes, fossil Anotoptysi and fossil Otophysi. Results of the survey thus far have determined the plesiomorphic character states for the following: median fin placement and shape, scale morphology, caudal skeleton and tail, portions of the anterior axial skeleton, pectoral and pelvic girdles, opercular series, suspensorium, hyoid bar, infraorbital series, basicranium, skull roof and cephalic canal pattern. There is little doubt that the Cyprinidae are plesiomorphic within the Cypriniformes but it is not known how well the prototype, when completed; might serve as a hypothetical ancestor for the order.

0747 Poster Session III, Sunday July 27, 2008

Photo Identification of Manta Rays in the Indo-Pacific Ocean

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Mark-recapture (or sight-resight) studies are one of the most prevalent and widely tested methods of estimating demographic parameters such as population size, survival, movement rate, and age/sex structure. This method uses natural skin pigmentation patterns, marks or scars present on animals, which makes it less disruptive to the animal and their environment than conventional tagging techniques. Photo-id libraries from the Maldives, Ningaloo Reef, WA and Yap Islands are being used to study population parameters and migration of manta rays from the Indo-Pacific Ocean. The aim of this study is to identify if there is a "typical" aggregation of manta rays and which size and /or sex is the most common. Cleaning stations and feeding grounds have been identified as the most important aggregation sites in each location but the number of mantas participating in them and the reasons

why they are grouping in such places are some of the questions we intend to answer. Using libraries with photos from several years, it is possible to determine residency of individuals and site fidelity, which helps in the understanding of population dynamics and sexual-biased migrations. The understanding of manta ray population traits and migration patterns is essential to 1) maintain the ecotourism industries that these rays support in hot spots like Ningaloo Reef, W.A. or Maldives Islands, and 2) to improve the local management plans and regulations. Moreover, the ongoing long-term project this study is a part of will improve the general understanding of manta ray movement through international waters, allowing the possibility of designing protected areas in international and shared waters.

0246 Poster Session I, Friday July 25, 2008

Abundance, Seasonal Occurrence, and Biological Information of Devil Rays (Batoidea: Mobulidae) in the Gulf Of California, Mexico.

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Devil rays have been harvested to an unsustainable level due to a strong fishery in the Gulf of California. The life strategy of this group, make them very vulnerable to over fishing, so studies are necessary for management and conservation plans in the area. Two fishery camps were sampled during May to July of 2002 and from February to October of 2004. A total of 356 organisms were caught, 135 of *Mobula japonica* (74 females, 61 males), 112 of *Mobula munkiana* (50 females, 62 males) and 109 of *Mobula thurstoni* (51 females, 58 males). *Mobula japonica* occurs mainly on summer months, we found that the most abundant size was 210 cm disc width (DW) and 61% of the organisms sampled were smaller than the estimated size at maturity (ESM); we also found gravid females. *Mobula munkiana* is known to be a winter species; however, we found it from February to July. The most abundant size was 50 cm DW and we found that 78% of the sample is smaller than the ESM; we also found gravid females and small organisms with the size suggested for birth. *Mobula thurstoni* occurs all year-round with a seasonal size segregation. The most abundant size in this study were 130 and 150 cm DW; 60% of the catch were organisms smaller than the ESM. Also gravid females were found in this species. The presence of juveniles, neonates and/or gravid females of the three species on the nets, make evident not only that this area have been used by these mobulids as mating and nursery ground, but also that the fishery is targeting on juveniles, which may collapse populations in a short period of time as happened with other species of elasmobranchs in the world.

0444 Herp Biogeography, Salons 4&5, Saturday July 26, 2008

Phylogeography of *Necturus beyeri* (Amphibia: Proteidae)

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Necturus beyeri, the Gulf Coast Waterdog, is a paedomorphic salamander inhabiting streams and rivers along the gulf coast region of the southeastern United States from eastern Texas to western Georgia. The complex history of the gulf coast drainages of southeastern North America has led to incongruent patterns among taxa in previous comparative phylogeographic analyses. Because these salamanders are aquatic, the history of the drainages they inhabit likely affects the current genetic diversity of this species. In this study we utilized the mitochondrial encoded ND2 gene to infer the historical relationships of gene lineages within *N. beyeri*. Samples were collected from throughout the range of *N. beyeri*. Because of debated species classification within the genus *Necturus* and the recent distributional changes of *N. beyeri* all currently recognized species of *Necturus* were included in the analysis. This will allow for the understanding of the historical processes that have shaped the current distribution of *N. beyeri*. The overall pattern shows both the influence of historical events as well as contemporary drainages on the phylogeography of this species. Findings show that gene lineages of *N. beyeri* are paraphyletic. The implications of these findings as well as the utility of mtDNA genes will be discussed.

0265 Fish Systematics IV, Salons A&B, Monday July 28, 2008

The Influence of Sexual Selection in the Diversification of Ponyfishes

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The phylogenetic relationships of ponyfishes (Teleostei: Leiognathidae) are reconstructed and morphological shape diversity (disparity) is measured and compared among clades. We test hypotheses suggesting that sexual selection on the light organ system (LOS) has influenced the rate of cladogenesis and morphological diversification within the family. Because of the presence of a sexually dimorphic LOS in the majority of species of leiognathids, it is hypothesized that sexual selection has led to increased rates of diversification. Increased rates of diversification are potentially correlated with changes in morphology associated with the LOS or flashing pattern rather than other systems (e.g., pigmentation pattern or external body shape), given that these other systems vary little among species of ponyfishes. Therefore, we would expect evolution of body shape variation to be limited or outpaced by evolution of variation in the LOS in sexually dimorphic leiognathids.

We recover a single origin of sexual dimorphism of the LOS in leiognathids, a pattern consistent with sexual selection increasing rates of cladogenesis given that the vast majority of species are recovered in this clade. We also find that leiognathids that are sexually dimorphic for the LOS are significantly more disparate in body shape than their non-dimorphic counterparts.

0263 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT PHYSIOLOGY/MORPHOLOGY

Water Quality Parameters Can Influence Baseline Corticosterone Levels in Larval Amphibians

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Anthropogenic disturbances are altering nearly every habitat type on a global scale. In freshwater systems, these changes have resulted in one of the highest extinction rates in the world. In addition to overt extinction, these alterations can generate significant changes in biotic and abiotic components of these systems that can act as stressors upon system inhabitants. Vertebrate organisms possess a highly conserved physiological mechanism for coping with stress – the hormonal stress response. Our study examined stress hormone levels in larval Jefferson Salamanders (*Ambystoma jeffersonianum*) in relation to water quality parameters in eight natural ponds across Maryland, Pennsylvania, and West Virginia. Baseline stress hormone levels were significantly different across all ponds. In addition, we found a significant negative correlation between pH and baseline stress hormone levels. There was also a trend for baseline stress hormone levels to be positively correlated with chloride levels and negatively correlated with conductivity. To supplement our field findings, we manipulated pH in the laboratory to determine the extent of pH influence on stress hormone levels. We used *A. jeffersonianum*, *A. maculatum*, *Rana sylvatica*, and *Hyla versicolor* as models. Reduced pH significantly increased baseline stress hormone levels in all four amphibian species. In addition, reduced pH significantly decreased survivorship in *A. jeffersonianum*, *A. maculatum*, and *R. sylvatica*. Our findings suggest that stress hormone levels can act as a physiological endpoint in assessing freshwater habitat quality. The establishment of a physiological endpoint, such as stress hormones, will hopefully alert conservation and management practices pertaining to freshwater habitats before irreversible problems arise.

0671 Poster Session II, Saturday July 26, 2008

Form, Function & Fitness—Selection and Performance Gradients for Mosquitofish Exposed to Predatory Sunfish

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Predators exert strong selection on prey traits. However, selection on traits is mediated by contributions of the traits toward enhancing performance. The most complete understanding of selection will take into account both primary traits and performance, and typically is best analyzed by path analysis. We refer to the 'form, function, fitness' concept as the Arnold paradigm after Stevan Arnold's seminal synthesis of selection and performance gradients (*Am. Zool.* 23:347-361). We found strong effects of prey morphology on their swimming speed, effects of predators on prey behavior, and effects of prey traits on survival with predators. Among the most effective prey defensive behaviors was to leap from the water and stick to emergent objects for up to several minutes, before flipping back into the water. Analysis for complex trait relationships, such as trait compensation (*Anim. Behav.* vol:pp-pp) is ongoing. This study documents the utility of analyzing multiple trait effects in a fully-specified path model to understand cause and effect in a multiply-determined selection regime.

0443 Poster Session II, Saturday July 26, 2008

The Occurrence of Large-sized Blueberry Roughy *Gephyroberyx japonicus* off the Southwestern Taiwan Coast

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Nine uncommon Trachichthyidae fish, identified as the blueberry roughy *Gephyroberyx japonicus*, were recently trawled in 280-290 m depth off the southwestern Taiwan coast between September and October 2007. Sizes of the fish ranged 401-525 mm (mean±SD, 482±41 mm) in total length and 939-2735 g (2056±584 g) in body weight, which were the known largest records in comparison with the conspecific specimens. Gonadosomatic indexes of the fish were 0.2-1.5 (0.9±0.9) for two males and 1.3-5.6 (2.9±1.6) for seven females. Preliminary otolith annuli examination and trace elements transect analysis indicated that the fish were of great

longevity, slow-growing and might be served as a proxy for the anthropogenic lead pollution sunk in the deep-sea.

0012 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008

Stock Assessment of the Shortfin Mako Shark in the Northwest Pacific - a Demographic Approach

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The shortfin mako shark (*Isurus oxyrinchus*) owns the life history characteristics of large sharks such as slows slowly, matures late, and produces few offsprings. It is vulnerable to overexploitation and has been put on the "Near threatened" category of IUCN Red List. The abundance of shortfin mako reduced 40% during 1986-2000 in the Atlantic. However, the stock status in the Pacific is still unknown. The objective of this study is to assess the stock status of the shortfin mako shark in the Northwest Pacific from 1990 to 2004 based on stochastic stage-based model. The virtual population analysis (VPA) results showed that the age-specific fishing mortality of 3⁺~6⁺ for females and 2⁺~7⁺ for males appear to be increased since 1996. The 20-year projection from stochastic stage-based model indicated that the abundance will decrease seriously under current fishing effort. The above results indicate the population will be collapse under current fishing pressure. The population will maintain equilibrium for the next 20 years if the total allowable catch (TAC) is set at 265 mt, which is equivalent to 57% reduction of current fishing pressure. However, close monitoring and modification of the TAC year by year is a necessary measure to ensure the long-term sustainability of the stock.

0583 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

Conservation Genetics of the Endangered Smalltooth Sawfish (*Pristis pectinata*)

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Smalltooth sawfish (*Pristis pectinata*) were once common in the southern U.S. Atlantic and Gulf of Mexico but declined by an estimated 95% last century, primarily due to incidental mortality in fisheries. Today, the U.S. range of the species is severely contracted and remnant breeding areas are now primarily located in a handful of sites in Southwest Florida. Now listed under the U.S. Endangered Species Act, it is critical that we develop a comprehensive understanding of the biology and status of smalltooth sawfish so that we will be fully prepared to meet the challenge of facilitating their long-term recovery. Given the magnitude of decline that has taken place and the well established link between genetic diversity and population viability, there is some concern about the genetic health of smalltooth sawfish in Florida. It is also important to understand the level of connectivity between different sawfish breeding grounds in Florida to effectively scale management actions. We have developed a suite of eleven microsatellite DNA markers (10-46 alleles per locus, average heterozygosity 0.84) that have proven useful for addressing these issues. By genotyping 117 sawfish sampled from Panama City to the Lower Florida Keys, we discovered that robust genetic variation persists in the Florida smalltooth sawfish population and there is only a modest signature of a genetic bottleneck arising from the recent large decline in their numbers. We also show a high degree of genetic connectivity between different Southwest Florida breeding grounds, indicating that they should be managed as a single interbreeding unit. As an interesting side observation on the natural history of smalltooth sawfish we also present evidence that pairs or groups of juvenile sawfish captured together are often composed of siblings, to our knowledge the first evidence of an extended postnatal association of littermates in a batoid elasmobranch.

0562 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

“Homebodies”: Extended Natal Philopatry in Immature Lemon Sharks

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Understanding the balance between philopatric (“home-loving”) behavior and dispersal from the natal area is a central issue in marine ecology, yet it has never been robustly examined for any cartilaginous fish. Near-exhaustive sampling and DNA profiling of 0-3 year old lemon sharks (*Negaprion brevirostris*; nearly 1000 individuals) within a tropical nursery (Bimini, Bahamas) over eight years (1995-2002) was followed by another five years (2003-2007) of sampling in adjacent, deeper habitats for immature sharks that originated from the 1995-2002 year classes (90-230 cm total length, N=150). This level of physical and genetic tagging allowed us to confidently identify locally-born individuals among all immature sharks captured adjacent to the nursery and to make an unprecedented estimation of the proportion of philopatric individuals relative to migrants in the juvenile population. We estimate that over 50% of juvenile sharks up to lengths of 150 cm (around six years old) sampled off Bimini were born locally, illustrating the importance of natal philopatry and local recruitment by immature individuals. The proportion of philopatric individuals was significantly higher in females than in males, indicative of possible male-biased dispersal. The proportion of local recruits significantly diminished after age six as sharks began to approach adult sizes, indicating that dispersal predominates during this “subadult” phase. Extended philopatric behavior by immature sharks-especially females-may be a precursor to natal homing later in life for purposes of reproduction, which is suspected to occur in sharks but has never been directly demonstrated. Given their antiquity, growing evidence for natal philopatry in sharks suggests an early origin of this behavior in vertebrates. The strong association of immature lemon sharks with their natal area also indicates that spatial management strategies focused around coastal nursery areas and adjacent juvenile habitat could significantly contribute to much-needed conservation for this and perhaps many other tropical shark species.

0662 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

Cross-domain Functional Ecological Tradeoffs: Developmental Response of the African Cichlid *Astatoreochromis alluaudi* to Trophic and Oxygen Gradients

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Divergent selection between alternative environments drives adaptive phenotypic diversification. As one might expect, fishes from alternative oxygen environments show strong diversification in gill morphology. But such fish also diverge in other traits such as the size and shape of muscles in the head, suggesting tradeoffs between gill proliferation and non-respiratory traits. In this study, we explore the developmental response of fish to the dual effects of hypoxia and durophagy. The molluscivorous cichlid *Astatoreochromis alluaudi* exhibits plasticity in trophic morphology, developing massive pharyngeal jaws with hypertrophied muscles on a mollusk diet and reduced pharyngeal jaw size and associated musculature on a soft food diet. Molluscivores like *A. alluaudi* in hypoxic waters thus face a dual challenge of developing enlarged respiratory apparatuses to maximize oxygen uptake and producing the trophic architecture to handle hard-bodied prey. We ran a laboratory rearing experiment to test for interactions between oxygen and food in their combined effects on trophic and respiratory morphology. Offspring of 3 sets of parents from each of two field populations (high-oxygen, mixed diet and low-oxygen, insectivorous diet) were split into four groups and reared in a 2x2 factorial design of variation in oxygen (hypoxia versus normoxia) and diet (snails versus flake food). We then measured respiratory (gill filament length, gill surface area), trophic (pharyngeal jaws, muscles), and whole-body morphological traits (geometric morphometrics). We found strong developmental plasticity in all three trait groups in response to rearing environment. We also found interactions between diet and oxygen for some traits, suggesting that nonrespiratory factors may influence the extent of divergence in respiratory characters, and vice versa. Such tradeoffs across ecological domains are not often studied but may be very important factors determining the architecture of adaptation.

0640 Poster Session I, Friday July 25, 2008

A Validation for the Use of Fin Photographs for Individual Identification of White Sharks (*Carcharodon carcharias*) off California and a Comparison between Two Analysis Methods

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One of the most widely used techniques to determine population and demographic information is the mark-recapture method. Non-invasive techniques to identify and mark individuals of rare species provide an easier method to collect these data with minimal impact to the animals. The behavior of the white shark, *Carcharodon carcharias*, and identifying markings on the trailing edge of the dorsal fin permit individual identification via high-resolution photographs. These photographs can be obtained either above or below water allowing greater probability of identification than other body markings. Here we used fin photographs from a 20 year study period in central California to validate the use of these markings as an individual identifier while comparing the accuracy of manual and computer-assisted identification methods. Manual identification required a reader to visually compare and match all known fins within the database, whereas computer-assisted techniques utilized DARWIN, a program developed to identify dolphin fins, to match the photographs. Results from the two methods were tested against the true matches determined from known secondary traits.

0310 Poster Session I, Friday July 25, 2008

Diet of the Freshwater Stingray *Potamotrygon motoro* (Potamotrygonidae) in the Brazilian Amazon River Channel

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Potamotrygon motoro is a widely distributed species in the Brazilian Amazon Basin. It is polychromatic and valued in the international ornamental trade. This study is a contribution to the feeding biology of this species in the Solimoes / Amazonas River channel. The samples (n = 50) were obtained throughout the Brazilian portion of the Solimoes / Amazonas River, in 2003. Specimens were subject to anesthesia and sacrificed. Stomachs were removed, fixed in formaldehyde solution (10%), preserved in ethanol (70%) and then had its content analyzed in the laboratory. Percentage of Frequency of Occurrence (% FO), Weight (% W), Number (% N) and Index of Relative Importance (IRI and %IRI) were calculated for each food item. Digestion and repletion levels were observed too. Results indicated that these stingrays in the

study area feed mainly on bony fish (Siluriformes and Peciformes), crustaceans (Decapoda, Palaemonidae), gastropods (Gastropoda) and insects (Isopoda). Fragments of plant tissue were observed among stomach contents. Repletion level showed that most (59%) stomachs had little content. Digestion level observation indicated that most items (62%) were highly digested (fragments only). Conclusively, *P. motoro* can be considered a piscivorous species that also includes other food items on its diet but on lower proportions.

0106 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Diversity and Conservation of Manta and Mobulid Rays from Brazilian Waters, Southwestern Atlantic

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Mobulidae comprises medium to large size rays that feed on plankton and are found worldwide in tropical and subtropical regions. There are 10 known species and these are among the most vulnerable elasmobranchs to fisheries. Most of these species have a very low fecundity producing a single offspring. Lately there were only three species known to occur in Brazilian waters (*Manta birostris*, *Mobula hypostoma* and *M. rochebrunei*). As sampling carried out with the fishing fleets increased and with examining of scientific collection specimens, three additional species were confirmed in this region (*Mobula japonica*, *M. tarapacana* and *M. thurstoni*), totalizing six species. The Mobulidae world distribution pattern reveals regional faunas characterized by the presence of large widely distributed oceanic-coastal species (*Manta birostris*, *Mobula japonica*, *M. tarapacana* and *M. thurstoni*) plus an accessory small coastal restricted range species, such as *M. munkiana* (eastern Central Pacific), *M. kuhlii* (western Indian Ocean), *M. eregoodootenkee* (Central Indo-Pacific), *M. rochebrunei* (eastern Central and western South Atlantic) and *M. hypostoma* (western Atlantic). The Brazilian coast is the only region in the world presenting two of these accessory species, which makes it the richest coast in terms of mobulid diversity (60% of all mobulids). In Brazil these elasmobranchs are captured mainly by drift nets and surface longlines. Mobulids are not a target species but most of the specimens caught are landed in fish markets. Occasionally very large individual are released from nets due to their size. The giant mantas (*Manta birostris*) are a highlight for contemplative diving around the world and may contribute to the eco-touristic industry as an important resource in some regions, such as in the Laje de Santos Marine State Park (São Paulo). Public and governmental awareness are needed to provide adequate management and protection for mantas and mobulids in Brazil.

0355 Herp Genetics, Salons A&B, Sunday July 27, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Hybrid Zone Dynamics among Salamanders in the Genus *Plethodon*

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Hybrid zones are active areas of research into the causes of speciation and maintenance of species boundaries. One goal of hybrid zone studies is to identify differential introgression of morphological and molecular markers, which is identified by discordance in marker frequency change across a hybrid zone. This study examines patterns of marker frequency change across hybrid zones among three species of plethodontid salamanders – *Plethodon jordani*, *P. metcalfi* and *P. teyahalee* – in the Southern Appalachian Mountains of North Carolina and Tennessee. Five markers are used to assess hybrid zone shape and width: (1) extent of red cheek pigmentation (diagnostic of *P. jordani*), (2) presence of dorsal and lateral white flecks (diagnostic of *P. teyahalee*), (3) a single nucleotide polymorphism (SNP) located in the mtDNA gene ND2, (4) a SNP in the nuclear DNA gene ILF3, and (5) a SNP in the nuclear DNA gene GAPD. Concordance in frequency change is assessed for all five markers, and reasons for discordance are discussed.

0266 Poster Session I, Friday July 25, 2008

Revision of the *Photoplagios leuciscus* Günther, 1860 Species Complex

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Photoplagios leuciscus traditionally has been considered to be a widespread species, with a range extending from Japan southward to Australia, and eastward to Madagascar. (The species was originally described from Moluccas, Indonesia.) Males are characterized by an expansive transparent triangular flank patch, which is used for luminescence signaling (i.e., photic communication). Several morphological variations have been identified in this taxon, which exhibit geographically localized distributions, and that may correspond to novel species. Based on data collected using traditional morphometric measurements and landmark based geometric morphometrics, we identify morphologically distinct and geographically disjunct lineages from within the putative range of *Photoplagios leuciscus*.

0460 AES Food & Feeding, Kafka/Lamartine, Saturday July 26, 2008

Older and Wiser: The Effects of Maturation and Experience on the Predatory Efficiency of Whitespotted Bamboosharks

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Foraging presents a significant challenge for neonatal predators. Adequate predatory skills must initially be present or must quickly develop. Additionally, predatory abilities may change over time. Physical maturation may increase predatory abilities due to improved neuromuscular coordination, increased sensory abilities, or morphological changes. Experience may allow predators to hone existing skills and develop new ones. To tease apart which improvements in predatory abilities were due to increased maturation and which were due to increased experience, three sets of comparisons were made on the predatory efficiencies of hatchling whitespotted bamboosharks: comparisons of sharks before and after 20 days of foraging experience to determine whether predatory efficiency does improve, comparisons of naïve sharks of different ages to determine whether predatory efficiency improves with increases in maturation, and comparisons of naïve and experienced sharks of the same age to determine whether predatory efficiency improves with increases in experience. Sharks of different ages (2 days old or 21 days old) were given 20 days of foraging trials with live prey (either worms only or shrimp only). Predatory efficiency, defined as duration of predatory event, was measured for sharks' initial foraging trials and final foraging trials. Individual sharks improve predatory efficiency after 20 days of foraging experience. Predatory efficiency improves with maturation alone for sharks foraging on shrimp, a highly elusive prey. Predatory efficiency improves with experience alone for sharks foraging on worms, a non-elusive prey. Maturation likely improves sharks' ability to create suction while feeding, a necessary ability when foraging on elusive prey. Experience likely improves predatory abilities through associative learning and search image formation. Both experience and maturation are necessary for sharks to exploit all possible prey.

0142 Fish Systematics II, Salons A&B, Friday July 25, 2008

Descriptions of Five New Species in the Genus *Metriaclima* (Teleostei: Cichlidae) from Lake Malawi, Africa

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Lake Malawi supports an enormous diversity of cichlid species, many of which lack formal descriptions. Five new species of rock-dwelling cichlids from the lake are described. The moderately-sloped vomer, isognathous jaws, and presence of bicuspid teeth in the outer rows of the jaws, among a suite of other morphological characters, place these species in the genus *Metriaclima*. All five species are part of

the *M. aurora*- species complex, based on the absence of a black band in the dorsal fin which is congruent with the ecologically similar species *M. aurora* (Burgess). Differences in morphology, in conjunction with assortative mating, distinguish these new species from each other and previously described species of the *M. aurora*-complex.

0343 AES Age & Growth/Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Age, Growth, and Maturity of the Little Skate, *Leucoraja erinacea*, from the Western Gulf of Maine, USA

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The little skate, *Leucoraja erinacea*, is the most common skate found in near-shore waters of the Gulf of Maine. Despite their high relative abundance, there is limited data describing their biology within this region. Moreover, recent stock assessment in the northeast United States indicated that the little skate's population is declining. In order to gain insight into the life history of little skates, growth rates and sexual maturity were evaluated from 435 specimens, collected within the coastal waters of New Hampshire and Massachusetts. Ages were estimated using vertebral band counts from skates ranging in size from 9.3 to 57 cm total length (TL). The index of average percent error (IAPE) and age-bias plots indicated our aging methods were precise and nonbiased. Growth rates did not differ between male and females and the combined age-at-length data resulted in Von Bertalanffy growth parameters of L_{∞} = 59.5 cm (TL) and k = 0.16. In order to validate the annual periodicity of band formation, oxytetracycline was injected into 20 individuals (10 male and 10 female) that were held in captivity for 12 months. Maturity ogives, based on data from shell gland mass, follicle size and circulating estradiol concentrations, suggest that 50% maturity in females occurs at age 9.5 years and 48 cm TL. Maturity ogives for males, based on clasper length, testes mass, circulating testosterone concentrations, and the proportion of mature spermatocysts in the testes, suggest 50% maturity occurs at 7.7 years and 46 cm TL.

0239 Fish Physiology, Salons 6&7, Sunday July 27, 2008; STOYE
PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Sausages with Sharp Teeth and Strong Muscles: Jawless Morphology and Force Production in Hagfishes

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Hagfish can dismember and ingest large chunks of flesh from marine carcasses without jaws. The hagfish feeding apparatus (HFA) includes a cartilaginous endoskeleton, keratinous teeth, and muscles. I examined the feeding morphology in two species, *Eptatretus stoutii* and *Myxine glutinosa*, representing the two major hagfish lineages. I measured the major skeletal and dental components of the HFA, and calculated physiological cross-sectional area (PCSA) and force production in the deep protractor muscle (DPM, the major dental plate protractor) and the clavatus muscle (CM, the major retractor). *E. stoutii* had larger dental plates, basal plates, and CM PCSA. The DPM in both species can generate 3 N, while the CM, which can generate up to 16 N, averaged 7 N and 10 N in *M. glutinosa* and *E. stoutii*, respectively. For comparative purposes, mean CM force from both hagfish species were plotted with the bite forces of various gnathostomes and scaled to body mass. The fixed pulley system configuration of the HFA minimizes reduction in force transmitted from the muscles to the dental plates and makes CM force a reasonable approximation of dental plate retractile force. Despite similar diets and kinematic profiles, feeding morphology varies between hagfish species. Lacking jaws does not preclude hagfish feeding muscles from generating high forces: the CM in both species generated comparable forces to bite forces of similarly sized gnathostomes. Collectively, morphological and kinematic data on hagfish feeding indicate that neither large gape nor bite force were necessarily an advantage that drove the evolution of jaws. I propose that an important selective advantage of jaws is that geometric variation in levers and linkage systems allow dietary niche diversity and rapid jaw movements for procuring elusive prey.

0025 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

A New Species of Swell Shark (Carcharhiniformes: Scyliorhinidae) from Papua New Guinea with Comments on Clasper Groove/Tube Function in Sharks

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A new species of *Cephaloscyllium* is described from five adult specimens (445-660 mm TL) taken in a "nautilus trap" in 240-274 m off the east coast of mainland Papua New Guinea. These are compared to two immature specimens from Rowley Shoals off NW Australia collected in 390-700 m, referred to as *Cephaloscyllium* sp. E by Last and Stevens (1994), that may be the same as, or closely related to, our PNG specimens. Our new species is distinguishable from other congeners by a unique pattern of small white spots, larger in males than females, that shows up especially in the dark large patches on the dorsum. These dark patches form nine irregular saddle-like marks across the head, body, and fins and extend paler onto the ventral surface. A mature female (660 mm TL) had 16 large yellow eggs (8-21 mm diameter). Claspers of the two adult male paratypes have their grooves fused into a closed tube for half their length. The adaptive function of this fusion into a closed tube on the proximal part of the claspers is discussed. In this and other sharks.

0165 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008;
STOYE GENERAL ICHTHYOLOGY

Movement Patterns and Foraging Ecology of the Manta Ray (*Manta birostris*)

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Manta rays (*Manta birostris*) were acoustically tracked in order to determine their daily movement patterns and foraging ecology in Hawaii. A combination of active and passive tracking was used to provide information on both the fine scale, short term and the course scale, long term movement patterns of the manta rays. Manta rays are shown to have site fidelity to specific foraging areas and cleaning stations. Manta rays optimize their foraging through the use of area restricted search patterns, allowing them to remain in dense plankton patches. Preliminary studies in the Gulf of Mexico and the Maldives suggest that foraging strategies may differ between oceanic and coastal areas.

0166 Poster Session I, Friday July 25, 2008

Sixteen Years of Photo-Identification of Hawaiian Manta Rays (*Manta birostris*)

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Manta rays (*Manta birostris*) have been a tourist attraction in Kona, Hawaii for over 25 years, where over 11,000 divers per year observe manta rays feeding at night. However, little is known about their basic biology. Data has been collected from dive instructors on the presence of individual manta rays at two dive sites along the Kona coast in order to investigate their life history, population structure, and site fidelity. One hundred and thirty five individuals have been identified in Kona since 1992. Manta rays in Kona appear to have a high site fidelity to certain feeding areas, long life, and low reproduction.

0596 Poster Session II, Saturday July 26, 2008

The Influence Of Larval Growth History And Exogenous Thyroid Hormone On Life History Allocation Patterns In The Axolotl (*Ambystoma Mexicanum*)

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We tested the hypothesis that variation in growth history and exogenous T₄ 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). Adult axolotls were paired and resulting embryos were hatched and larvae were raised individually in plastic container in reverse-osmosis water. Hatchling larvae were fed freshly hatch brine shrimp. As larvae grew, they were fed tubificid worms. We examined growth by periodic weighings (to the nearest mg) using a top-loading balance. 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 then dissected and weighed to the nearest milligram. Dissection also allowed us to determine sex in order to test the hypothesis that allocation was sex-dependent. Feeding treatments had desired growth effects. Treatment with T₄ resulted in complete metamorphosis of all treated salamanders. In the T₄ treated salamanders, metamorphosis was independent of larval growth rate. Allocation differed among treatments and was dependent on sex. Females stored significantly less than males, while having significantly larger gonads than males. Furthermore, female gonad mass was significantly influenced by feeding treatment whereas male gonad mass was not; this indicates the expensive allocation cost of reproduction in females.

0518 Fish Systematics II, Salons A&B, Friday July 25, 2008

Cypriniformes Tree of Life: Postcranial Characters in Cobitoid Fishes

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As part of the Cypriniformes Tree of Life project, we assessed postcranial characters used by previous investigators for consistency across all cypriniform lineages as well as developing new characters. Among cobitoids, postcranial characters of the vertebral column, intermusculars and pelvic fins support an arrangement of cobitoids as (Catostomidae (Gyrinocheilidae (Botiidae (Cobitidae (Nemacheilidae, Balitoridae))))). Cobitoids, excluding catostomids, share a reduction of the intercalarium and loss of the intercostal ligaments that pass obliquely between the anterior ribs. Within this group, gyrinocheilids lack the platelike expansion of the predorsal neural spines, reduction of supraneurals to 1 or 0, and at least a partially encapsulated swimbladder that are characteristic of the loaches. Cobitids (sensu stricto) possess a series of enlarged epicentral bones associated with vertebrae 4-7. Nemacheilids and balitorids share synapomorphies of the tripus and subdivided swimbladder capsule. In the enigmatic *Ellopostoma* transitional vertebrae extend far anteriorly, to V9, and the horizontal component of the transverse process of V2 is expanded but visibly distinct from the encapsulated swimbladder. We assess these character states relative to balitorids and also examine the recent placement of *Vaillantella* as sister to the clade of cobitids, nemacheilids and balitorids.

0275 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Temporal Use of Rock Ledge Habitat by Six-lined Racerunners (*Aspidoscelis sexlineata*) on Southeast Minnesota Bluffs

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Six-lined racerunners are associated with sandy, open habitats, including "goat prairies" on south- or southwest-facing slopes of bluffs in southeast Minnesota. A remote camera was placed beneath overhanging rock ledges on a bluff in Houston County, Minnesota, to monitor timber rattlesnakes, but it also obtained thirty-three photographs of racerunners. The camera was set to take one photograph per hour but was also sensitive to motion. In addition, recording thermometers were positioned to record substrate temperature beneath an overhanging ledge and on the exposed substrate on the slope outside the ledge. Racerunners apparently used the ledges throughout the entire season that the camera was set (from late May through early September). However, they were photographed beneath ledges only from late morning to mid-afternoon. Frequencies of racerunner photographs during two-hour

blocks from 06:00 to 20:00 were significantly different from those expected under the hypothesis that they should be equally likely to be observed during any two-hour block. The hypothesis that racerunners use ledges for overnight refuge can also be rejected because there was no visual evidence of them leaving in the morning or entering in the evening. It would appear instead that racerunners used the shade beneath ledges as a temporary refuge from high temperatures during sunny afternoons, when ground surface temperatures in the sun may exceed 50° C.

0026 AES Age & Growth/Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Comparing Biological Parameters of the NE Atlantic and Mediterranean Populations of the Deep Water Lantern Shark, *Etmopterus spinax*

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Etmopterus spinax is a small sized deep water lantern shark that occurs in the Eastern Atlantic and the Mediterranean. Differences in depth distribution, catch per unit effort (CPUE), size at maturity and fecundity were compared between a population that has suffered high levels of fishing mortality during the last decades (southern Portugal in the NE Atlantic) and a population where low fishing pressure below 500 m occurs at present or has occurred in the last decades (Alboran Sea in the W Mediterranean). The research survey CPUE in the NE Atlantic is substantially lower than in the Mediterranean throughout the entire depth range. The NE Atlantic population is maturing at smaller sizes than the Mediterranean population and has a lower mean fecundity. Specifically, sizes at maturity for the NE Atlantic and the Mediterranean were respectively 25.39 and 28.31cm TL for males and 30.86 and 34.18cm TL for females, while mean fecundities for the NE Atlantic and the Mediterranean were respectively 9.94 and 11.06 oocytes per mature female. This work evidenced the possible presence of density dependant mechanisms in the NE Atlantic population of *E. spinax* that has lowered the size at maturity as a result of excessive fishing mortality. However, given that this is an aplacetary viviparous shark, where fecundity is dependant on female size, this compensatory mechanism seems to be less efficient than what would be expected.

0124 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

The Impact of Plant Traits on Larval Amphibian Development

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During spring and summer 2007 we conducted a field assessment of the performance of three larval amphibian species (*Bufo americanus*, *Rana sylvatica*, and *Rana palustris*) in wetlands dominated by nine different native and nonnative plant species in upstate New York (n=4-9 cages per plant species, 61 cages total). We collected egg masses (n=4-5 per species) as they became available and added week-old tadpoles to cages (64 per cage for *Bufo*, 32 for *Rana*). We monitored tadpole survival and environmental conditions (e.g. temperature, %DO) weekly, and weighed all individuals at metamorphosis. In the fall of 2007 we harvested 3 quadrats of plant material from each cage location to assess biomass, leaf C:N and leaf phenolics. We conducted multiple regressions and used Akaike's Information Criterion to select models. Our results indicate that plant biomass tends to improve larval amphibian performance, while certain other qualities, specifically increased C:N and phenolics, are associated with declines in performance. Overall, we find that traits, rather than origin (native vs. nonnative) determine the quality of habitat plants provide for larval amphibians.

0680 Poster Session III, Sunday July 27, 2008

Transient Ontogenetic Expression of Hermaphroditic Gonad Morphology in the *Gobiosoma* Group of the Neotropical Seven Spined Gobies (Gobiosomatini, Gobiidae)

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The Neotropical seven-spined gobies (tribe Gobiosomatini) constitute a speciose, monophyletic gobiid clade exhibiting significant microhabitat specialization which may have played a major role in their rapid evolution. Functional hermaphroditism, which is common among gobiids, can promote exploitation of patchily distributed micro-niches by countering potential reductions in reproductive opportunities. However, the extent of hermaphroditism in the Gobiosomatini is unknown. Many of the speciose Gobiosomatini clades are found within the '*Gobiosoma*' group (*sensu* Ruber et al. 2003). One species within this group, *Elacatinus (Tigrigobius) multifasciatus* is a known hermaphrodite and two others are functionally gonochoric, but exhibit transient hermaphroditic ovarian structure among immatures. In this study, ovarian morphology among immature and adult *Gobiosoma* group species was examined to see if hermaphroditic gonadal features are present. No evidence of new cases of functional hermaphroditism was found among eight species within the *Gobiosoma* group, but six species exhibited transient expression of hermaphroditic gonadal

features associated with the immature ovary. Among 12 species from nine non-Gobiosomatini genera which have no record of hermaphroditism, none exhibited similar transient hermaphroditic ovarian features that might otherwise be the norm among gobiid taxa. These findings suggest that hermaphroditism may have been a shared feature early in the evolution of the Gobiosoma group within the Gobiosomatini and therefore may have played a contributory role in rapid speciation events.

0143 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Barcoding Fishes of the Gulf of Maine

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As part of the Fish Barcode of Life program (FISHBOL), tissue samples of up to 5 individuals per species were collected, mostly from fishes caught during fishery surveys by the Northeast Fisheries Science Center (NEFSC). Most of the voucher specimens have been deposited at the National Museum of Natural History (USNM). This project will be of direct benefit to NEFSC and NMFS once we have built a COI database of most of the fish species occurring in the region. 1) Barcoding works for all stages in the life cycle so barcoding will assist in identification of larval fishes. This is particularly important because most of the NMFS leaders in "larval fish taxonomy" have retired leaving us with identification problems. 2) Barcoding usually differentiates between closely related species that are difficult to distinguish such as the hakes (*Urophycis*) or silver hakes (*Merluccius*). This is particularly useful for large specimens that are difficult to bring back for identification. 3) Barcoding can positively identify fishery products such as fish fillets. 4) Barcoding can legally verify identifications of fishes caught as by-catch and species under regulation. 5) Barcoding is useful in identifying stomach contents. So far, tissues have been collected and analyzed from 508 specimens representing 162 species, 144 genera, and 90 families. This includes 101 species from the Gulf of Maine out of a fauna of 252 species plus many species from nearby in the western North Atlantic.

0724 Poster Session III, Sunday July 27, 2008

The structure of lizard assemblages in cerrado *sensu stricto*, central Brazil, under different burn regimes

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Fire is a natural disturbance agent in tropical savannas, modifying the structure of animal and plant communities and transforming the landscape. We investigated the effects of fire on the structure of lizard assemblages in the Cerrado of central Brazil, using pit-fall traps. We determined the effects of burn regime upon lizard richness, abundance and evenness and the association between lizard abundance and habitat characteristics induced by fire. We sampled five plots of cerrado *sensu stricto* under different burn regimes: quadrennial fires, biennial fires at early, modal, and late dry-season, and control, without fire. Lizards were surveyed during five days by month, from December 2005 to November 2006, totaling 600 trap*days by plot. Lizard abundance and evenness were lower under extreme fire regimes, in agreement with the intermediate disturbance hypothesis, but richness was smaller under intermediate regimes. Fourteen lizard species were recorded, six of which occurred under a single fire regime (*Enyalius* aff. *bilineatus*, *Tropidurus torquatus*, *Polychrus acutirostris*, *Mabuya guaporicola*, *Bachia bresslaui*, and *Tupinambis duseni*). Two generalist species (*Tr. itambere* and *Ameiva ameiva*) did not occur under extreme regimes. *Tropidurus itambere* and *Micrablepharus atticolus* dominated under more severe regimes and *Ma. frenata* and *Ma. nigropunctata* prevailed in the absence of the fire. Total lizard abundance did not vary throughout the year, but evenness was higher in the wet season. The effects of fire were significantly related to changes in habitat structure, but had little relation with climate variability throughout the year. Habitat characteristics in plots under different fire regimes and the presence of exclusive lizard species suggest that, if natural burns lead to a heterogeneous landscape, they can drive lizard richness in a regional context. Anthropogenic burns or the complete absence of fire have the opposite effect. This pattern may be shared with other animal taxa and anthropogenic fires, with high-frequency and low periodicity, as well as the complete suppression of burns, must be avoided. The maintenance of these artificial regimes can result in great losses of local and regional diversity.

0159 Fish Ecology II, Salons A&B, Monday July 28, 2008

Unmasking Florida's Hogfish: Habitat, Behavior and Life History of the Hogfish (*Lachnolaimus maximus*)

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Visual transect surveys were performed and hogfish (*Lachnolaimus maximus*) were harvested over a range of depths and habitat types within the central eastern Gulf of Mexico. Hogfish were recorded as present during 73% of all performed dives, and were most common over rugose natural hard bottom habitat. As depth and distance from shore increased, hogfish density decreased; however, mean hogfish size and age showed a positive relationship with depth. A dramatic difference emerged between shallow (<30 m) and deep (>30 m) water collections, with fish transitioning into males at a much smaller size and younger age within shallow water. Furthermore, fish older than 8 years and larger than 559 mm FL were not recorded from shallow water sites, while deep water collections yielded fish as old as 19 and as large as 765 mm FL. Observed sex ratio had a mean value of 1:10 M: F, and showed no change with season or site depth, suggesting that hogfish maintain harem structure throughout the year. Gonad histology and visual observations of courtship behavior support previous accounts that hogfish spawn in the winter and spring, with highest reproductive activity recorded during March and April. Evidence is presented for a more protracted spawning period at greater depths. Growth parameters as well as survival and mortality estimates are similar to those estimated previously for hogfish within the eastern Gulf of Mexico.

0202 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Reproductive Biology and Gonadal Cycle of the Lesser Guitarfish, *Zapteryx brevirostris*, from the Coastal Southwest Atlantic

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The Lesser guitarfish *Zapteryx brevirostris* (Chondrichthyes: Rhinobatoidea) is a common lecithotrophic viviparous batoid from coastal Southwest Atlantic waters. In order to study the reproductive ecology a total of 656 (334 males and 656 females) individuals of *Z. brevirostris* were captured by bottom trawl in the Southwest Atlantic coastal ecosystem between 34° and 42°S. The size of the smallest mature male was 462 mm and the largest immature female was 572 mm. Male size at maturity was

estimated in 502 mm total length (77% of the maximum TL). The range between smallest mature and largest immature female was 460-600 mm and size at maturity was estimated in 505 mm (65% of the maximum TL). An opposite trend was observed between spermatogenesis and gonadosomatic index (GSI) in males. The smallest GSI (Jul-Aug) was related to mature spermatocysts and deferent ducts filled with sperm, while the highest GSI (Feb) was associated with immature spermatocysts and empty deferent ducts. Female reproductive cycle is most likely to be triennial. This conclusion was based on the monthly variation of the GSI and largest ovarian follicles diameter. Ovulation occurs in Oct-Nov and embryos born with 150 mm TL after a gestation period of approximately 10 months. This reproductive information is important for fisheries assessments in order to determine the resilience of each species to fishing pressure.

0685 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Manta Systematics and Nomenclature

Leonard J. V. Compagno¹, Andrea D. Marshall², Tom Kashiwagi², Michael B. Bennett²

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The devilrays (Family Mobulidae, Suborder Myliobatoidei, Order Rajiformes), are currently divided into two distinctive confamilial genera, *Mobula* Rafinesque, 1810 and *Manta* Bancroft, 1828 which rarely have been split into two families. *Manta*, the giant devil rays or mantas (blanket in Spanish) includes one of the largest living cartilaginous fishes reaching a width of 6-7 m. Authors of the late 20th Century and early 21st Century generally consider *Manta* to be monotypic and to include a single species, *M. birostris* (Walbaum, 1792). *Manta* has one of the more extensive generic and species synonymies of any living genus of cartilaginous fish. The genus *Manta* has 10 generic and 25 species synonyms, mostly without type specimens. Recent research on *Manta* off Mozambique, Mexico and Indonesia, conducted by A. Marshall and involving photographing individuals and groups of animals, has revealed two obvious species of *Manta* that are separable by morphology, size and behaviour. Genetic analyses by T. Kashiwagi provide support for the presence of more than one species of *Manta*. We discuss the systematics and nomenclature of *Manta* including problems with the identity of the original *M. birostris* from 'Carolina', United States of America, and its possible synonyms, the status of regional species of *Manta* with notes on Whitley's 1936 attempt to split *Manta* into three poorly characterized genera and 10 poorly defined geographic species (including three new species), and the applicability of nominal species of *Manta* to the two species from Mozambique. We suggest that a neotype should be designated for *M. birostris* based on an extant specimen cited by Bigelow & Schroeder's 1953 monograph on Western North Atlantic batoids.

0749 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

How Harvesting Turtles Impacts the Currency of Life-history Evolution

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For 42 of the past 53 years, the life histories of three species of turtles (*Chrysemys picta*, *Emydoidea blandingii*, and *Chelydra serpentina*) were studied on the University of Michigan's E. S. George Reserve in southeastern Michigan. Maximum longevities recorded to date are 75 yr, 60 yr, and 50 yr for Blanding's, Painted, and Snapping turtles, respectively. We examined: 1) the relationship of juvenile growth rates with size and age at maturity, 2) early adult growth on clutch size and frequency in Painted turtles, and 3) indeterminate growth as a mechanism for increasing the proportion of late in life to early births of individuals. In addition, we compared age or age group specific body sizes, reproductive traits and survival for all three species to test the contrasting predictions of the *Relative Reproductive Rate Hypothesis* (that predicts traits that will increase the reproductive output or survival of older compared to younger individuals) and the *Senescence Hypothesis* (that predicts a reduction in reproductive output or survival in older versus younger individuals). Indeterminate growth occurred in all three species, but juvenile growth rates and ages at maturity are a more important determinant of variation in adult body size in the populations. Older females increased parental investment and reproductive frequency, rather than clutch size. Because the value of adult turtles of all three species (in terms of population dynamics) increased with age, sustained increases in adult mortality due to commercial harvests of adults will have inevitable and serious impact on populations.

0085 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

The Interopercular-preopercular Articulation: A Novel Feature Suggesting a Close Relationship between *Psilorhynchus* and Labeonin Cyprinids (Ostariophysi: Cypriniformes)

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The bones of the opercular series (interopercle, preopercle, opercle and subopercle) vary little in terms of their general appearance and position among members of the order Cypriniformes. Except for a few characters relating to the shape of particular bones (e.g. the ventral edge of the opercle in cobitid fishes), the opercular series of cypriniform fishes appears to have contributed little to our understanding of their phylogenetic relationships. During recent investigation of the osteology of cypriniform fishes in general, and *Psilorhynchus* in particular, a novel and previously undocumented feature of the opercular series was discovered: an articulation between the anteriormost tip of the interopercle and preopercle. This articulation is achieved through a single, short, nodule-like process on the medial face of the

preopercle and the lateral face of the interopercle. The surface of each nodule is covered in a thin meniscus-like coating, which may serve to cushion the articulatory surfaces. Further investigation revealed that an identical articulation is also present between the interopercle and preopercle in all members of the Labeonini (a subgroup of the cyprinid subfamily Cyprininae). This derived character may suggest a close relationship between *Psilorhynchus* and labeonin cyprinids.

0028 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

Supplemental Feeding for Tourism Radically Alters Movement Patterns and Spatial Distribution of the Southern Stingray, *Dasyatis americana*

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Supplemental feeding of southern stingrays, *Dasyatis americana*, has occurred at Stingray City Sandbar (SCS) at Grand Cayman as a tourist attraction since 1986. We investigated the influence of supplemental feeding on the movement patterns of stingrays by actively tracking both fed and non-fed stingrays using acoustic telemetry. Seven wild and seven provisioned stingrays were tracked manually for between 5-72 h, and site fidelity of five mature females at SCS was investigated over the course of one year using automated acoustic receivers anchored to the seafloor. Female stingrays at SCS utilized significantly smaller 24 h activity spaces (0.13 ± 0.08 km²) than wild female stingrays (0.88 ± 0.17 km²). Fed stingrays were highly active over a small area during daytime at the feeding site, but had limited nocturnal activity, whereas wild stingrays were more active during the night with limited activity during the day. Core areas of activity overlapped little among wild stingrays (3%), whereas core activity areas of provisioned stingrays at SCS overlapped much more (72%). Provisioned female stingrays consistently frequented SCS during periods of supplemental feeding and exhibited long term (up to six years) site fidelity to this site. Supplemental feeding has altered diel activity patterns and spatial distribution of stingrays at SCS and has enabled the local density of *D. americana* to increase to atypical levels. Our study suggests that food availability directly influences size and location of core areas of activity as well as population density of southern stingrays. The dramatic shifts in behavior and the altered population structure of stingrays also suggest that the aggregation of stingrays at SCS may alter predator-prey relationships and nutrient cycling, and possibly mating systems within the entire community at this location over long time periods. Supplemental feeding of wild marine animals may potentially alter movement patterns of individuals being fed, modify population structure and may ultimately affect the entire marine ecosystem. Managers charged with regulating existing sites where marine animals are fed by humans and policy makers responsible for management of similar sites established in the future should recognize potential far-reaching impacts of such activities on the local marine environment and take appropriate measures to monitor and if necessary enact mitigation measures.

0758 Fish Conservation, Drummond, Sunday July 27, 2008; STOYE CONSERVATION

Galaxoid Fishes, Remnants of Pristine Patagonian Lakes, and the Ecological Impacts of Invasive Trout

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Galaxoid fishes are the most speciose fish taxon in the sparse freshwater fish fauna of the cold-temperate southern hemisphere and are amongst the most threatened fishes known. Trout, native to the northern hemisphere, have become naturalized in all temperate countries of the south, where they tend to replace galaxoid fishes. These invaders are thought to be responsible for galaxoid declines based on evidence from stream habitats, where trout abundance is often negatively correlated with galaxoid distributions. The impacts of trout in lake habitats, however, are virtually unexplored, and yet lakes have been postulated to act as possible refugia for native galaxoid fishes. We therefore investigate whether lakes provide effective refugia for galaxoids, how trout influence galaxoids in these ecosystems, and whether uninvaded lakes still exist in Chilean Patagonia. Pilot surveys in the Aysén region revealed several uninvaded isolated lakes and ponds, and a strong decrease in galaxoid abundance as the abundance of trout increased in invaded lakes. The most prevalent galaxoid species (*Galaxias platei*) show morphological variation which correlates with the trout-invasion gradient, suggesting strong natural selection and local adaptation. We also examine hypotheses about behaviour and trophic position of *G. platei*, and explore cascading effects in lower trophic levels of lake ecosystems (*i.e.*, zooplankton composition and size). This research will inform how native species adapt to invasive species (if at all), and the ecosystem-level consequences of such interactions. Furthermore, by identifying causal mechanisms driving galaxoid species decline, we hope to initiate conservation efforts for the protection of Patagonian aquatic diversity.

0149 Poster Session II, Saturday July 26, 2008

Feeding Ecology of an Introduced Generalist Frugivorous Fish: The Fate of Pacu in the Sepik River, Papua New Guinea

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Feeding ecology of the Pacu (*Piaractus brachipomus*), a generalist frugivorous Neotropical fish introduced into the Sepik River, Papua New Guinea is analyzed based on specimens collected over a decade after the introduction. We describe the diet of juvenile and sub-adult Pacu from a populated floodplain lake of the East Sepik River and compare it to that of a natural population from the Orinoco River Basin (South America). As in natural populations, introduced Pacu presented

ontogenetic variability in its diet. Individuals between 100 and 200 mm SL preferentially feed on fruits and seeds, fish remains, and vegetable material (other than fruits and seeds). Individuals between 200 and 300 mm SL feed on similar amounts of aquatic plants and fish remains. Pacu over 300 mm SL feed mostly on fish remains, and, to a lesser extent, on aquatic plants. Interestingly, the fish remains found in the stomachs were scales of variable shape and size, teeth, bone, and fin-ray fragments. Remains of other fish guts were found in the stomachs of two large individuals. The nature of these fish remains suggests that the larger specimens of Pacu are relying heavily on carrion. Pacu from the Sepik showed a different diet than that of individuals from the natural population. Although preliminary, this study shows how a species that has large preference for fruits and seeds, and that possesses morphological adaptations to feed on fruits and seeds, can drastically switch its diet under conditions of limited food availability. The results of this study could be used to make predictions on the future of natural Pacu populations after deforestation. Further studies should focus on the feeding ecology of adult Pacu in the Sepik, on populations upstream in the Sepik where there is still riparian forest, and on the potential impact of introduced Pacu to native species.

0094 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008; GRUBER

Elasmobranch Commercial Landings in Portugal from 1986 to 2006, with Virtual Population Analysis and a Method for Evaluating "Supply and Demand"

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Portuguese commercial elasmobranch landings were analyzed for the period 1986 - 2006 and totaled 108.671 ton. An average of 5.175 ton were landed yearly, representing 8 orders, 14 families and 44 species. Annual landings for the fishery generally decreased over time, with a corresponding increase in price per kilogram. The most landed group, Skates (*Raja* sp.), accounted for 33% of the landings, or 35.614 ton. They were followed by Catsharks (*Scyliorhinus* sp.), Portuguese dogfish (*Centroscymnus coelolepis*), Leafscale gulper shark (*Centrophorus squamosus*) and Gulper shark (*Centrophorus granulosus*) (accounting for 12%, 12%, 10%, and 9% of the landings, respectively). In the absence of CPUE data, the comparative trends of landings and price were employed as an indicator of the "status" of specific elasmobranch species. *Raja* sp., *Centrophorus granulosus*, Smoothhounds (*Mustelus* sp.), Torpedo rays (*Torpedo* sp.), Kitefin shark (*Dalatias licha*) and Angel sharks (*Squatina* sp.) displayed indications of possible overexploitation, and merit the focus of future research. The pattern shown by fishing effort over time (i.e. number of fishing vessels over time) displayed a marked decrease, although this was substantially lesser than the decrease shown by landings of the species mentioned earlier. It is unlikely, therefore, that such decrease in landings is justified solely by a decrease in number of fishing vessels. Similarly, the increase in price shown by all species was largely superior to the increase in inflation, which would suggest that the increase in inflation alone would not account for the increase in price. All the

results and data seem to corroborate the notion that some species are, in fact, under over-exploitation and in need of immediate management. These findings were all substantiated by virtual population analysis, which yielded higher fishing mortalities to those species where previous methods suggested overfishing.

0665 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

Molecular Phylogenetics and Biogeography of Wobbegong Sharks (Orectolobiformes: Orectolobidae)

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Wobbegong sharks (Orectolobiformes: Orectolobidae) are dorso-ventrally flattened, demersal sharks that are endemic to the western Indian and eastern Pacific Oceans. They are medium to large in size and are harvested as a food source at several locations throughout their distribution including Australia, China, Japan and Malaysia. In Australia, where they are the most speciose, they are commercially targeted in New South Wales and Western Australia and there is evidence to suggest that populations are declining. This, together with considerable taxonomic uncertainty, has stimulated conservation concern for these sharks. Irrespective of this, there are very few management strategies in place for wobbegongs and available biological information is limited. Morphometric and meristic investigations aimed at answering questions of taxonomy constitute a large proportion of wobbegong research effort. Despite such investment, there has been little focus on the study of species interrelationships or Orectolobid evolution. Furthermore, no prior investigations have adopted a molecular approach to studying these sharks. One component of our work, a molecular phylogenetic analysis of the family Orectolobidae functions to fill this void. Samples of all Orectolobid species (and some undescribed taxa) were collected from Australia and the Indo-Pacific. We obtained genetic information from both mitochondrial and nuclear DNA markers and used the data to reconstruct the evolutionary relationships among wobbegong species. Here, we will demonstrate how our molecular data is inconsistent with the current taxonomic arrangement of the family and go on to describe how these results can contribute to resolving taxonomic uncertainties. We will also propose a biogeographic scenario for the wobbegong sharks that begins with a tropical origin, subsequent colonisation of Australian waters followed by re-colonisation of the tropics.

0116 AES Management, Jarry/Joyce, Sunday July 27, 2008

Productivity and Susceptibility Analysis of Coastal Sharks in U.S. Atlantic and Gulf of Mexico Waters

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Productivity and Susceptibility Analysis, or PSA, is a risk assessment approach useful for evaluating the vulnerability of stocks of different species to fisheries. Depending on data availability, PSA can range from simple qualitative assessments to more detailed quantitative evaluations. We applied a quantitative approach to evaluate the biological productivity and susceptibility to different gears of large and small coastal sharks off the U.S. East Coast and Gulf of Mexico. For the productivity component, we used published biological information to develop Leslie matrices, and incorporated uncertainty in age at maturity, lifespan, and annual age-specific fecundity and survival rates through Monte Carlo simulation. The susceptibility of each species or population to different gear types was evaluated as the product of four sub-components or probabilities: availability, encounterability, selectivity, and post-capture mortality. Availability of the population to the fishery of interest was calculated as the percentage overlap of the range area of the fishery with the range area of the population; encounterability of the population by the gear in question was calculated as the degree of overlap between the population and gear depth ranges; selectivity of the gear was estimated using the mean size at capture and known selectivity curve or the selectivity of a similar species in a similar gear; and post-capture mortality was derived from multiple scientific observer programs that collect information on the status and/or disposition of the shark catch. We plotted productivity and susceptibility paired values to facilitate interpretation, and calculated a risk index based on the Euclidean distance to rank each population or species and help identify those that should receive preferential research and management efforts.

0303 Poster Session I, Friday July 25, 2008

Oceanic Conditions, Chlorophyll-*a* and Zooplankton; Exploring the Reasons for Seasonal Migrations of *Manta birostris* in Southern Queensland Waters.

Lydie Couturier, Kathy Townsend, Scarla Weeks, Michael Bennett

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Manta rays occur in coastal waters around North Stradbroke Island in southern Queensland in the Austral spring/summer, arriving in October and leaving in March. It is hypothesised that the appearance of *Manta birostris* at this site coincides with rising water temperatures and increases in primary production in the coastal waters, leading to zooplankton blooms that provide a rich source of food for these rays. The departure of manta rays is hypothesised to be due to a significant decline

in either the quality or quantity of available zooplankton, and is likely to be correlated with measurable oceanic conditions. We used satellite imaging to map sea surface temperatures and concentrations of chlorophyll-*a* along the Queensland coast and, in particular, around the study sites at North Stradbroke Island throughout the year. Plankton tows were conducted at specific sites where manta rays are known to aggregate seasonally. These tows occurred at the same locations in the months prior to the arrival of manta rays, during their presence and after they had left. Plankton species were identified, counted and the total sample was analysed for lipid content, ash fraction and energetic content on a monthly basis. Information on the presence or absence of manta rays at the study sites was collected to explore possible links with measurable biotic and abiotic environmental factors.

0502 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

How Many Species of Goliath Grouper are There?

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The goliath grouper, *Epinephelus itajara* (Epinephelidae), is an exceptionally large marine fish that inhabits sub-tropical and tropical waters of the Americas and western Africa. Due to a lack of readily observable morphological variation in specimens across its range, goliath grouper have been regarded as a single species, thus challenging paradigms of allopatric speciation. We tested the hypothesis that Pacific and West Atlantic populations constitute a single species by analyzing nuclear and mitochondrial DNA sequence data. We found numerous fixed genetic differences for mitochondrial loci between Pacific and West Atlantic goliath grouper ($d \approx 3.5\%$ at 16S and $d \approx 6\%$ at cytochrome *b*; $\phi_{st} = 0.98$ [$p < 0.001$] for 16S and $\phi_{st} = 0.975$ [$p < 0.001$] for cyt *b*.), and the nuclear S7 intron had three fixed nucleotide differences between Pacific and West Atlantic populations. Within the West Atlantic, we found virtually no genetic differences ($d < 0.01$ at 16S and $d < 0.02$ at cytochrome *b*), but statistically significant population structure ($\phi_{st} = 0.03$ [$p = 0.07ns$] at 16S; $\phi_{st} = 0.139$ [$p < 0.001$] at cytochrome *b*). These data indicate that: (i) goliath grouper in the West Atlantic are likely subdivided into discrete Caribbean and Brazilian populations, (ii) goliath grouper populations in the Pacific and western Atlantic represent at least two distinct species (we resurrect the species *Epinephelus quinquefasciatus* Bocourt 1868 for Pacific goliath grouper), and (iii) morphological and molecular evolutionary rates may not run in parallel and thus may obscure conventional interpretations of these data.

0063 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

No Evidence for Ecological Isolation in Relation to Dissolved Oxygen Regime in an African Cichlid Fish: A Possible Role of Phenotypic Plasticity?

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Gene flow among environments may be reduced via natural selection if well-adapted residents are favoured over mal-adapted dispersers and dispersing alleles, a process termed ecological isolation. However, phenotypic plasticity in ecologically important traits may permit increased gene flow. Here we test for ecological isolation in a species for which high levels of phenotypic plasticity have been observed in ecologically important traits. *Pseudocrenilabrus multicolor* is an African cichlid fish that is found in a wide range of environments, including high-oxygen lakes and rivers, and low-oxygen swamps. Divergent gill morphology is observed between dissolved oxygen regimes, and previous studies have shown that plasticity in gill morphology is high. We use microsatellite data to test for the effects of dissolved oxygen on population structure while controlling for the effects of geographical variation. Specifically, we compare genetic variation within versus among geographical locations and within versus among dissolved oxygen regimes, and test for isolation-by-distance along the waterway. We document that populations are highly structured according to geographical location and isolation-by-distance, but find no evidence that they are structured according to dissolved oxygen regime. We speculate that high gene flow may be permitted between selective regimes due to phenotypic plasticity.

0602 Poster Session III, Sunday July 27, 2008

An Assessment of Presence of Chytrid Fungal Infection in Tiger Salamanders in North Dakota

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No formal analysis has focused on the presence of chytrid fungus in salamanders in North Dakota. In ongoing attempts to determine amphibian population abundances and xenobiotic influence on amphibians, we analyzed tail tissue and skin swabs (n = 80) for *B. dendrobatidis* from eight tiger salamander (*Ambystoma mavortium*) populations from North Dakota. Tail clips were preserved in 70% ethanol and stored in a -80°C freezer. Populations represent areas in northwest, north-central, southwest and the turtle mountain regions of North Dakota where the Amphibian Growth Project has ongoing life history analyses. At present, at least one individual from each sampling location has been analyzed. Ten individuals from each location

will be assessed. Initial results have shown no indication of chytrid presence in analyzed populations.

0095 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Movement Patterns and Habitat Preferences of Ten *Mobula japonica* Tagged in the Gulf of California, Baja California Sur, Mexico

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Mobulid rays are the subject of an intensive and expanding artisanal fishery in the Gulf of California. Anecdotal reports suggest that populations in the Gulf of California have declined dramatically over the last 20 years. *Mobula japonica* is a pan-tropical species that appears in the Gulf of California seasonally and is listed as near threatened in the 2007 IUCN Red List of Threatened Species. Our research is focused in this region and on this species because they are relatively abundant, can be reliably sampled, and are the subject of directed and bycatch fisheries mortality in artisanal and purse-seine fisheries in the region. *M. japonica* occurrence seems to coincide with the large influx of warm water apparent each spring. However, it is unlikely that this summer increase is caused by migration, as their increase in abundance is simultaneous both in tropical and warm temperate waters. It is more likely that mobulid rays disperse offshore or move to deep waters during the winter in tropical and warm temperate areas but seasonally aggregate in certain locations of high prey density, such as the waters offshore of the Baja California Peninsula, making them highly vulnerable to intensive fisheries in the area. Ten *M. japonica* were tagged with Pop-Up Archival tags near La Paz in the Gulf of California during 2004 - 2006. Preliminary results indicate that *M. japonica* move out of the Gulf and into the Pacific during late summer/early fall. Resolving these seasonal movement patterns and aggregating areas are key to the conservation of this species.

0065 Herp Systematics, Drummond, Friday July 25, 2008

On The SSAR Names List

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There have been three scientific and standard English names lists published by the SSAR that were additionally endorsed by the HL and ASIH. Criticism and disagreement have been expected with publication of these lists and I have not been disappointed. The purpose of this talk is to try clarify several things about the list, such the charge of the committee, how the list is put together, and how the list is reviewed. Concepts of consensus and authority will also be examined.

0137 Poster Session I, Friday July 25, 2008

Preliminary Study on the Age and Growth of the Spinetail Mobula, *Mobula japonica*, (Müller and Henle, 1941), with Comments on its Vertebral Column Structure

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This study provides the first information on the age and growth of any species of the *Mobula* genus, and contributes to the knowledge of the life history of *Mobula japonica*. We analyzed 55 longitudinal vertebral sections from organism caught in southern Gulf of California. Disc width (organism's size, DW) ranged between 1095 mm to 2400 mm. Using dissection and radiographic analysis of the vertebral column, we found that vertebrae only appeared at the posterior region, being the most adequate for age determinations the vertebrae below the dorsal fin. We found a significant linear relationship between disc width and vertebral size (radius), suggesting a proportional growth. In order to enhance the growth bands in the vertebrae, a modification of the Violet Crystal staining technique was used. The average percent error (APE) and the percent of agreement (PA) between readers were high. The oldest observed age was 14 bands (female with 2300 mm DW), while the youngest was 1 band (female with 1210 mm and a male of 1390 DW size). The preliminary von Bertalanffy growth equation estimated was $DW_t = 2338.07 (1 - e^{-0.2771(t - 1.676)})$.

0681 Poster Session II, Saturday July 26, 2008

**Field Evidence of Unpalatability of Northern Red Salamanders,
*Pseudotriton ruber***

Paul Cupp

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Two separate incidental observations provide evidence that northern red salamanders, *Pseudotriton ruber*, are unpalatable to some predators. In similar instances the salamanders were found lying on a rock beside a creek in Rockcastle Co., KY and had been severely injured. They apparently had been placed on the rock by predators that were unable to eat them. The first *P. ruber*, found on April 29, 1990, had bite marks over much of the body and part of the right leg had been ripped off with the humerus remaining. Obvious severe injuries were present on the upper left side of the trunk. There were no apparent injuries to the head or tail. The second *P. ruber* was found on September 22, 1994 within the same vicinity in the same creek as the previous animal. Only one bite mark was obvious on the right side of the head, and the cloacal vent and hindlimbs had a deeper red color. Both *P. ruber* ceased all movements and died within five hours of the initial observations. These observations support previous proposals that these salamanders are distasteful to some predators. Predators may learn to avoid such encounters and other red salamanders would benefit.

0363 Poster Session I, Friday July 25, 2008

Management of Skate Fisheries off the Northeastern United States

Tobey Curtis

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A number of skate species (Family Rajidae) are widely distributed across the continental shelf off the northeastern United States, and are subject to fishing mortality in the region's extensive commercial fisheries. Historically, skates were commonly caught as bycatch in trawl and dredge fisheries targeting other, more valuable species, such as cod, flounder, monkfish, and sea scallops. Catches were largely discarded. In recent years, however, the value of skate products has increased in domestic and foreign markets, resulting in increases in landings and the emergence of localized targeted fisheries. In response, the New England Fishery Management Council (Council) drafted the Northeast Skate Complex Fishery Management Plan (FMP) that was implemented by the National Marine Fisheries Service (NMFS) in 2003. The FMP included management measures for seven skate species: winter (*Leucoraja ocellata*), barndoor (*Dipturus laevis*), thorny (*Amblyraja radiata*), smooth (*Malacoraja senta*), little (*Leucoraja erinacea*), clearnose (*Raja eglanteria*), and rosette (*Leucoraja garmani*). Among its measures, the FMP included establishment of an open access Federal permit to possess skates, biological reference points for determining stock status, prohibitions on possession of overfished skates (barndoor, thorny, and smooth skates), possession limits for the skate wing fishery,

and an exemption program for vessels targeting small skates for bait markets. In 2007, NMFS declared that winter skate had become overfished, triggering the need to initiate Amendment 3 to the FMP, which would establish a stock rebuilding program for winter skate, and contribute to the rebuilding of other overfished skate stocks. The amendment is currently under development by the Council, but progress has been hampered by a lack of data on skate biology, population dynamics, and species-specific trends in fishing mortality.

**0247 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY**

Genetic Diversity Reveals a Cryptic Evolutionary Lineage in *Sphyræna barracuda*

Toby Daly-Engel

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The management of the world's highly vagile reef predators requires an understanding of population connectivity and the identification of cryptic evolutionary lineages. Current taxonomy indicates a single species of the great barracuda, *Sphyræna barracuda*, but differences in coloration and behavior are apparent between Pacific and Caribbean forms. To evaluate the evolutionary depth of these differences, we conducted a global phylogeographic survey using a 629 base pair fragment of the mitochondrial cytochrome *b* gene. These data indicate two colonization events from the Indo-Pacific to the Atlantic via southern Africa. The samples of East Atlantic barracuda all contain a single unique haplotype nested within a network of Indo-Pacific haplotypes, indicating a recent invasion from the Indian Ocean, possibly after the most recent glacial period. The Caribbean population is distinguished by 1.1-1.9% sequence divergence, indicating an older colonization to the western Atlantic on the order of 500,000 – 900,000 years ago. Both colonization events may have been facilitated by cessation of the cold water upwelling on the Atlantic coast of southern Africa and intrusion of tropical Indian Ocean water into the Atlantic at the end of each Pleistocene glaciation. The highly divergent Western Atlantic population represents a previously unrecognized evolutionary lineage within *S. barracuda*.

0633 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008; STOYE PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY

Long-term Thermal Biology of the Gila Monster in the Sonoran Desert: What A 500,000-Hour Thermal History Tells Us about Thermal Preference and Organism Performance

Jon Davis

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Availability of thermal energy is a physical property of the environment that influences evolution of organisms since nearly all biological processes (from enzyme kinetics to digestion to reproduction) are temperature sensitive. In ectothermic animals, environmental temperatures directly influence body temperatures and thus organism performance. I used radiotelemetry and surgically implanted temperature dataloggers to examine the long-term thermal ecology of the Gila monster (*Heloderma suspectum*), a large desert lizard, in nature. I recorded hourly body temperature of 16 to 40 lizards semi-continuously from 2003-2007 resulting in a thermal profile for this species composed of nearly 500,000 body temperatures. I assessed thermal preference seasonally and during surface activity and inactivity (i.e., when in a refuge) and also conducted a series of laboratory experiments to assess the thermal sensitivity of key processes that affect foraging ability and immune function. I found that walking endurance, olfactory ability, and wound healing rate are temperature sensitive with better performance occurring at 25 and 30 °C, near the species' 29 °C preferred body temperature, and poorer performance occurring well below (20 °C) and above (35 °C) preferred body temperature. Gila monsters live at relatively cool temperatures (<30 °C) 75 % of their lives and strongly avoid body temperatures above 34 °C. Overall, the species spends 50 % of its life near (± 3 °C) preferred body temperature, and thus, performance of many physiological functions is likely optimized.

0639 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Urbanization and Immunology: Injury Incidence, Wound Healing, and Hematology of Urban And Natural Gila Monsters in The Sonoran Desert

Jon Davis

Arizona State University, Tempe, AZ, United States

Understanding the effects that urbanization has on wildlife populations is a central concern facing contemporary biologists. Most studies have assessed the effects of habitat alteration or introduced competitors and predators on birds and mammals, yet other important issues and taxa have received less attention. I examined the effects that urbanization has on injuries, hemoparasites, and immunocompetence of free-ranging Gila monsters (*Heloderma suspectum*) at natural and urbanized field sites in the Sonoran Desert. I quantified the types of injuries and frequencies of occurrence and measured wound healing rate in the field to determine if differences exist between the populations. I also examined blood smears to determine hemoparasite prevalence and strength of innate immune response of lizards at both sites. Results

indicate higher incidence of both injuries and hemoparasite infections in urban animals compared to natural animals despite urban animals being in better overall body condition. The results of this study reveal effects of urbanization on a long-lived lizard that have not previously been reported.

0346 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Placement of the Goatfishes (Perciformes: Mullidae) Within an Acanthomorph Context Using RAG1 and a Total Evidence Analysis of Mullid Interrelationships

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The goatfishes (Family Mullidae) comprise a group of tropical and temperate marine perciform fishes characterized by a pair of moveable sensory hyoid barbels used to locate food. Previous investigations of acanthomorph relationships have not been structured to explicitly place Mullidae. We selected the single-copy nuclear gene RAG1 to elucidate the position of Mullidae within Acanthomorpha under parsimony, Bayesian, and maximum likelihood frameworks. In addition, to date, no comprehensive molecular investigation of genera within the family has been performed. Phylogenetic interrelationships among all six genera of goatfishes were reconstructed using a total evidence approach with molecular data from the nuclear genes RAG1, *zic1*, *myh6*, and *ENC1* and the mitochondrial COI gene in combination with previously-published morphological characters. The results of these analyses, performed using both parsimony and Bayesian criteria, were compared with the results of a molecular data-only hypothesis.

0401 Poster Session I, Friday July 25, 2008

A Morphological Investigation into a Potential New Species of *Moxostoma* (Cypriniformes: Catostomidae) from the Kansas River Basin

Matthew Davis, Gloria Arratia

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Taxonomy of the North American redhorses, particularly the genus *Moxostoma* (Cypriniformes: Catostomidae), has been widely studied and revised numerous times. The observed presence of few morphological differences among several species in the genus *Moxostoma* have previously made the diagnosis of individual species problematic. Specimens of *Moxostoma macrolepidotum* from the Kansas River basin have previously been regarded as hybrids or intergrades between *M. macrolepidotum* and *M. pisolabrum* based on the size of the upper lip, which is described as being developmentally larger than those of *M. macrolepidotum* at the same relative age, but thinner than *M. pisolabrum* and lacking any presence of a pea

shaped bulb that characterizes the lips *M. pisolabrum*. Recent work using geometric morphometrics has identified that the putative hybrid specimens represent a distinct morphotype for the lip width character and are potentially a new species (*M. cf. macrolepidotum*). We further examine the morphology of *M. macrolepidotum*, *M. pisolabrum*, and *M. cf. macrolepidotum* in order to evaluate the potential elevation of *M. cf. macrolepidotum* to species level status. Specimens examined included whole alcohol preserved and specimens cleared and stained for bone and cartilage.

0388 General Ichthyology I, Drummond, Saturday July 26, 2008

A Geometric Morphometric Study of Photophore Patterns in Lanternfishes: Species Recognition, Mate Recognition, Neither, or Both? (Scopelomorpha: Myctophidae)

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Lanternfishes (family Myctophidae) comprise approximately 238 species of small mesopelagic and bathypelagic fishes that possess a highly diverse array of light organs. They are among the most abundant and speciose groups of deep sea fishes and play a critical role in the oceanic food web. The complex patterns of photophore and other light organs arranged on the head, ventrolateral body, and caudal region have previously been hypothesized to play a number of evolutionary roles, including species recognition, sexual selection, and camouflage. We use geometric morphometric procedures to quantitatively test three hypotheses as follows: (1) That the position of ventrolateral photophores plays a role in species recognition. (2) Intraspecific variation in ventrolateral photophore pattern is correlated with sex. (3) If variation in ventrolateral photophore pattern is sex-dependent, it is correlated with other sexually dimorphic characteristics. (e.g., caudal luminous organs).

0340 Poster Session I, Friday July 25, 2008

Management of Manta Ray (*M.birostris*) Interactive Tours in the Shallow Lagoonal Waters of Ningaloo Reef, Western Australia - A Global Benchmark for Tourism Interactions

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A comprehensive 'Code of Conduct' for manta ray interactions is being implemented at Ningaloo Reef Western Australia to reduce unnecessary pressures upon manta rays and ensure the long term, year-round sustainability of eco-tourism. In the shallow lagoonal waters of Bateman Bay, interactive snorkelling tours to swim with manta rays have become so popular that they take more people per annum than those targeting the iconic whale shark. Commercial operators use light planes to locate manta rays within the <50km² bay, where they can be observed year-round targeting specific food items, mating and giving birth. Current pressure is significant and potential for further increases in pressure is high. The tourism industry is concerned with current pressures and there have been several incidents where mantas have physically rammed or breached upon swimmers. In response to this, the WA Department of Environment and Conservation with community consultation has formulated a 'Code of Conduct' for manta ray interactions. This follows on from the highly successful Western Australian Closed Season Notice for Whale Sharks (CSNWS), (a legal mechanism to control interaction activities) which has become a global benchmark. The 'code of conduct' for manta ray interactions includes conditions similar to the CSNWS such as minimum distances, time limits, and controls of total passenger and in water numbers. It also has specific clauses to protect 'cleaning stations' and mating aggregations. It is hoped that implementation of this code for manta rays will ensure a sustainable in-water viewing industry and allow manta rays to continue visiting important habitats (such as Bateman Bay in the Ningaloo Reef Marine Park) with minimal interference.

0302 Poster Session I, Friday July 25, 2008

Observation and Sighting Description of the *Manta Birostris*, in BoraBora Island (French Polynesia - South Pacific)

Moeava de Rosemont

NOAA, California, United States

Manta *Birostris* are permanent resident inside BoraBora's lagoon. In order to know more about its population, an ID program and a sighting survey have been monitored since August 2002 till June 2005. The method: each dive has been done with a digital video equipment to record mantas behaviour. Then the footages are played to identify (when it is possible) the black belly pattern of each individual. Each new manta sighted has its own file and every interesting behaviour is archived on tape. In June 2005, we did formally identified 43 females and 42 males. With this

empiric method and recurrent sightings, we discovered that there was a resident colony inside the lagoon, and some mantas cruising the lagoon occasionally, mostly during the mating season. In the same time, as we could regularly sight the same individuals, we could deduce that the pregnancy time does not exceed 12 months. Other basic biology have been monitored as the growth of a new born manta ray, the healing process (when wounded) and the question of the albinos individuals. Some interrogations have occurred as the presence and use of pheromone mostly during the mating process. Since June 2005, the Mantas have disappeared from the place they used to clean, and the survey has been interrupted. Hotels constructions nearby and tourism activities are probably one explanation. Fortunately, they came back since July 2007 and we hope that we will be able to assist again to the manta's mating dances for the next season.

0129 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Demographics of an Island-Associated Manta Ray (*Manta birostris*) Population in Maui, Hawaii, and Implications for Management

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During 2005 - 2007, 187 individual manta rays were photo-identified from a single cleaning station site in Maui, Hawaii. A discovery curve showed no asymptotic trend, indicating the number of individuals using the site is considerably larger than the total identified. Of these individuals, 58% were observed on more than one occasion within and across years, suggesting philopatry to this area. Males accounted for 47% of the individuals in the population, of which 69% were considered sexually mature based on the claspers extending beyond the pelvic fins. The average encounter rate per dive was 5.50 manta rays per hour. They were habitually absent at first light, with encounter rates increasing throughout the day. No matches were found when compared against 133 individuals photo-identified from a well-studied population off the Big Island (www.mantapacific.org), a distance of only 60 miles. Evidence of shark predation was seen in 12% of the population, and 6% had a missing or non-functional cephalic fin, likely caused by entanglement in monofilament fishing line. During an intensive survey period from September to December 2007, a mean of 140 individuals (95% CI = 119-175) was estimated to be using the area at this time. Estimated annual apparent survival (survival minus emigration) was 0.77 (95% CI = 0.65 - 0.86). These findings are consistent with a population of manta rays moving into and out of the cleaning station vicinity, with a varying portion of the total population temporarily resident at the study site at any given time. These findings add further support to the existence of demographically independent, island-associated populations in Hawaii. The lack of protection for these populations makes them vulnerable to impacts from target and non-target

fisheries, and from exploitation of manta ray aggregation sites by commercial scuba diving operations. Management on an island-area basis is recommended.

0128 Poster Session I, Friday July 25, 2008

Using Paired-Laser Photogrammetry for Measuring Manta Ray (*Manta birostris*) Sizes. Are Maui's Mantas Horizontally Challenged?

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Paired-laser photogrammetry was used to measure the disc width (DW) of 78 manta rays (*Manta birostris*) from a nearshore Maui population. The mean ratio of DW to disc length (DL) for 43 of these individuals was 2.30 (N=43, SD=0.10). The mean ratio for mature males (determined by the claspers extending beyond the pelvic fins) was not significantly different than that for immature males ($t(14)=0.59$, $p=0.56$) indicating that the DW to DL proportion remains constant throughout development. DL measurements were more reliable and more easily obtained than DW measurements using paired-laser photogrammetry. Given this, DL measurements were used and converted to the more conventional DW measurement equivalent using the ratio of 2.30. Female DW ranged from 2.42 m to 3.70 m (mean=3.22 m, N=40). The maximum female DW in this population is 25% smaller than the maximum reported for a female in Indonesia (White et al., 2006), and as much as 59% smaller than that reported in other parts of the world (Last & Stevens, 1994). Male DW ranged from 1.98 m to 3.18 m (mean=2.80 m, N=33). The maximum male DW in this population is 22% smaller than the maximum DW reported for a male in Indonesia (White et al., 2006). Males were sexually mature at a DW greater than 2.79 m, (N=20), 26% smaller than what has been reported for males in Indonesia. These results support paired-laser photogrammetry as a non-invasive and precise method for sizing manta rays in the field and suggest that manta rays in Maui mature and grow to a much smaller body size than what is observed in Indonesia and other populations worldwide.

0712 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

Micro-mechanics and Material Properties of the Tessellated Skeleton of Cartilaginous Fishes

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The natural history of many sharks seems paradoxical: their long lives and swimming styles demand large numbers of cyclic loading cycles on their cartilaginous skeletons and yet cartilage cannot repair. Fatigue damage is

proportional to the number of loading cycles and the strain energy in each cycle, so sharks should be subject to large amounts of irreparable fatigue damage. There are several ways that structures can avoid this type of damage: either overbuilding (the excess safety factor decreases strain energy) or having some properties, which allow strain energy to dissipate. The former may well be occurring though we do not know of any evidence that cartilaginous skeletal elements have a larger safety factor than bony ones. We do have evidence, however, that elasmobranch skeletons are inherently fatigue-resistant and that this is a function of the type of calcification of the tissue. The uncalcified hyaline-like cartilage core of each element is overlain by a tessellated bark of abutting mineralized tiles (tesserae), adjoined by a fibrous phase. Nanoindentation tests show that the mineralized tissue behaves nearly elastically and is more than two orders of magnitude stiffer than the uncalcified layer, which is highly viscoelastic. In comparison with compact bone, which has a damping coefficient of 0.009 and spongy bone (0.0552) tessellated cartilage has a damping coefficient of 0.085. This is the same as unmineralized cartilage (0.085) but the tissue is far stiffer. A Reuss isostress model of a composite beam in bending shows that the compressive side is loaded more than the tensile side shifting the strain energy into a more difficult to damage loading regime. In this way, the tiled and calcified design of tessellated elasmobranch cartilage inherently allows for growth and fatigue-resistance in a skeleton that cannot remodel.

0413 Poster Session I, Friday July 25, 2008

Dentition of the Southern Thorny Skate, *Amblyraja doellojuradoi* (Pozzi, 1935): Qualitative Analysis and Anomalies

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Dentition analysis of cartilaginous fishes is an important tool for determining species, establishing phylogenetic relationships between extinct and living taxa, and describing ontogenetic morphological changes. This work constitutes the first description of *Amblyraja doellojuradoi*'s dentition. The jaws (n = 72) were extracted, cleaned and prepared with two different treatments. Some of them were dried and whitened with 30% diluted hydrogen peroxide; while the tooth plates of others were taken and pasted on a vegetal paper. In the Southern thorny skate the dentition was gradient monognathic heterodonty. In the upper jaw, the symphyseal teeth and approximately the two rows on both sides of them have low cusps, but their size increases in lateral teeth and reduce again in the commissural teeth. In the lower jaw, the cusps from the symphyseal teeth are larger and arched, reducing their size to the commissural teeth. *A. doellojuradoi* presented ontogenetic heterodonty, having the juvenils cusps with little development, while adults have too much developed and sharp-pointed cusps. This ontogenetic change was manifest both in males and females, although in the first one was more conspicuous. Two kind of anomalies were observed in some specimens: (1). an additional incomplete row between two complete rows, and (2) an increasing tooth base size and division of their cusp until the tooth divided completely in the same row. Gradient monognathic heterodonty as

well as ontogenetic heterodonty is common in skates' dentition. Indistinct sexual heterodonty observed in *A. doellojuradoi* was also recorded in *A. radiata* and *Dipturus batis* whereas other species exhibit marked sexual heterodonty or absence of heterodonty. Regarding anomalies in tooth arrangement, this is the first record of that kind of malformation in skates' dentition.

0259 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Asymmetrical Reproductive Isolation between Terminal Forms of the Salamander Ring Species *Ensatina eschscholtzii*

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Salamanders of the *Ensatina eschscholtzii* complex have featured prominently in evolutionary biology because they represent one of the few examples of a ring species. The nature and extent of reproductive isolation between the terminal forms (*E. e. eschscholtzii* and *E. e. klauberi*) is paramount to the ring species interpretation and to unresolved taxonomic debates about the number of species within the complex. Previous analyses of four contact zones between these taxa have revealed geographic variation in levels of hybridization, ranging from complete reproductive isolation to rare hybridization restricted to narrow hybrid zones. Here, I report frequent hybridization at one contact zone (Palomar Mountain, San Diego Co., USA) and document levels and direction of gene exchange and introgression. I genotyped 173 salamanders for nine microsatellites and one mitochondrial gene and used a Bayesian model-based clustering algorithm to classify individuals as belonging to pure parental or hybrid classes. A higher proportion of hybrids (37/173=21%) was detected than had been reported previously. No F1 hybrids were found; most hybrids were classified as F2s or backcrosses with *eschscholtzii*. All 37 hybrids possessed mitochondrial DNA from only one of the two parental forms (*klauberi*). The substantial frequency of hybrids along with mtDNA results indicate that reproductive isolation is incomplete and asymmetrical, with hybrids formed from female *klauberi* mating with male *eschscholtzii* (but not vice versa) and female hybrids mating with male *eschscholtzii*. These results inform ongoing debates about species boundaries in *Ensatina*, and provide predictions for patterns of behavioral isolation in this and other contact zones between the terminal forms of the ring.

0267 Herp Conservation, Salons 4&5, Sunday July 27, 2008; STOYE
ECOLOGY & ETHOLOGY

**Reductions in Metamorphic *Bufo americanus* Survivorship Associated with
Invasion by an Exotic Plant**

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Habitat loss is considered to be a key causal factor in losses of native biodiversity around the world, while the habitat that remains faces a growing threat from invasion by exotic species. Despite the fact that some of the most successful and widespread of these exotics are plant invaders, and the habitat alterations they initiate can be extensive, there is little information on the impact of plant invasions on native fauna. One common exotic plant in the eastern United States is the Asian grass *Microstegium vimineum*; this plant invades habitats where amphibians are commonly found, such as forests, wet meadows and bogs. In order to evaluate the effect of these invasions on amphibian survivorship we constructed 16 enclosures, one on either side of eight independent *M. vimineum* invasion fronts, into each of which we released 100 metamorphic American toads (*Bufo americanus*) in two cohorts of 50 toads each. These cohorts were separated based on time to metamorphosis, with the release of the second cohort occurring two weeks after that of the first. Survivorship estimates conducted six weeks later revealed that the survivorship of the first cohort was significantly lower in invaded pens ($p=0.015$), while there was no significant effect of invasion on the second cohort ($p=0.515$). Our results indicate that invasion by exotic plants can negatively affect amphibian survivorship, perhaps through the loss of food resources or changes in the environmental structure, but that these effects may be mediated by the timing or condition of these animals as they enter the terrestrial environment. As amphibian populations are especially sensitive to reductions in survivorship during their terrestrial life phases, increases in mortality occurring during these stages may represent a significant threat to amphibian biodiversity.

0626 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

**Movements and Site Fidelity of *Manta birostris* in the Komodo Marine
Park, Indonesia**

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To examine the movements of manta rays in the Komodo Marine Park, Indonesia an acoustic array was installed at up to seven sites in the park between 2000 and 2003. A total of 41 acoustic tags were deployed in three separate deployments. Mantas were recorded in the park for up to 526 days with an average duration of 183 days (± 136 days) when mantas made from 3 to 303 individual visits to different sites (median 58

visits). There was a clear preference for three sites that comprised over 90% of manta activity. The most popular site (German Flag) was off the southern tip of Komodo Island in an area with a high degree of bathymetric structure. Examination of the longest records suggests some site preference with 5 of 7 individuals spending greater than 90% of their time at the location where they were tagged. Using a general linear model it was possible to examine the effects of daytime, lunar phase, aggregation site, season and tidal phase on visitation patterns. The vast majority of visits were recorded during daylight hours at all sites. The strongest effects of both the lunar and tidal phase were apparent in the northern sites with the most visits occurring when tidal intensity was the greatest during full and new moons. The strongest seasonal pattern was observed in the south where no mantas were recorded during the first quarter in any year. This coincides with a regional increase in temperature and reduction of productivity associated with monsoonal shifts. This study improved the predictability of manta visitation patterns, which will increase the success of manta-based ecotourism. The long-term fidelity indicates that marine protected areas centered around aggregation sites is one tool that could help protect this species from overexploitation.

0669 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

The Venn of Phenotype—Method to Fuse and Contrast Geometric and Traditional Morphometric Data, Exemplified with African Cichlids

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Partial least squares (PLS) has become common in morphometrical analysis. We review current uses of PLS in morphometrics and extend this method to fuse traditional and geometric morphometric data blocks. We first scale each data block to unit size, then use PLS to extract the “cross variance” (covariance across blocks), which we term ‘shared’ variance. Shared variance allows comparison (focus on similarity) of blocks; it can be thought of as the overlap or redundancy of two data blocks. ‘Unique’ variance is the remainder of variance, which we obtain by orthogonalization of original data blocks to the shared block. Unique variance allows contrast (focus on differences) between blocks. The shared and unique variances conceived in this manner can be expressed as a Venn diagram, where shared variance is the overlap and unique variance is the “half-moons” of nonoverlap in the diagram. We demonstrate our conceptual framework and method using traditional and geometric morphometric data from two species of African cichlid fishes (*Sarotherodon melanotheron*, *S. galilaeus*). We found that shared variance between traditional and geometric morphometrics was approximately 50%. So approximately half the phenotypic information from the two methods was redundant (shared) and half was information unique to each method. Meristic information, for example, loaded heavily on unique variance vectors for traditional

morphometrics. Our method presented allows for complete dissection (comparison and contrast) of variance contributed by two dissimilar data blocks. More generally, this method can fuse and facilitate comparison and contrast in any multi-block data problem, morphology or otherwise.

0670 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

Divergent Selection Creates Parallel Population Differentiation and Phenotypic Plasticity—Livebearing Fishes Diversified across Predation Gradients

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Predators often drive phenotypic diversification of prey. In livebearing fishes, the fitness gradient imposed on body shape by predators has driven population differentiation into “fast” and “slow” swimming morphologies (*Am. Nat.* 164:335-49). But do populations differ in morphology due to canalized genetic differentiation, phenotypic plasticity, or both? A previous result (*Evolution* 58:2305-18) demonstrated strong quantitative genetic differentiation and cast doubt there was any room left for plasticity to contribute to the diversification observed in nature. Here, we report results of a reciprocal common garden rearing study which tested for predator-induced morphology in prey fishes. Livebearing fish of three species (*Brachyrhaphis rhabdophora*, *Gambusia affinis*, *Poecilia reticulata*), from populations containing or lacking native piscivorous fishes, were raised in both the presence and absence of predators (*Parachromis dovii*, *Lepomis cyanellus*, *Crenicichla altifrons*). Resulting prey morphology was assessed using geometric morphometrics. Prey exhibited phenotypically plastic morphology induced by predator cues. Furthermore, the axis of plasticity through trait space paralleled both the fitness gradient and genetic differentiation. Such parallelisms, for reasons we will detail, are a hallmark of divergent natural selection. This study system suggests that divergent selection so strongly structures the architecture of phenotypic variation, that the signature of diversification is echoed at several levels of the biological hierarchy, including developmental (plasticity, allometry and developmental noise) and phylogenetic (among family, population and species differentiation) axes.

Estimating Heritability of Life-history Traits in a Natural Population of Lemon Sharks (*Negaprion brevirostris*) Using Long-term Pedigree Data

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Determining the genetic basis of phenotypic traits is central to our understanding of evolution and conservation of natural populations. This requires accurate knowledge of the relatedness among sampled individuals, which is a rarity for most marine systems. We address this issue by performing quantitative genetic analyses on a natural population of lemon sharks (*Negaprion brevirostris*) from a nursery site at Bimini, Bahamas. We specifically test whether genetic differences can explain the observed divergence in early life history traits between juvenile sharks from Bimini, and those at other surveyed nursery sites in the western Atlantic (*i.e.*, Marquesas Key, Florida; Atol das Rocas, Brazil). Indeed, Bimini sharks are selected to be smaller at age and slower growing than other populations of lemon sharks, but it remains to be seen whether these trait differences are genetically or environmentally determined. Here, we use newly developed litter reconstruction methods based on microsatellite data to generate a long-term pedigree (1991-2007) for Bimini sharks containing 112 dams, 358 sires, and nearly 1400 offspring. The heritability of size (*i.e.*, body length and mass), condition, and growth was estimated using a restricted maximum-likelihood "animal model", which accounts for potential confounding factors (maternal and environmental effects). Power and sensitivity analysis were also performed to help define the apparent bias and precision of our methods. That is, we estimated the power of our pedigree to detect significant heritability, when present, as well as simulated the effects of parental genetic misassignment on our ability to recover quantitative genetic parameters. This study advances knowledge in this area as the genetic and environmental influence on morphological traits has rarely been studied under natural conditions, and never before in a large marine vertebrate.

0579 Fish Ecology II, Salons A&B, Monday July 28, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Development of the Slow-Twitch Oxidative Myotomal Muscle in the Yellowfin Tuna (*Thunnus albacares*)

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In most fishes, the slow-twitch muscle (SM) that powers sustained swimming is located in lateral wedges just under the skin. Tunas, which elevate their SM temperature above ambient water temperature by conserving metabolic heat using vascular counter-current heat exchangers, have more medially positioned SM. This study investigated the development of SM in juvenile yellowfin tuna, *Thunnus albacares*. *T. albacares* samples ranging in fork length (FL) from 40 to 74 mm were hatched, cultured, and frozen in liquid nitrogen at the Inter-American Tropical Tuna Commission laboratory at Achotines Bay, Panama. Larger juvenile *T. albacares* (118-344 mm FL) were collected by hook and line off of Oahu, Hawaii, and were frozen at -80°C. Fish were sectioned with a cryostat at positions along the body representing 50%, 60%, and 70% FL. SM fibers were identified by staining for the mitochondrial enzyme succinic dehydrogenase and with SM-specific antibodies. The Scion Image analysis program was used to measure the cross-sectional area of SM in each section. The amount of SM as a percentage of total cross-sectional area (% SM) at 60% FL, the position of the maximum % SM in adults, was calculated. As fish increased in length, the total amount of SM at 60% FL increased exponentially and % SM at 60% FL gradually increased. The proportion of the SM cross-sectional area that was medial, not contained in the lateral wedge, increased significantly with FL. At 60% and 70% FL the SM position was similar, but most of the SM in the 50% cross-section was adjacent to the horizontal septum. As the amount of SM increases with size, so does the potential for heat production, which is important for maintaining stable elevated SM temperatures when entering cooler waters to search for prey. Thus, the development of SM may affect the distribution of *T. albacares*.

0384 Poster Session I, Friday July 25, 2008; CARRIER

Three Dimensional Escape Response in the White-spotted Ratfish, *Hydrolagus colliei*

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Escape responses are vital to the survival of prey during predator-prey interactions. This study documented the kinematics of the escape responses of white spotted ratfish, *Hydrolagus colliei* (Chimaeriformes). Three *H. colliei* (345-460 mm TL) were trawled off the coast of San Juan Island, WA and housed in flow through aquaria at the University of Washington, Friday Harbor Laboratories. Seven escape responses were elicited with a forceful tap on the caudal region and recorded using a high

speed camera at 250 fps. The video sequences were digitized for both lateral and dorsal views, obtained simultaneously from a mirror suspended at a 45° angle above the tank. Video analysis was based on displacement of center of mass, calculated from straightened frozen specimens. Escape responses generally included a large vertical excursion which corresponded to $77 \pm 14\%$ (mean \pm SEM) of the horizontal displacement. Large vertical excursions in escape locomotion are relatively unusual in fish, although they have been observed in previous work (e.g. hatchet fish, *Carnegiella strigata*, and knifefish, *Xenomystus nigri*). The potential advantages of this type of response may lie in eluding predators that have little vertical maneuverability. The average latency time to response was about 200 ms (108- 332 ms), which is higher than the latency values commonly observed in teleosts (10-50 ms). This was unexpected, since ratfish are the only chondrichthyans whose adults are known to have Mauthner cells, the giant neurons largely responsible for the fast response time. The average head turning rate during stage 1 was 1515 ± 548 deg. s⁻¹, which is in line with results on other fish. Maximum acceleration was 75.3 ± 19 m s⁻² and maximum speed was 3.01 ± 0.45 m s⁻¹. Overall, locomotor performance appears to be higher than that observed in the only other chondrichthyan species studied (*Squalus acanthias*).

0050 Fish Physiology, Salons 6&7, Sunday July 27, 2008

Markers of Hypoxic Stress in Fishes: A River Restoration Evaluation

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The Kissimmee River in central Florida was once a winding river with an expansive floodplain, but was channelized in the 1960s to provide flood control. Channelization led to seasonal hypoxia which caused a shift in relative abundance of fish species. The river has since been partially restored, and therefore provides an ideal site to study biomarkers and their value in assessing environmental restoration success. Hypoxic stress in fish can cause organismal and ecological disruptions and alterations. The stress response can be divided into two categories: the physiological stress response includes the release of cortisol and monoamines and the cellular stress response refers to the upregulation of heat shock proteins (Hsp). Few studies have looked at the correlation between the two in fish. For this study, various stress markers were analyzed, including brain monoamines, heat shock proteins, and plasma cortisol. Samples were collected from hypoxia sensitive fishes, the largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*), then contrasted with air-breathing fishes, the Florida gar (*Lepisosteus platyrhincus*) and bowfin (*Amia calva*). Fish were collected from at three sites throughout the year. Statistical analysis (MANOVA) showed overall significantly higher stress response in hypoxic game fish than those in normoxia. Specifically, there were significantly higher hsp72 levels, DOPAC, and Dopamine turnover (DOPAC:DA) found in game fish collected in hypoxic waters. Hsp60 and cortisol was significantly higher only in hypoxic bass while serotonin and 5-HIAA were significantly higher in hypoxic bluegill sunfish. On the other hand, air-breathing fish did not show higher stress

levels during hypoxia. The cellular and physiological responses could not be correlated, perhaps because the rise and fall of hormones and Hsps do not coincide. Overall, this study suggests that game fish will surely benefit from a fully restored river as lower stress levels correlate to better growth and reproductive success.

0216 Herp Systematics, Drummond, Friday July 25, 2008

Can Reptile Species be Distinguished with Solely Morphometric Characters?

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Since the beginning of biological classification of organisms, taxonomists have classified species based on morphological traits. Such features are usually coded as presence/absence or meristic characters. Recently, molecular characters have also been used in classification, to some extent. Unlike other potential morphological characters, morphometric characters have been used sparingly. In most cases, continuous morphometric characters have been placed in bins to create discrete characters, which are easier to handle in taxonomic and phylogenetic studies. Other times morphometric characters have been used in addition to discrete characters to augment classification or decisions about phylogenetic placement. The goal of the current study is to determine whether solely morphometric characters are sufficient to classify closely related reptile species. A total of 102 adult individuals of the six species of the lizard genus *Proctoporus* (Gymnophthalmidae) were measured; 25 length characters were measured for each. Multivariate statistics were utilized to test which character combinations were sufficient to discriminate among these closely related species. The combination of snout-vent length, snout-eye length, interorbital width, tympanum height, dorsal scale length, and ventral scale length was able to properly assign species at least 71% of the time. Sexual size dimorphism and geographic variation were also detected for some morphometric characters. This study demonstrates that size-only characters do have taxonomic value, especially for reptile species. For morphologically similar species like *Proctoporus*, it has been difficult to discover an adequate number of scale-based meristic characters for taxonomic designation and phylogenetic inference. Morphometric data may provide a viable alternative, contributing valuable characters that can be used relatively easily in the field to distinguish among similar reptile species.

Homing and Straying Following Experimental Translocation of PIT Tagged Fishes

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Stream habitats continue to be fragmented, affecting the normal movements of fishes. How fish respond to fragmentation, by homing and straying, can affect the size, structure, recruitment and persistence of local populations. We examined the movement behaviour of sea lamprey *Petromyzon marinus*, white sucker *Catostomus commersoni*, and rock bass *Ambloplites rupestris* in five study streams on the north-shore of Lake Ontario, Canada in two translocation experiments where fishes were marked using Passive Integrated Transponder (PIT) tags. Three of the study streams have dedicated low-head sea lamprey barriers and two streams have perched culverts with no fish bypass. In the first experiment, tagged, naïve sea lamprey were translocated from outside of the study area and randomly released in equal numbers close to the mouths of the five study streams. As a reference sample, sea lamprey caught within the streams were also tagged and released within their stream of capture. In the second experiment, one subsample of fishes netted in the study streams was tagged and translocated to a randomly assigned study stream, while another subsample was released in the stream of capture as a reference. Movements of translocated and reference fishes from both experiments were monitored using stationary PIT tag-detecting arrays placed at two locations within each stream. Frequencies of inter-stream movements for translocated and reference groups were then compared. Within a reproductive season, translocated sea lamprey exhibited greater inter-stream movement than sea lamprey caught in our study streams. Translocated and reference groups of white suckers and rock bass exhibited little inter-stream movement. Among reproductive seasons, 68% of translocated white suckers and rock bass returned to their initial stream of capture, demonstrating a high degree of reproductive homing. The propensity for fishes to move between streams has important implications for fisheries management and conservation.

0223 Fish Conservation, Drummond, Sunday July 27, 2008

A Missing Link in Population Biology of Reef Fishes: Molecular Ecology of Larval Dispersal in Gobies

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Planktonic larval dispersal is of critical importance in the ecology, evolution and management of marine fish populations. However, little is known about the scale and pattern of larval dispersal for most marine fishes. A major obstacle to progress has been the impracticability of surveying distributions of larval fish species in planktonic communities. Identification by microscopy is labor intensive, often inaccurate and in many cases larvae can only be identified to family level. DNA barcoding is a novel method for taxonomic identification of organisms based entirely on the 5' portion of the mitochondrial gene, cytochrome oxidase subunit I (COI-5). 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, Republic of Panama, using DNA barcoding to identify individual larvae. Over half of the larvae were identified to at least genus level using this technique. Our study adds four additional species to the 11 previously reported as adults for this archipelago. Larvae of *Coryphopterus eidolon*, which had not previously been reported from this region, were collected along with three yet unmatched species. Our results suggest a strong correlation between species composition in larval assemblages and habitats associated with adult populations, including spawning and recruitment sites. Strong onshore winds are the likely reason for increased fish larval density and biomass recorded in shallow nearshore waters during the dry season. Goby larvae aggregations mostly occurred close to adult benthic habitats suggesting nearshore larval retention. Overall, our results demonstrate the practicability and accuracy of DNA barcoding in the identification of early developmental stages of fishes.

0292 General Ichthyology I, Drummond, Saturday July 26, 2008

Phylogeography and Population Structure of Rio Grande Chub, *Gila Pandora*

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The Rio Grande chub (*Gila pandora*) is endemic to the Rio Grande and Pecos River in southern Colorado and New Mexico, and has a limited distribution with a disjunct population in the Davis Mountains of Texas. This species is severely impacted by stream diversion, habitat degradation, fragmentation, and introduced nonnative fishes. To more fully understand ramifications of these processes, genetic diversity was assessed in populations of *Gila pandora* in the upper Rio Grande drainage of CO

and NM. Results revealed shallow genetic diversity in *G. pandora*. Sequence data from four mtDNA regions were analyzed across 237 specimens and consisted of partial sequence of ATPase 8/6 and ND2 genes [671 and 656 base pairs (bp), respectively, and 694 bp of the D-loop region (all sequences from 5' end)]. While numerous haplotypes are distributed within and among populations, the divergence amongst these is relatively low (i.e., caused by differences at but a few basepairs only). However, on average, 70% of haplotypes found in a given population are unique to it. Pair-wise comparisons show significant differences between populations. Genetic diversity is distributed mostly within and among populations, and shows only minor divergence among drainages. From a conservation standpoint, *G. pandora* should be managed solely by population, for populations-within-rivers and individuals-within-populations are significantly differentiated, whereas drainages are not.

0296 Herp Genetics, Salons A&B, Sunday July 27, 2008

Did Vicariance Shape Population Structure of Sideblotched Lizard, *Uta Stansburiana*, in Grand Canyon, AZ?

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Landscape features often serve as vicariant barriers to gene flow and thus as mechanisms to fragment biodiversity. In Grand Canyon National Park (GCNP), striking landscape predominates, and when sliced by the Colorado River, demonstrates a multiplicity of layers, some of which erode slower than others. Many of these provide the impetus for faults, canyons and synclines that can serve as subtle vicariant mechanisms and truncate gene flow among upstream and downstream populations. Indeed the river itself can also serve as a vicariant barrier by separating populations from one another on each side of the river. To test for the magnitude and extent of geographic isolation in GCNP, 18 populations (188 individuals) of Side-Blotched Lizard (*Uta stansburiana*) were sampled along the Colorado River corridor throughout GCNP. Mitochondrial (mt) DNA was extracted from pieces of tail collected non-lethally, and two fast-evolving mtDNA genes (ATPase 8 and 6) were sequenced using an ABI Prism 3100 Genetic Analyzer. Haplotypes clustered into two distinct lineages that differed by 2.5% sequence divergence. One lineage was restricted to Marble Canyon and upper Grand Canyon. The second contained the majority of individuals and revealed three distinct subclusters, each differing by at least 1% sequence divergence from one another. One of these was restricted to Marble and upper Grand canyons, whereas a second was found in Western Grand Canyon. A third (representing a single haplotype) was located on the South Rim (Navajo Reservation) at Powell Trailhead. The pattern of genetic diversity detected in Side-Blotched Lizards mirrors a faunal break associated with Muave limestone and a narrowed river corridor at Havasu Creek [River Mile (RM) 160]. The Grand Canyon Rattlesnake (*Crotalus abyssus*) is restricted to localities above this RM, whereas the Speckled Rattlesnake (*Crotalus mitchellii*) is found below this area.

0233 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

Proteomic Analysis of Mechanisms of Anoxia Tolerance and Hypoxic Preconditioning in the Epaulette Shark

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Epaulette sharks (*Hemiscyllium ocellatum*) withstand severe, episodic hypoxia and even anoxia at tropical temperatures. The reef platform around Heron Island, Australia, serves as a natural hypoxic preconditioning environment. We adopted a discovery-based approach to identify proteins/mechanisms involved in low oxygen tolerance. Using two-dimensional gel electrophoresis, we examined proteome changes in response to hypoxic preconditioning (1 or 2 sessions of ~5% oxygen saturation, 24 hours apart) and anoxia (1 or 2 sessions of <0.3% oxygen saturation, 24 hours apart) in epaulette shark tissues. Proteins that were regulated by anoxia exposure and/or hypoxic preconditioning were identified by MALDI-TOF/TOF mass spectrometry and mapped to molecular pathways using bioinformatics tools. Using these data, we tested the hypotheses that 1. the severity of low oxygen exposure influences patterns of protein abundance in relevant cellular pathways (e.g., cellular stress response, redox balance, metabolism), and 2. preconditioning leads to upregulation of compensatory mechanisms of low oxygen tolerance.

0126 AES Management, Jarry/Joyce, Sunday July 27, 2008

Quantifying Regional Differences in Shark Abundance and Distribution: A Step Towards Ecosystem Management

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A directive of the United States Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) is incorporation of ecosystem principles into future stock assessment. Ecopath/Ecosim routines are a common way to model such ecosystem effects, but rely on detailed biological data for model inputs. Modelers often lump sharks and other predatory fishes into a single group of apex predators, when in reality this apex predatory role is likely species and region specific. To investigate the trophic role of sharks in our region, monthly longline surveys were conducted to assess fine scale patterns of shark abundance and distribution in the northern Gulf of Mexico. This survey straddles an area where disjunctive shark abundances have historically been shown. Multivariate analysis of 2007 data indicate adjacent areas within the Gulf of Mexico Large Marine Ecosystem (LME) show differences in shark community structure as revealed by non-metric multi-dimensional scaling and ANOSIM routines. Consequences for region specific differences in trophic transfer and management issues are discussed.

0645 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Thermoregulation and Habitat Selection in Wood Turtles (*Glyptemys insculpta*): Chasing the Sun Slowly

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It is widely accepted that reptiles are able to behaviorally regulate their body temperature (T_b), but this generalization is primarily based on studies of lizards and snakes in the temperate zone. Because the precision of T_b regulation may vary considerably between taxa and over geographical ranges, studies of semi-terrestrial turtles in climatic extremes are relevant to the understanding of reptilian thermoregulation. We studied the thermoregulation of 21 freeranging wood turtles (*Glyptemys insculpta*) at the northern limit of their range in Quebec, using miniature data loggers to continuously measure their internal T_b and external temperature (Text). We simultaneously recorded the available operative environmental temperature (Te) using 23 physical models randomly moved within each habitat type, and located turtles using radio-tracking. The habitat inhabited by wood turtles was thermally constraining and target T_b was only achievable by basking during a short 5 h time window on sunny days. Wood turtles did show thermoregulatory abilities, as determined by the difference between turtle T_b distribution and the null distribution of Te that resulted in T_b closer to target T_b. Although most individuals regulated their T_b between 9:00-16:00 h on sunny days, the regulation was imprecise, as indicated by the indices of thermoregulation precision ($|T_b - \text{target } T_b|$). The comparison of habitat use to availability at the scale of the entire study site and 100 m wide movement corridors scale indicated selection of open habitats and avoidance of closed habitats at both scales. The hourly mean shuttling index ($|Text - T_b|$) suggested that turtles used sun/shade shuttling from 9:00-16:00 h to elevate their T_b above available Te. Overall, turtle thermoregulation increased their metabolic rate, used as a surrogate of the rate of energy gain, by 20% over thermoconformity. Our data support the prediction of the cost-benefit model that thermal generalists would achieve greater net benefit than thermal specialists in an environment where thermoregulation costs are high.

0078 Poster Session III, Sunday July 27, 2008

Is Cating's Method of Transverse Groove Counts to Annuli in American Shad (*Alosa sapidissima*) Applicable to Rivers Other than the Hudson and the Connecticut?

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Aging of American shad by the Cating method, which uses scales, was developed for the Hudson River population of shad and validated for the Connecticut River population of shad. However, scales of American shad are difficult to read, and a recently published assessment to age Delaware River shad populations failed to validate Cating's method. A source of concern arises because life history of shad varies with latitude. Being semelparous at southern latitudes and iteroparous in the northern may result in latitudinal differences in scale formation. The purpose of this study is to determine if shad from river systems at different latitudes can be aged consistently using Cating's method of transverse groove counts. To examine the hypothesis that transverse groove counts per annuli are consistent for rivers in different latitudes, scales were taken from shad in the Delaware River in Pennsylvania and the St. Johns River in Florida. The number of transverse grooves per annulus were recorded and compared to counts tabulated by Cating for Hudson River shad. Thus far, preliminary data show a significant difference ($p < 0.05$) in transverse groove counts per annuli between shad from the Hudson River and shad from the Delaware and St. Johns rivers. Further analyses are underway to increase sample size, add data from other rivers, and to include otolith age comparisons.

0740 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Using Trees to Save Sharks and Rays

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The typical approach to conservation is to save the species most at risk of extinction and these are typically the most charismatic or distinctive species. For example, the only elasmobranchs on the CITES annexes are Whale, White and basking sharks - arguably the world's most charismatic animals. While protecting charismatic species is a valid and important approach to saving the biodiversity we care about - how do we ensure that the less-charismatic underworld of elasmobranchs is prioritised for conservation action in an appropriate objective manner? Recent advances in our understanding of the evolutionary phylogenies of sharks and rays can be used to identify the most evolutionary distinct globally endangered species. Evolutionarily distinct species have few close relatives and harbour proportionally more genetic diversity and are often extremely distinct in the way they look, live and behave. We outline our approach to updating a global phylogeny of sharks, ray and chimaeras

and combining this with the IUCN SSG Global Shark Assessment to generate a list of Shark EDGE species deserving further conservation or management attention.

0730 Poster Session I, Friday July 25, 2008

Functional Morphology of the Gills of Amazonian Freshwater Stingrays (Elasmobranchii: Potamotrygonidae)

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The aim of this study was to describe the epithelial morphology of gills in potamotrygonid species. The Na⁺/K⁺-ATPase-rich cells are numerous on the filament epithelium, but they may also appear relatively abundant on the lamellae of the gills of *Potamotrygon schroederi*. In addition, a multicellular complex of chloride cells is usually found on the afferent edge of the gill filament of *Potamotrygon* sp. (a new species). Interestingly, these two species are endemic of acidic and ion-poor blackwater of the Rio Negro (Central Amazon Basin). The gill morphology of those species differs in some aspects from the others potamotrygonid (*Paratrygon aiereba*, *Potamotrygon motoro*, *P. aff. orbignyi*, *P. scobina* and *P. orbignyi*). In all potamotrygonid rays, the mitochondria-rich cells (MRC) lacks the tortuous basolateral tubular system, instead does have moderate infoldings. In addition, they apical membrane is characterized by dense microvilli with intra- and interspecific variation. In contrast to MRC, the pavement cells (PVC) cover almost all gill epithelial. The apical membrane of PVC is characterized by the presence of microvilli or microridges which differ between species. The most conspicuous features of the PVCs are the presence of subapical secretory vesicles that contains mucous PAS-positive. The gill arch epithelium also has numerous large glandular mucous cells which are strongly PAS-stained. These morphological features probably allowed to the Potamotrygonidae family evolve their freshwater tolerance from marine incursion during the Early Miocene. Financial support: FAPEAM.

0425 Poster Session I, Friday July 25, 2008

Taxonomic Revision of the Flatfish Genus *Trinectes* (Achiridae; Pleuronectiformes)

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Flatfishes, order Pleuronectiformes, are among the most diverse groups of marine euteleostean fishes with 716 species and 123 genera currently recognized. Taxonomic relationships within this order remain obscure for many families. This is especially true for diverse families composed of many small-sized species, such as the Achiridae. The present study focuses on the taxonomy and systematics of amphi-american flatfishes of the achirid genus *Trinectes*. Species within this far-ranging taxon occur predominantly in coastal, warm-temperate to tropical marine waters and occasionally in freshwater. Previous studies suggest that *Trinectes* is a monophyletic clade and is the sister group to *Achirus*. The main objective of this study is to assess the validity of all nominal species associated with *Trinectes* and in particular its Atlantic representatives. This taxonomic revision is based on a study of the morphology and meristics of all available type material as well as hundreds of non-type specimens assignable to the nominal species. Preliminary results suggest that of the 16 nominal species that are included in this genus, four Atlantic species are valid. The present research is part of a larger study that will also examine the evolutionary intrarelationships and biogeography of members of *Trinectes*.

0329 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

The Effects of Leaf Teas from the Invasive Amur Honeysuckle (*Lonicera maackii*) on Wood Frog (*Lithobates sylvaticus*) Tadpole Digestion

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Encroachment from invasive non-native species can change habitats, thus contributing to global amphibian declines. Leachates from invasive plants can add metabolites (tannins) or toxins (phenolics) from decomposing leaf litter to aquatic systems and thereby potentially impact the development and fitness of larval amphibians. Amur honeysuckle (*Lonicera maackii*) is an invasive shrub that dominates many of the edge habitats of the eastern United States and is the predominant woody vegetation along many streams and ponds. Wood frogs (*Lithobates sylvaticus*) range throughout this area, and are one of the first to breed in the spring. If plant chemicals leached from *L. maackii* leaves do affect frog tadpoles, then *L. sylvaticus* larvae would be very susceptible due to their temporal proximity to when autumn leaf fall entered the water. We tested the hypothesis of invasive plant chemical impact on tadpole development in *L. sylvaticus* by examining tadpole digestive efficiency and metamorph fitness (performance & energetic) of larvae raised under varying concentrations in leaf "teas" from three sources: 1) the invasive

Amur honeysuckle (*L. maackii*), 2) natural mixed hardwood leaf-litter, and 3) a pure water control. Our results suggest reduced digestive efficiencies, time to metamorphosis, and fitness performance of metamorphs in frogs raised in invasive plant leaf teas compared to natural leaf teas or a water control. Tannin uptake may disrupt tadpole digestion, thereby reducing absorption of nutrients, leading to slower growth rates and decreased fitness of metamorphs. We found that frogs raised in higher concentrations of *L. maackii* teas had significantly lower fitness than frogs raised in mixed hardwood teas or the water control. This indicates that the degradation of leaves from invasive plants, by changing water chemistry in ponds and streams, may reduce survival rates of developing amphibian larvae, thereby contributing in yet another way to the global decline of amphibians.

0104 Poster Session III, Sunday July 27, 2008

Reproductive Ecology of the Fish Assemblages of Two Floodplain Lagoons of the Low Orinoco River Basin

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The reproductive ecology of the fish assemblages of two floodplain lagoons of the Low Orinoco River basin with different levels of human intervention was studied. This included condition factor, gonadosomatic relation index, absolute fecundity, eggs diameter, proportions of gonadal stages, sizes and fat and reproductive activity index. The fishes were caught during a whole hydrological period using gill nets. There were significant differences ($P < 0,05$) between lagoons and among hydrological seasons in the condition factor for some of the species studied, which might be attributed to different sample sizes and levels of anthropogenic intervention. This measure tended to be higher when the levels of water were descending, moment when the biggest proportions of fat in the stages 2 and 3 and the longest sizes were registered. The latest gonadal stages: IV to V, were registered mostly on June during the beginning of the rainy season, as well as the highest gonadosomatic relation values for all the species. In the two lagoons the index of reproductive activity indicated that this was very intense (29 - 35%) for the fish communities during such period too. In general terms the study of the proportions and indexes revealed that the fishes invest their energy in reproducing during the beginning of the rainy season when the lagoons start to connect with the Orinoco River and when the levels of water are going down they use their energy supply in growing longer and fatter. However, there was not a relation ($P > 0,05$) between the reproductive activity and the fluctuation of the water levels. Finally, this research furnishes new information about fish species for which little or no data at all on reproductive biology existed, such as *Achirus novoae*, *Platydoras costatus*, *Loricaria cf. cataphracta*, *Cynodon gibbus*, *Loricariichthys brunneus*, *Hypostomus plecostomoides*, *Plagioscion cassattii* and *Triporthus venezuelensis*.

0031 Herp Reproduction, Salons 4&5, Sunday July 27, 2008

Sperm Storage in the Female Mediterranean Gecko, *Hemidactylus turcicus*: Implications for Reproductive Competition with *H. frenatus* in the Southeastern United States?

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The Mediterranean Gecko, *Hemidactylus turcicus*, is an oviparous, invasive species found throughout the world, including the southern United States. In Louisiana, *H. turcicus* appears to be free of competition and has been rapidly expanding its range in the past several decades. However, in Florida and Texas, *H. turcicus* is heavily out-competed by closely related competitors that do not occur in Louisiana, including *H. frenatus*, of which a substantial amount of reproductive morphology and ecology is known. While *H. turcicus* has been seen to have seasonal reproduction, little was known about the seasonal variation of their oviduct and if or when they are capable of storing sperm, which can have substantial implications for reproductive competition. We analyzed the annual reproductive cycle of sperm storage and seasonal variation in the oviduct of *H. turcicus* using light microscopy and electron microscopy. Using similar techniques, previous studies have found that *H. frenatus* store sperm in the uterine-infundibular region for up to 36 weeks, and that their oviducts are active year-round. In *H. turcicus*, we found that sperm are stored in the uterine-infundibular region of the oviduct, and sperm were only found being stored from mid-May through late August, with residual sperm found in the oviduct until November. Additionally, *H. turcicus* has seasonal reproduction, producing between three and four clutches during the spring and summer, but during the fall and winter months there is minimal activity in the oviduct.

0217 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR

A Comparative Study of Habitat Selection by Blanding's Turtles (*Emydoidea blandingii*) in Natural and Altered Landscapes

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The habitats selected by an organism can have dramatic consequences on their survival and reproduction. Habitats that animals use more frequently than expected based on chance are considered to be preferred and can therefore be interpreted as high quality. Therefore studies of habitat selection indirectly test which habitats are of high versus low quality. In natural landscapes, high quality habitats may be common and not represent limiting resources. Under these conditions, organisms would predictably be habitat generalists, using a variety of high quality habitats. Conversely, in altered landscapes, high quality habitats may be limited by physical barriers, habitat destruction, or habitat modification. Under these conditions,

organisms should respond as habitat specialists, favouring limited, high quality habitats. Blanding's Turtles (*Emydoidea blandingii*) were studied using radiotelemetry over two years at two sites in Ontario, Canada to investigate the species' response to habitat alteration. One site located in Algonquin Provincial Park was relatively natural, whereas, the other, an urban park in Toronto, was highly altered. Macrohabitat selection, quantified at two spatial scales, and movement patterns were qualitatively compared between sites. In the natural landscape, Blanding's Turtles were habitat generalists, and used a variety of wetland habitats, whereas in the altered landscape, turtles were specialists, and selected man-made wetlands and marshes. This study indicates that management groups should take into consideration local habitat features, and refrain from making broad definitions of critical habitat based on studies done in altered landscapes.

0372 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Cryptic Diversity in the Mississippi Embayment: Phylogeographic Evidence from the Least Madtom, *Noturus hildebrandi*

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Noturus hildebrandi is distributed in a series of drainages located in the Mississippi Embayment ranging from western Tennessee in the north to western Mississippi in the south. Based on a north-south clinal pattern of morphological variation, two subspecies, *N. h. latus* from Tennessee and *N. h. hildebrandi* from Mississippi, have been described. To further investigate relationships among these populations, I examined mitochondrial cytochrome *b* (1138 bp) sequence data from individuals representing the entire range of *N. hildebrandi*. Phylogenetic analysis of these sequences suggests current subspecific designations do not correspond with evolutionary relationships among populations. Three distinct lineages were recovered: one comprising populations from the northern and southern extremes of the range, a second from the Wolf River and Yazoo systems, and a third from the Hatchie River. *Noturus hildebrandi* populations were recovered as paraphyletic with respect to *N. baileyi*, consistent with results of previous studies. Populations from the Hatchie River were particularly divergent. I will discuss these results in the context of cryptic diversity and the biogeography of the Mississippi Embayment.

0007 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Conservation Genetic Analysis of Alternate Life History Modes in *Eurycea tynnerensis*

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Species that exhibit alternate life history modes present a unique conservation case, because populations of each life history mode may have different habitat requirements and may be vulnerable to different environmental perturbations. Furthermore, population genetic assessments are necessary to maximize the conservation of intraspecific genetic diversity. The Oklahoma salamander, *Eurycea tynnerensis*, is endemic to the Ozark Plateau and is listed as a "Species of Special Concern" by the state of Oklahoma. This species has two discrete adult life history strategies (paedomorphic and metamorphic). However, these alternate life history modes were previously considered separate species and conservation efforts focused only on the paedomorphic life history mode. I performed population genetic analyses of aquatic and terrestrial populations of *E. tynnerensis* from across their distribution using both mitochondrial and nuclear loci. I collected sequences of the ~1100 base pairs of the mitochondrial gene *cytochrome b* and the ~500 base pairs of the independent nuclear gene *proopiomelanocortin*. This data is used to examine the geographic distribution of genetic diversity and then integrated with patterns of life history variation to effectively develop conservation strategies for this species.

0604 Poster Session III, Sunday July 27, 2008

Mowing Guidelines in Turtle Habitat: Pastures, Successional Fields, and Hayfields

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Grasslands, shrublands, pastures and hayfields are important habitats for turtles, particularly the wood turtle (*Glyptemys insculpta*) and eastern box turtle (*Terrapene carolina*). Therefore, maintenance of these habitat types is essential, often requiring periodic mowing, though other methods of control are possible (e.g. prescribed burns, grazing). Mowing during the spring and summer months can also cause significant annual mortality; in several western Massachusetts populations of wood turtles mortality may be as high as 10%. Similarly, research in Quebec and Massachusetts found that in rural areas, adult mortality due to mowing is much higher than the mortality due to automobiles. We performed experiments with non-living surrogates to determine if mortality risks vary among different types of machinery, and to determine the mower blade height required to minimize the likelihood of killing or injuring turtles. We found a difference in mortality risk

between mowing equipment at a 4" blade height; with 100% mortality due to flail mowers, 50% from brush hog rotary mowers, and 0% percent from sicklebar mowers (these results excluded the effects of tractor type, which is also likely to be significant). Our study also showed that blade heights of 6" or more decreased the mortality risk to turtles from 53% to 5%. Based on our results we developed a set of mowing guidelines. These guidelines provide a suite of options, each of which is predicted to reduce turtle mortality. We recognize that all options will not be appropriate for every circumstance and that land managers may need to modify these guidelines to accommodate the needs of other species as well. Things to consider include: mowing rotation, percent of area mowed, timing, mower style, blade height, directionality, and mower speed. In all situations, the most conservative option is to avoid using heavy machinery in early successional habitats from May 15-September 15.

**0536 Fish Ecology I, Drummond, Thursday July 24, 2008; STOYE
ECOLOGY & ETHOLOGY**

**Breakdown of the Size-Advantage: Evolutionary Changes in Mating
Behavior Influence the Loss of Sex Change in Groupers**

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The size-advantage model asserts that mating system characteristics influence the incidence and direction of sex change in animals. Although it is supported by numerous experimental and theoretical studies, none have tested predictions of the model within the context of a robust, species-level phylogeny. Using this approach, we tested whether changes in sexual pattern in groupers (Teleostei: Epinephelidae: Epinephelini), and in particular the loss of sex change, were related to changes in two traits related to the mating system: mating group structure and sperm competition intensity. All phylogenetic reconstructions indicated that protogyny and pair spawning are the plesiomorphic conditions for the lineage; both gonochorism and group spawning evolved independently at least four times in three different genera. Tests of correlated evolution showed that evolutionary transformations in sexual pattern from protogyny to gonochorism were significantly correlated with transformations in mating pattern from paired to group spawning, and transformations in mating group structure occurred prior to or simultaneously with transformations in sexual pattern. Sperm competition, as reflected by relative testes weights in males, is significantly higher in gonochoric species than protogynous species. This phylogenetic comparative study suggests that the loss of sex change in some groupers was influenced by changes in mating group structure from paired to group spawning and associated increases in sperm competition among males. Moreover, it provides phylogenetic support for predictions of the size-advantage model and empirical evidence for the influence of sperm competition on sex allocation in animals.

0335 Poster Session I, Friday July 25, 2008

Feeding Habits Of The Scalloped Hammerhead *Sphyrna lewini*, in Ecuadorian Pacific

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The research on biology of Scalloped hammerhead *Sphyrna lewini* in Ecuador are scarce. To know more on this worldwide shark we review 116 stomach contents from sharks caught in the ecuadorian Pacific and unloaded in Manta, Ecuador from January to December 2004. This shark is caught yearround with the higher catches from January to June. The Scalloped hammerhead feed on cephalopods, fishes and crustaceans. Using the Index of Relative importance (IRI), we found that the cephalopods *Histioteuthis* spp (22.7%) and *Dosidicus gigas* (21.9%) were the main prey, following by the fishes *Merluccius gayi* (6.5%) and *Anchoa* spp. (4.3%). *S. lewini* is an oceanic predator because predate more on oceanic cephalopods from the families Histioteuthidae and Ommastrephidae; however also consume fishes from the benthic zone as *Merluccius gayi*.

0588 Poster Session I, Friday July 25, 2008

Demographics and Habitat Partitioning of Elasmobranchs in Port Royal Sound, South Carolina: Preliminary Results

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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. This long-term project has four main objectives: (1) to determine which species of elasmobranchs are utilizing Port Royal Sound as habitat, (2) to determine if species partition themselves spatially, temporally, by sex and/or size, (3) to determine if Port Royal Sound is a nursery ground for elasmobranchs, and (4) to determine if species assemblages are unique by comparing results with previous studies in South Carolina. Three generalized areas were sampled regularly along with episodic wild card sites. Twenty adult lines (16/0 hooks) and twenty pup lines (12/0 hooks), baited with Boston mackerel were bottom-set concurrently during slack tides throughout the summer. Elasmobranchs were identified, measured, tagged (only sharks) and released. We caught 174 elasmobranchs (n = 61 on long-lines, 113 on rod-and-reel) comprising ten species: *Rhizoprionodon terranova* (n = 129), *Carcharhinus limbatus* (17), *Dasyatis sabina* (12), *C. acronotus* (4), *C. plumbeus* (4), *D. americana* (3), *C. isodon* (2), *Galeocerdo cuvier* (1), *Sphyrna lewini* (1), and *S. tiburo* (1). Most individuals captured were young-of-year or immature. Catch per unit effort (CPUE, #sharks/100 hooks⁻¹ h⁻¹) for adult and pup lines was 2.7 ± 0.63 (x ± SE) and 12.1 ± 1.83 (x ± SE), respectively, for all areas. Port Royal Sound or nearby areas may represent Essential

Fish Habitat for a number of species of sharks and rays. Next sampling season we are expanding the effort and we will investigate habitat partitioning. This is the first large-scale comprehensive survey for elasmobranchs in Port Royal Sound.

0314 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

The Status of *Pristis pristis* (Chondichthyes, Pristiformes) Reconsidered

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Sawfishes (Chondrichthyes, Pristidae) are considered endangered species worldwide, but their conservation and management have been undermined due to poor understanding of the group's taxonomy. A central issue to be resolved regarding sawfish taxonomy and conservation is the status of *Pristis pristis* (Linnaeus 1758), a species commonly presumed to have been extirpated from European and north African waters. The purpose of this work was to review this particular aspect of sawfish taxonomy and properly propose an assignment for this nominal species. This goal was accomplished through a thorough review of the historical taxonomic literature and specimens, supplemented with empirical observations on specimens examined at collections for external morphology and DNA sequence comparisons. The nominal species *P. pristis* is a composite and it has historically been associated with features from several different species, and as such, is a chimaeric taxon that does not exist in nature. The more recent asserted association between *P. pristis* and the largetooth sawfishes is the product of taxonomic misinterpretation. The suppression of the name *P. pristis* is proposed.

0601 Poster Session I, Friday July 25, 2008

Elasmobranch Fisheries off Northeastern Brazil, Western Equatorial Atlantic

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The conservation status of elasmobranchs is of worldwide concern since examples of rapid population declines caused by fisheries pressure have become commonplace. In Northeastern Brazil, interest in elasmobranch products has grown in the recent years, due to the increased value of shark fins and batoid sub-products. The goal of the present study was to provide preliminary data on both the identity and the quantity of elasmobranchs captured off Northeastern Brazil. Captures were recorded during industrial and small-scale fisheries landings in Fortaleza, CE. The industrial fisheries employing longlines ranged from 25 to 168 m in depth on the continental

slope off Northeastern Brazil (1°00'S, 9°00'S). Twenty-one landings were monitored between November 2004 and November 2006. Overall, 1873 dressed shark carcasses were landed, including *Carcharhinus* spp. (n=661), *Ginglymostoma cirratum* (n=582), and *Carcharhinus acronotus* (n=445). 674 batoid carcasses were landed, primarily *Dasyatis* spp. (n=656). Small-scale fisheries, employing hook and line, and gillnets ranged from 10 to 100 m in depth on the continental shelf off Ceará State coast (03°23'S, 38°05'W; 03°25'S, 038°48'W). Landings were monitored weekly from September 2006 to March 2008. A total of 795 sharks were landed, including *Rhizoprionodon* spp. (n=427), *Ginglymostoma cirratum* (n=124), and *C. limbatus* (n=95). 1227 batoids were recorded, including *Dasyatis americana* (n=1073), and *D. guttata* (n=115). Results will be presented and discussed in light of shark fisheries monitoring and management.

0108 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Evolution and Maintenance of Divergent Lineages in an Endangered Freshwater Fish, *Macquaria australasica*

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Genetic diversity is essential for organisms to evolve to changes in their environment. Although geologically relatively stable, southeastern Australia has experienced significant changes in landscape and climate conditions to which species have evolved. For freshwater taxa, variable hydrological regimes and habitat availability have been very strong determinants of current species distribution and population structure. We have conducted a range wide phylogeographical study of Macquarie Perch, *Macquaria australasica*, in order to understand the relationship between landscape and freshwater fish evolution in southeastern Australia, and to assess the levels of genetic diversity and divergence in this endangered species. We found 46 mtDNA control region haplotypes from 35 sampling locations with up to 6% sequence divergence between lineages. Phylogenetic reconstruction indicates that the species originated on the coast, east of the Great Dividing Range (GDR) and subsequently colonised inland to the Murray-Darling Basin (MDB), west of the GDR. Mismatch analysis suggests that this colonisation may have been followed by demographic expansion of the population approximately 536kya. Nested clade and IM analyses also support a series of range expansions and fragmentations across the species range during the Pleistocene. We conclude that the unexpected high levels of diversity and divergence observed in *M. australasica* may be due to the interacting factors of habitat specificity, localised recruitment and Pleistocene climate fluctuations. The comprehensive phylogeographical approach used here has given valuable insight into the aspects of *M. australasica* biology and its interactions with the environment that may be critical to its conservation management.

0061 Poster Session III, Sunday July 27, 2008

Description of a *Liopropoma* Larva from the Gulf of California (Actinopterygii: Serranidae)

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A complete postflexion 18.5 mm *Liopropoma* larva, dip-netted at night at the surface in the Gulf of California, Mexico, is described. The second and third dorsal spines are both unusually elongate. The second spine is about ten times the body length, with twelve heavily pigmented swellings or vanes connected by a soft, flexible filament that tends to coil, resembling the siphosome of a siphonophore. This spine development may be a case of Batesian mimicry giving the fish the appearance of being entangled in venomous tentacles of a Portuguese Man o' War (*Physalia physalis*) or other cystonect such as *Rhizophysa eysenhardti*. Morphometrics are similar to adult *L. fasciatum*, especially the head length, snout length, interorbital width, length of the caudal peduncle, caudal concavity and the pelvic spine length. The depth of the caudal peduncle is more similar to *L. longilepis*. Specimen when fresh had orange chromatophores over most of the body. After preservation melanophores are present only over the cranium, the eye and in the elongated dorsal filaments. Other described *Liopropoma* larvae are compared and discussed.

0697 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Silence of the Frogs: Investigating the Disappearance of the Leopard Frog (*Rana sphenoccephala*) from Long Island, New York

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The southern leopard frog (*Rana sphenoccephala*), once considered one of the most abundant frogs in coastal portions of New York State, has suffered drastic declines over the past several decades. Leopard frogs are now exceedingly rare if not completely extirpated from Long Island and the rest of the surrounding New York State coastal region, aside from one tenuous population on Staten Island. Their disappearance has occurred across a variety of landscapes and habitats ranging from areas of heavy development to pristine, well-protected natural areas. This study seeks to elucidate decline factors and identify primary threats, develop conservation strategies, and prevent similar future extirpations of this species from the few known surviving populations elsewhere in the state. My research is testing and evaluating four potential negative threats associated with environmental perturbation and anthropogenic influence including: disease, invasive vegetation, contaminants, and overwhelming interspecific competition from two closely related frog species. I am collecting data *in situ* by raising leopard frog tadpoles in enclosures within historic

Long Island wetland sites where this species is now extirpated. By using leopard frog tadpoles from nearby extant populations as bio-indicators, I am monitoring development and survival under various conditions and treatments with the goal of isolating specific causes and trends to help explain this decline and aid in future biodiversity conservation efforts.

0544 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Are Predators to Blame for the Detection of a Novel Hypercalcification Disorder in Tadpoles?

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The detection of sudden or novel abnormalities in wildlife is often seen as an indication that a pollutant or other anthropogenic stressor is present in an environment. For example, a novel hypercalcification abnormality was discovered in bullfrog tadpoles inhabiting recently constructed wetlands receiving treated wastewater. The abnormality has not been reported at older constructed wetlands. The abnormality results in significant calcification of soft tissues including tail musculature. Why are tadpoles with gross handicaps able to survive such that they can be detected? We used mesocosms to test the hypothesis that in the presence of a natural predator, hypercalcified tadpoles would show reduced survival compared to reference tadpoles. As expected, hypercalcified tadpoles showed significantly higher mortality rates in the presence of a predator compared to reference tadpoles. In the absence of a predator, there was no difference between reference and hypercalcified tadpole survival. Laboratory trials demonstrated that hypercalcified tadpoles had shorter burst distances in response to simulated predator attack. These results suggest that the detection of hypercalcified tadpoles is related to the absence of significant predation risk. The constructed wetlands where the abnormality occurs are relatively young and do not have a mature predator community. This also highlights that an increased frequency of abnormalities in wildlife may in part be due to declines in local predator communities, and that the failure to detect abnormalities does not mean that a pollutant or other stressor is not present.

0325 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Under Pressure: Ventilation and Feeding in the White-spotted Ratfish, *Hydrolagus collei* (Chimaeroidea)

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Holocephalans possess a fused upper jaw and a non-suspensory hyoid. They are commonly considered to be durophagous fishes, but there is evidence that they may also be capable of suction feeding. This implies that suction is being generated in a mechanical system where the upper jaw cannot protrude and the hyoid cannot depress the jaws, posing serious potential limitations on suction generation as we have come to understand it based upon elasmobranchs and actinopterygians. As a first attempt at understanding if, and how, suction is generated within the extant Holocephali, we measured intra-oral pressures in nine individuals of *Hydrolagus collei* during ventilation and prey capture. Pressure transducers were implanted in the orobranchial and parabranchial cavities, and pressure was recorded during several modes of respiration; ventilation during paired sculling of the fins, ventilation during alternating sculling of the fins, ventilation with fins at rest and head elevated, ventilation with the fins at rest and head resting on the substrate, ventilation during quiescent swimming along the bottom, and during prey capture. In each of the modes there appeared to be a trend whereby a single pump dominated; that is to say, the two-pump (i.e. suction-pressure) models prevalent in elasmobranchs and actinopterygians does not appear to fully function in *Hydrolagus*. We postulate that during ventilation, water is drawn into the orobranchial cavity using primarily the hypobranchial musculature. The activity of these muscles greatly increases the volume of the branchial region as the nested branchial arches are expanded ventroposteriorly and the orobranchial chamber is extended posteriorly. The net effect is for water to be pulled through the retracted gill curtain, as opposed to being pushed through by forces generated anterior to the gill region. Subambient pressure drops of up to 1000 Pa were recorded during feeding strikes on small crabs or pieces of mussel body. A subset of these strikes were recorded using high-speed video which revealed that the labial folds on either side of the mouth descend to create a small, tubular mouth opening. A small, laterally enclosed mouth opening is ascribed to enhanced suction producing abilities in other aquatic lineages, and the labial folds in chimaeroids may be convergent in this sense.

0411 Poster Session III, Sunday July 27, 2008

Unusual Jaw Morphology Facilitates Piscivory in the Pike Killifish, *Belonesox belizanus*

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Piscivory has evolved independently hundreds of times among aquatic-feeding vertebrates. Evolution of this foraging behavior is typically accompanied by convergent evolution of long-snouted, heavily-toothed jaws used for capturing fish. A few examples of vertebrates that possess this morphology include: ichthyosaurs (Sauropsida; Ichthyosauria), plesiosaurs (Sauropsida; Plesiosauria), crocodylians (Sauropsida; Crocodylia), ichthyorniform birds (Class Aves; Order Ichthyornithiformes), dolphins (Mammalia; Cetacea), gar (Osteichthyes; Lepisosteiformes), and pike (Osteichthyes; Esociformes). In these vertebrate lineages, an upper jaw that is fused to the neurocranium is used as a fixed element upon which force from the lower jaw is applied when trapping prey species between sharp, triangular teeth. Therefore, when closing, every one of these jaws could be considered to be a single class three lever. To our knowledge there is only one exception to this bauplan for piscivory: *Belonesox belizanus*, the “pike killifish.” At first glance, this species shows gross morphological convergence with other piscivores in its elongate snout and tooth morphology. However, using high-speed video-imaging, we observed a novel aspect of the anterior jaws: *B. belizanus* retain a mobile premaxilla that rotates anteriorly and dorsally during mouth opening. Thus, during mouth closing, the jaws of *B. belizanus* function like a pair of toothed ‘tongs,’ where two class-three levers are combined to simultaneously apply force to the prey item. We posit that this unusual morphology reflects the evolutionary history of the cyprinodontiform fishes, which, as a group, typically possess jaws that are modified for picking-based modes of prey capture.

0396 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

Using Blood Physiochemistry To Compare Capture-related Stress Responses in Pelagic Sharks

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Pelagic sharks with a high degree of swimming activity, such as those in the family Lamnidae (e.g., shortfin mako, *Isurus oxyrinchus*, and porbeagle, *Lamna nasus*), are well known for long distance migrations, high endurance, and aggressive fights when caught on recreational and commercial fishing gear. By contrast, non-lamnid species, such as the blue shark (*Prionace glauca*, Family Carcharhinidae), that inhabit the same pelagic environment appear to be more sluggish swimmers. This study

examined blood chemistry of pelagic sharks in order to compare the degree of capture-stress between lamnid (active) and non-lamnid (sluggish) species. Blood samples were taken from all sharks caught using commercial long-line gear and hematocrit (a potential indicator of aerobic capacity) was measured at capture and was used to determine whether erythrocyte swelling and/or lysing had occurred during capture. The concentrations of plasma ions and metabolites (i.e., Na⁺⁺, K⁺, Cl⁻, Ca⁺⁺, Mg⁺⁺, glucose and lactate) were used as additional potential indicators of cellular stress. Additionally, blood samples were analyzed for levels of heat shock protein, *Hsp70*, an indicator of the cellular stress response. Hematocrit values for lamnids (mean=28.8±9.4%, n=51) were significantly higher (p<0.05) than those of non-lamnid species (mean=17.4±6.3%, n=77). Initial results from plasma chemistry analysis indicate significant differences in glucose and lactate levels between lamnids (mean glucose=122.0±22.1mg/dL, mean lactate=23.0±8.0mmol/L, n=19) and non-lamnids (mean glucose=91.6±20.7mg/dL, mean lactate=8.5±7.0mmol/L, n=25). Initial stress protein results show *Hsp70* levels for both groups after 15-240 minutes of long-line gear fight time were approximately four times as elevated when compared to results obtained for unstressed sharks in a previous study. Overall, preliminary findings indicate that active and sluggish sharks species display differences in physiochemical blood parameters resulting from capture on longline gear. Further investigation will reveal whether swimming activity can be used as a means of estimating stress at capture and potentially post-release survival.

0418 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Endemic Genera in the Family Rajidae

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The family Rajidae is one of the most useful among other marine animals, for the analysis of the origin and distribution of sea faunas. Skates (Rajidae) are unique among chondrichthyans for their high species diversity. They have an extreme nonmigratory life mode and are exclusively bottom dwelling fishes at any age, beginning from eggs with fibrillar filaments for attachment to the bottom. The cosmopolitan distribution of the group is accounted for by its large age rather than by a deep-sea life mode. They all live at relatively low depths. Most species live in the shelf and upper slope up to 1000 m of depth, which does not allow them to move across deeper marine regions. They are most diverse at higher latitudes, but are replaced in shallower, warm temperate to tropical waters by stingrays (Myliobatoidei). The high degree of endemism exhibited by the skates is somewhat enigmatic given their relatively conserved body morphology and apparent restrictive habitat. The family Rajidae comprises 27 genera, 11 of these could be considered endemic. Most of them (eight) occurring in the southern hemisphere, whereas only three occurring in the northern hemisphere. The southern hemisphere shows the two extremes with respect to distribution of endemic genera. On one side, South Africa has a great richness in genera of skates (12) but none of them is endemic, and the

Antarctica with two genera, considered the most cosmopolitan of the world. On the other side Australasia and South America, show very curious diversity and distribution at a regional level. In the early Oligocene the Drake Passage started to open and the cold Antarctic circumpolar current began, could this phenomenon be the key of the numerosity and distribution of the endemism on the south hemisphere?

0100 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

The Mechanism of Chemical Delivery to the Vomeronasal Organs in Squamate Reptiles

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Vomeronasal chemoreception, an important chemical sense in squamate reptiles, is mediated by paired vomeronasal organs (VNOs), which are only accessible via ducts opening through the palate into the oral cavity. Three biomechanical stages can be recognized for vomeronasal chemoreception: *sampling*, via tongue-flicking; *stage I delivery*, where the chemical-laden fluids are delivered to the VNO fenestrae in the palate; and *stage II delivery*, the movement of the fluid through the fenestrae into the lumina of the VNOs. In this study we conducted a comparative analysis of oral morphology in snakes and lizards to examine the mechanism of stage I delivery. We found that the foretongue lies within a chamber (or chambers if the tongue is deeply forked) formed primarily by the sublingual plicae ventrally, and the palate dorsally. There is little or no space around the foretongue (or tines of the tongue) when the mouth is closed. We propose a hydraulic mechanism for stage I chemical transport in squamates: when the mouth is closed, the compliant tongue is compressed within the chamber(s) and the floor of the mouth is elevated, expressing fluid from the sublingual glands within the plicae. Chemical-laden fluid covering the tongue tip(s) is forced dorsally and posteriorly toward the VNO fenestrae. In effect, the tongue and floor of the mouth act as a piston, pressurizing the fluid surrounding the foretongue so that chemical transport to the VNO ducts is effected almost instantly. This is contrary to a previous hypothesis that posited that the sublingual plicae act as direct conveyors of chemicals to the VNOs. Importantly, our hypothesized mechanism works regardless of tongue form (which is highly variable in squamates), and it meets the important requirement that in species with deeply forked tongues the chemicals sampled by each tine remain separate throughout delivery - thus allowing for tropotaxis.

0765 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Impacts of Post-fire Geological Processes on Amphibian and Fish Habitat in Southern California

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Coastal southern California is a fire prone landscape that traditionally experienced summer lightning strike fires associated with monsoonal conditions. Human caused fall firestorms in southern California are becoming more common and the burn areas are greater and often now include entire watersheds. Several amphibians and fish in southern California are very rare or almost extirpated and they may now exist only as localized populations within the headwaters of specific watersheds. Many of these species are federally and/or state listed and at risk of global extinction or local extirpation. Post-fire aquatic habitat change has been documented to be causing continued loss of populations. Two geological processes appear important in these changes: dry ravel and debris flows. The USGS has been developing a series of predictive models to predict the volume and probability of debris flows following burns as tools for reducing risk to life and property under various precipitation scenarios, and could serve as a natural resource management tool. We evaluate these models as they relate to amphibian and fish habitat and document the physical processes that take place following watershed burning from our recent observations. We also discuss recent data about ash from the 2007 firestorms as it potentially relates to distributional patterns observed following the 2003 firestorms. Active management through extreme measures may be required in some instances to salvage populations until ecological resilience is restored in the southern California landscape.

0260 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008

Morphological and Functional Investigation of the Radialis Muscle in Shark Tails

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The swimming kinematics and hydrodynamics of heterocercal tails in elasmobranchs have been the focus of a number of recent studies. However, the locomotor functions of the internal morphological structures of the heterocercal tail remain unexplored. In this study we examine the morphology and function of the radial muscle, or radialis, during swimming in the spiny dogfish *Squalus acanthias*. The radialis consists entirely of red muscle fibers and is located ventral to the segmented axial myomeres in the most distal region of the caudal fin, originating on the ventral processes of the vertebral column and inserting along the horizontal septum. The muscle fibers of the radialis share a similar fiber orientation and lie in close association with the deepest layer of the subdermal connective tissue sheets. We

combined bilateral electromyography of the radialis with simultaneous video to determine the point of activation of the radialis within the tailbeat cycle. Our results indicate that the radialis is active immediately after maximum lateral excursion of the caudal fin to the ipsilateral side. We also find that the activity patterns of the radialis on the right and left side of the body are approximately 180 degrees out of phase. Morphology and motor patterns of the radialis suggest that this muscle is acting as postural reinforcement, and controlling the orientation of the dorsal lobe of the caudal fin during steady swimming.

0627 Poster Session III, Sunday July 27, 2008

**Phylogeographic Structure of the Federally Threatened Slackwater Darter,
*Etheostoma boschungii***

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The Slackwater Darter is historically known from five independent tributaries to the south bend of the Tennessee River, including: Little Shoal Creek; Cypress Creek; Swan Creek; Brier Fork and Copeland Branch of the Flint River system; and several headwater streams of the Buffalo River system. This species requires two unique, contiguous habitats to complete successful reproduction: 1) Non-breeding habitat- small to moderately large streams; and 2) Breeding habitat- winter seepage water in open pastures or wooded areas. Since gaining federally threatened status in 1977, *E. boschungii* has declined in abundance at several sites and is nearly absent from several others. Recent studies have identified reduced connectivity among the two necessary habitats due to stream channel incision and road culvert construction. As a result, a captive breeding program has been initiated to maintain "Ark" populations of *E. boschungii*, yet nothing is known about the genetic composition of this species throughout its range. In order to provide a genetic foundation for further conservation plans of the Slackwater Darter, we used the complete mitochondrial ND2 gene to reconstruct the phylogenetic history of this rapidly declining species. Phylogenetic analysis, including numerous congeners as outgroup taxa, recovered *E. boschungii* as monophyletic and sister to *E. tuscumbia*. Within *E. boschungii*, Flint River specimens were basal and sister to a group containing Cypress Creek individuals plus Buffalo River individuals. We found slight haplotype variation within each of these three clades; however, the three lineages were highly diverged and well supported, with Cypress Creek and Buffalo River clades differing by 3.9% sequence divergence and Flint River individuals differing from the Cypress/Buffalo clade by 8.5% divergence. These results suggest that *E. boschungii* has been historically isolated among different drainages examined thus far. Samples from Shoal and Swan creeks are needed to further explain diversity within this species.

0620 Fish Conservation, Drummond, Sunday July 27, 2008; STOYE CONSERVATION

Conservation Genetics and Evolutionary History of the Federally Endangered Watercress Darter, *Etheostoma nuchale*

Brook L. Fluker

The University of Alabama, Tuscaloosa, AL, United States

The endangered Watercress Darter, *Etheostoma nuchale*, is native to only four springs of the Black Warrior River drainage in Alabama, including Glenn, Thomas, and Seven springs in the Valley Creek system and Roebuck Spring in the Village Creek system. It is also present in Tapawingo Spring (Turkey Creek system), where two-hundred individuals from Roebuck Spring were successfully introduced in 1988. A recent molecular phylogenetic analysis using the mitochondrial (mt) ND2 gene revealed a paraphyletic *E. nuchale*; Village Creek *E. nuchale* forms a monophyletic group with *E. swaini* (Gulf Darter) from Walker County Shoal Creek which is sister to Valley Creek *E. nuchale*. A combination of mtDNA sequence data and ten microsatellite loci were used to further investigate genetic structure among *E. nuchale* populations, including the evolutionary history with *E. swaini* from Walker Co. Shoal Creek. Four genetically distinct genetic populations were identified: (1) Glenn + Thomas springs; (2) Seven Springs; (3) Roebuck + Tapawingo springs; (4) Walker Co. Shoal Creek (*E. swaini*). Though the Walker Co. Shoal Creek population was genetically distinct from *E. nuchale* populations, a greater degree of genetic structure was found among Roebuck Spring *E. nuchale* and all other taxa. These results suggest that Roebuck Spring *E. nuchale* are substantially diverged from all other *E. nuchale* and from Walker Co. Shoal Creek *E. swaini* and that *E. nuchale* is a complex of two different species that potentially arose through multiple colonization events.

0693 General Herpetology I, Salons 4&5, Sunday July 27, 2008

Scaling in Snakes, and Damuth's Energetic Equivalence Rule: Snakes Don't Follow it

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Body size is one of the most fundamental properties of an organism, and its relationship to population abundance has long been a focus among biologists. Mean population densities generally decline with species' mean body mass (The Energetic Equivalence Rule) with a slope of -3/4 (Damuth's Rule). However, snakes have not previously been tested, and the local size-density relationships in discreet communities of snakes do not seem to follow Damuth's Rule. New snake data from a snake community in south Louisiana, as well as data from the literature will be presented and compared to the overall pattern of The Energetic Equivalence Rule. Possible explanations for the incongruence will be discussed, including the relative body size scale, ecology, and natural history of snakes.

0394 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Life History Traits of Cottonmouths (*Agkistrodon piscivorus*)

Neil Ford

University of Texas at Tyler, Tyler, Texas, United States

It is important to understand the factors influencing adult body size, growth, age at first reproduction and reproductive traits because these characteristics affect distribution and abundance of species. General studies that include considerable data for life history traits of cottonmouths have been conducted in Southwest Missouri, Northeast Texas, Northwest Arkansas, Virginia, North Carolina and Florida. Growth rates are faster in juveniles than adults and females stop growing sooner than males. Males grow larger than females in all areas but the eastern subspecies reach larger adult body sizes and take longer to mature than the western form. Age at first reproduction is 3 years or longer for all populations. Reproductive frequency is variable and appears to be consistent with a capital breeding strategy; females in some populations can reproduce in consecutive years but most take two or more to gain enough energy. Mean litter size varies by population but is greatest in the southeast (5.5 to 7.7) and lowest in northwest Arkansas (4.1). For most populations litter size is correlated with maternal SVL. Neonate length and mass are variable and often negatively correlated to litter size but also increase with maternal body size. Energy input is likely to be the factor producing the variation in life-history traits within and between populations.

0392 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Introduction to the Symposium: Cottonmouths, "*Agkistrodon piscivorus*": Cockroaches of the Snake World

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Cottonmouths, *Agkistrodon piscivorus*, are most often perceived with negative connotations both from the general public and even by herpetologists. They are not particularly colorful and usually considered to be aggressive. Despite this, the species has been a study animal for a number of biologists. There are several reasons for this. First, it is abundant, found in high densities in an incredible diversity of habitats in the southeastern United States: creeks, ponds, rivers, lakes, marshes, swamps and even marine environments. Second, it is relatively easy to work with; being large and heavy-bodied, and not particularly cryptic or hard to capture. It has a tolerance to the presence of humans not seen in other snakes, that allows actual field observations of behavior. Most important, however, in the selection of this species for study, is its adaptability to so many environmental conditions. A survey of early and current literature suggests these animals eat almost any animal live or dead, can survive in any environment, tolerate pollution, drought, and floods and maybe even human persecution. As the world degrades, those who have said only cockroaches will survive may want to add the cottonmouth to the list of animals

tough enough for our future world. This symposium is presented to focus attention of the value of this species in particular areas of study.

0299 Poster Session II, Saturday July 26, 2008

Cannulation of the Second Afferent Branchial Artery in Atlantic Cod, *Gadus morhua*, as a Method of Reducing Sampling-induced Stress

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Atlantic cod, *Gadus morhua*, is one of the most commercially important species in New England waters. Despite their importance, little is known about their stress physiology. As with most fisheries, some captured cod are subsequently discarded because of their small size or because quotas are exceeded. The fate of these discarded fish is not well understood. Understanding the amount of trauma endured during capture and the ultimate fate of these fish becomes important to fisheries regulators when assessing fishing mortality and its impact on stock sizes. In a pilot study designed to assess stress physiology, wild caught cod were kept in flow through seawater tanks at the University of New Hampshire's Coastal Marine Lab (New Castle, NH). Blood samples, taken to measure plasma cortisol levels, were obtained in two different ways to compare the stress induced by each sampling method. In one method, fish were captured from the tank, anesthetized, and blood samples were taken by syringe from the caudal vein. This occurred 3 times per week. In the second method, fish were cannulated by surgically inserting a piece of PE-50 tubing into the second afferent branchial artery, and were sampled once daily for a week. Plasma cortisol levels were analyzed by radioimmunoassay and compared statically using an ANOVA and a Tukey's test. It was hypothesized that plasma cortisol levels in the undisturbed, cannulated fish would be lower than those in the disturbed fish, and their plasma cortisol levels would better reflect baseline levels. Cortisol levels and cortisol profiles for each of the blood sampling methods will be reported.

0177 Herp Behavior, Salons A&B, Thursday July 24, 2008

Revisiting The Territorial Imperative: The *Desmognathus* Paradox!

Don Forester, Lynette Plenderleith, Marcie Wampler

Towson University, Towson, MD, United States

The Mountain Dusky Salamander (*Desmognathus ochrophaeus*) is reported to exhibit territorial behavior. We conducted experiments to determine whether adult salamanders exhibit prior residence during encounters with equally sized conspecifics (*i.e.*, does familiarity with a territory predict successful defense). We collected 154 adult salamanders (72 females, 82 males) from the Allegheny Mountains of western Maryland, USA and divided them into pairs matched by size and gender. Salamanders were housed and tested in a climate controlled room

(16±2°C; 15L:9D photoperiod) and fed fruit flies twice weekly. Prior to testing, we placed 'resident' salamanders in individual bioassay trays (12.5 x 12.5 cm) on a substrate of moistened filter paper for one week, and allowed them to establish territories. At the beginning of a trial, we added an 'intruder' to the dish and monitored the behavior of both salamanders for 20 minutes under dim red light. Two weeks after the first trial, we performed a reciprocal trial, with the previous intruder becoming resident. We catalogued a suite of agonistic behaviors including: fore-trunk raised (FTR), all trunk raised (ATR), nudge, bite, multiple bite and jaw lock. We calculated an index of aggression (IA) for each animal as a resident and intruder. Our data reveal that males are significantly more aggressive than females (mean combined IA for 41 pairs of males during the first round =16.0; 36 pairs of females=7.1; $W=1205$, $p \leq 0.043$), but resident salamanders (regardless of their sex) are not significantly more aggressive than intruders. Salamanders of both sexes displayed significantly less aggression during their second trial (perhaps due to familiarity) and when the data were pooled across sexes this decrease was significant ($p \leq 0.037$). Although *D. ochrophaeus* exhibit stereotypic, agonistic behaviors similar to those reported for *Plethodon*, unlike *Plethodon* the outcomes of symmetrical social encounters are not influenced by residential status.

0068 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Foraging Site Selection in Prairie Kingsnakes: An Experimental Examination

Angela M. Fornell, Stephen J. Mullin

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A critical component to a predator's survival is the choice of foraging sites that yield enough predatory success to meet energetic demands. To elucidate cues used to select foraging sites, we examined foraging site selection in prairie kingsnakes (*Lampropeltis c. calligaster*), a generalist species whose foraging mode is phenotypically plastic. Our objectives were to determine: the pattern of foraging site selection; the importance of chemical and physical cues that kingsnakes use when foraging; and, whether or not kingsnakes adjust their foraging patterns in response to alterations in the microhabitat. We tested subjects in a large experimental arena under several treatment conditions that simulated various components of a natural habitat setting. We quantified changes in subject behavior in response to the presence of a chemical trail and/or physical cue, as well as interrupting a chemical trail cue with a physical cue. Our subjects spent more time investigating edge microhabitats within the enclosure, and more time in areas that had been treated as opposed to those that had not been primed with any cues. Physical cues might play a larger role than chemical cues when selecting foraging sites under certain habitat conditions. Regardless of the presence or manipulation of cues, snakes spent more time performing active foraging behaviors than they did foraging from a stationary position (i.e., ambush posture). This is consistent with the foraging strategy for this genus. Plasticity in foraging behavior appears to facilitate predatory success in Prairie Kingsnakes, even when confronted with an altered microhabitat.

0593 Fish Conservation, Drummond, Sunday July 27, 2008

Cryptic Threats to the Adaptive Radiation of Threespine Stickleback (*Gasterosteus aculeatus*)

Susan Foster, John Baker, Rachel Chock, Matthew Wund

Clark University, Worcester, MA, United States

The adaptive radiation of the threespine stickleback, *Gasterosteus aculeatus*, is unusual in that modern oceanic stickleback are thought to closely resemble the oceanic populations that gave rise to the post-glacial radiation in coastal freshwater habitats. Thus, we can use modern oceanic fish to infer ancestral character states with unusual assurance, and can use them to infer character polarity in the radiation. This allows us to address a wide range of evolutionary issues in ways rarely possible in the vertebrates- potential that is further enhanced by genome sequencing and development of an array of molecular tools that permit evaluation of the genomic causes of diversification and parallelism in this remarkable radiation. The value of this radiation for exploration of the causes of evolutionary diversification depends on the continued existence of both oceanic and unusual, derived freshwater populations. In some cases, extreme populations and even species pairs have been lost to extinction. In other cases however, the loss has been more cryptic, involving hybridization or microevolutionary loss of some extreme phenotypes. In the latter cases, the unusual phenotypes are lost through evolutionary reversion to ancestral types, or to types more typical in the region. We argue that anthropogenic change tends to homogenize environments, and that it is causing a cryptic reduction in population diversity in the radiation. Because this loss of biodiversity occurs without extinction it can easily proceed unnoticed. We conclude by arguing that such cryptic decline in diversity poses a tremendous threat to this radiation - and that it will be very difficult to curtail given the general abundance of threespine stickleback throughout its range.

0559 Herp Genetics, Salons A&B, Sunday July 27, 2008

Parentage Analysis of the Fossorial Sand Skink, *Plestiodon reynoldsi*

Alicia Fox, Aaron Schrey, Henry Mushinsky, Earl McCoy

University of South Florida, Tampa, FL, United States

Understanding the reproductive behavior of secretive species is an important aspect when conducting studies for conservation and management. In order to make decisions related to management it is beneficial to know the proportion of individuals contributing to the gene pool, as well as the patterns of dispersal. The 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 has been found among distinct geographic samples across the range of the sand skink, but there is information lacking regarding its mating system and fine-scale dispersal patterns. The goal of this study is to investigate parentage, reproductive success, and genetic relatedness among sand skinks sampled within a

single scrub location near Davenport, Florida. Four sites (less than 2 km apart), consisting of multiple transects of pitfall arrays, were used to sample the Davenport location for sand skinks ($N > 500$). Parentage analysis will be performed among all individuals sampled and estimates of relatedness will be calculated for each site using multiple microsatellite loci. Significant genetic differentiation exists among the four sites, suggesting a lack of gene flow. Low rates of dispersal or the existence of neighborhoods of closely related individuals could be reasons for the apparent lack of gene flow. Characterizing these fine scale genetic properties of a local scrub habitat will provide needed information for conservation efforts, especially if detectable family structure exists.

0290 Fish Conservation, Drummond, Sunday July 27, 2008

The Role of Fishing Pressure in Structuring American Eel Population Dynamics in the St. Jones River, DE

Dewayne Fox¹, Colette Cairns¹, Larissa Bailey², Kyle Shertzer³

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Due to perceived declines in abundance of anguillid (*Anguilla spp.*) eels, there have been calls for more comprehensive data on eel ecology. The American eel (*A. rostrata*) supports an important commercial fishery in the mid-Atlantic region which accounted for 83% of the total US landings in 2005. To better understand the population dynamics of American eel, we initiated a mark-recapture study with both fishery-dependent and fishery-independent components in the St. Jones River, DE. All American eel captured ($n=10,118$) were PIT tagged and released. Higher salinity sites, which experienced the most commercial pressure, generally produced larger catches but with smaller ($<350\text{mm}$) eel. In total, there were 5,860 recapture events, of which 3,506 (59.8%) were from fishery-independent sampling and 2,354 (40.2%) were via the commercial harvest. Preliminary analysis of recaptured individuals reveals that the majority ($<80\%$) are recaptured at the initial site of tagging; in addition, there appears to be no clear seasonal pattern in degree of movement. Through this project, we will be able to generate estimates of survival and to assess the impact of the commercial harvest on the St. Jones River population of American eel. Mortality estimates generated through a combination of recaptures and tag return data showed an increase in mortality during months when fishing occurred. Our findings show the strength of working closely with harvesters to develop a more thorough understanding of American eel population dynamics.

0155 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

Distribution and Assemblages of New Zealand Demersal Chondrichthyans

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National Institute of Water and Atmospheric Research, Wellington, New Zealand

Data from more than 19,000 research trawl tows were used to determine the depth and latitudinal distributions of New Zealand's demersal chondrichthyans. Thirty-seven species or species groups of sharks, rays, and chimaeras were included, of which 28 were deepwater forms, preferring depths greater than 200 m on the continental slope. Skates and rays generally occurred shallower than 600 m, except for *Brochiraja* spp. and *Bathyraja shuntovi*, which extended to 1200 m and 1400 m respectively. Chimaeras were typically found deeper than 400 m, except for *Callorhinchus milii* (shallower than 100 m) and *Hydrolagus novaezealandiae* (200–500 m). Shark species occurred from the surface to depths exceeding 1450 m (the effective maximum depth of the trawl samples). Most species had wide latitudinal ranges (10–15°), but some were restricted to northern waters (*Dasyatis brevicaudata*, *D. thetidis*, *Myliobatis tenuicaudatus*, *Sphyrna zygaena*, *Centroscymnus coelolepis*), some to central New Zealand (*Callorhinchus milii*, *Typhlonarke* spp.), and one to southern waters (*Bythalaelurus dawsoni*). Depth range was positively correlated with preferred depth and latitudinal range was positively correlated with preferred latitude. Assemblages of species were determined using correspondence analysis and Ward's cluster analysis. Species split into two main groups: those preferring depths shallower and deeper than 400 m, respectively. The shallow group was further subdivided by latitude into northern and central New Zealand assemblages. The large deepwater assemblage was relatively stable because of strongly overlapping depth and latitudinal ranges for many of the species.

0054 Poster Session I, Friday July 25, 2008; CARRIER

Preliminary Results on the Life History of Four Bering Sea Skate Species, Genera *Bathyraja* and *Rhinoraja*

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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 at Moss Landing Marine Laboratories are continuing their efforts to collect, analyze, and synthesize important life history information, including age, growth, and reproduction, of various chondrichthyans and other fishes, to be used for fisheries management. The four species in the current study include the commander skate, *Bathyraja lindbergi*, whiteblotched skate, *Bathyraja maculata*, whitebrow skate, *Bathyraja minispinosa*, and mud skate, *Rhinoraja taranetzi*. Samples have been, and will continue to be, collected during NOAA Fisheries survey cruises in the eastern Bering Sea and through the observer program. At this time, more than 230 *B.*

lindbergi, 170 *B. maculata*, 215 *B. minispinosa* and 145 *R. taranetzi* have been collected. Vertebrae, caudal thorns, and reproductive organs from each species will be used to estimate age and maturity. Preliminary estimates of total length at 50% maturity are: *B. lindbergi* females 77.9 cm and 84.2 cm for males, *B. maculata* females 96.0 cm and 98.0 cm for males, *B. minispinosa* females 66.38 cm and 68.85 cm for males, and *R. taranetzi* females 61.4 cm and 57.9 cm for males.

0057 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

What Happens after We Throw Them Back? The Physiological Response of Sharks to Capture Stress

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Quantifying post-release mortality of chondrichthyans poses a considerable challenge to researchers. Understanding the physiological mechanisms that can carry an organism beyond its homeostatic limits under very stressful circumstances is of paramount importance to developing a method that allows predicting the post-release fate of an animal. However, studying the capture-related stress physiology of chondrichthyans in the field is very difficult because many factors such as duration of stress exposure or water temperature, may have profound effects on physiological processes, and obtaining further blood samples without recapture is virtually impossible once an animal is released. To avoid the difficulties associated with monitoring the condition of sharks following capture and release in the wild, we captured Port Jackson sharks, *Heterodontus portusjacksoni*, and gummy sharks, *Mustelus antarcticus*, by gill-net, hook-and-line, and trawl-net in a controlled laboratory setting, and measured struggling effort and obtained repeated blood samples during a recovery period of 72 hours post-stress. We found dramatic species-specific differences in stress tolerance. Increasing plasma lactate concentration appears to be a good indicator of stress in sharks. Lactate accumulates in white muscle cells as a metabolic by-product of anaerobic muscle activity, and is slowly released into the bloodstream, but a lack of concordance between struggling effort and plasma lactate concentration suggests that elevated circulating lactate levels do not merely reflect increased physical activity of an animal. Different types of fishing gear affected sharks to a varying degree, but the duration of stress exposure had a minor effect on the magnitude of the lactate response. In some cases, severe disturbance of the electrolyte balance presumably led to delayed mortality. Plasma lactate and potassium levels were extraordinarily high in moribund sharks. The data collected will be very useful in understanding and managing the consequences of capture stress.

**0282 General Ichthyology II, Salons 6&7, Saturday July 26, 2008; STOYE
GENERAL ICHTHYOLOGY**

**Primitive Pleuronectiform Conditions and the Evolutionary Origin of
Flatfish Asymmetry: New Insights from Old Fossils**

Matt Friedman

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All living flatfishes (Pleuronectiformes) have highly asymmetrical skulls, with both eyes placed on one side of the head. This arrangement, which is one of the most extraordinary anatomical specializations among vertebrates, arises through migration of one eye during post-larval development. While the transformation of symmetrical juveniles into asymmetrical adults is well-documented, the evolutionary origins of flatfish asymmetry are uncertain because there are no transitional forms linking flatfishes with their symmetrical relatives. The supposed inviability of such intermediates has given pleuronectiforms a prominent role in debates on the mode and tempo of evolution, leading to attacks on natural selection and arguments for saltatory change. To date, paleontology has failed to illuminate flatfish origins; all extinct pleuronectiforms have been placed within the crown group. Using data from newly prepared fossils and computed tomography (CT) scanning, I show that †*Amphistium* and a new genus, both from the Eocene (56-40 Ma) of Europe, are the most primitive pleuronectiforms known, falling along the stem outside the extant radiation. These two taxa have strongly asymmetrical skulls, like living flatfishes, but they display primitive characters unknown in extant forms, providing a new picture of generalized pleuronectiform conditions. The most remarkable feature of these fossils is incomplete orbital migration, with eyes remaining on opposite sides of the head in post-metamorphic individuals. This condition is intermediate between that of living pleuronectiforms and the arrangement found in other fishes, indicating that the evolution of the profound cranial asymmetry of extant flatfishes was gradual in nature. Like the anatomically primitive living pleuronectiform *Psettodes*, †*Amphistium* occurs as both right- and left-handed morphs at near-equal frequency, establishing antisymmetry as the primitive condition for flatfishes. This corresponds to a general pattern in the evolution of post-larval asymmetries, where an antisymmetric phase precedes fixation of one chiral morph.

0315 Fish Systematics I, Salons A&B, Friday July 25, 2008

**Biodiversity and Systematics of African Sucker-mouthed Catfishes
(Mochokidae: Chiloglanidinae)**

John Friel, Thomas Vigliotta

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The subfamily Chiloglanidinae of the Mochokidae contains more than 60 nominal species widely distributed in African river systems. Members of this subfamily are readily distinguished from other African catfishes by distinctive jaws and lips modified into a sucker or oral disc used for adhering to and feeding upon objects in

fast flowing waters. The overall body form of chiloglanidins is remarkably convergent with similar morphologies that have evolved independently in some Neotropical catfishes (Astroblepidae and Loricariidae) and some Asian catfishes (Subtribe Glyptosternina of the Sisoridae). As currently recognized, this clade contains just 3 genera, *Chiloglanis*, *Atopochilus*, and *Euchilichthys*. Recent fieldwork for the All Catfish Species Inventory along with a review of museum collections has revealed a much higher level of morphological and taxonomic diversity than was previously known. Preliminary results of our ongoing systematic study of this clade will be presented. This will include rediagnoses of genera, the synonymization, resurrection, and reassignment of some species, and the descriptions of new taxa.

0058 Fish Conservation, Drummond, Sunday July 27, 2008; STOYE CONSERVATION

Life History and Population Structure of *Beryx decadactylus* (Berycidae) in the Western North Atlantic

Claudia Friess

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Beryx decadactylus (red bream) is a deep-sea benthopelagic fish with a circumglobal distribution on insular and continental slopes and seamounts. It is commercially exploited together with its congener *B. splendens*, and catch rates for both species have declined. Limited biological information for management of red bream is available from a few studies conducted around the Azores and, where species data are unavailable for management, biological parameters are assumed to be similar to those of *B. splendens*. In the United States, red bream is caught incidentally in the wreckfish (*Polyprion americanus*) fishery which operates off the southeast coast. The aim of this study was to determine the life history parameters of the local red bream population and investigate its genetic stock structure in the North Atlantic. Specimens sampled from the wreckfish fishery ranged from 410 to 630 mm fork length, and were all determined to be mature through gonad histology. Females in spawning condition were observed from June - September, while males were found to be in spawning condition rear-round. Sectioned otoliths were difficult to interpret, but age estimates were higher than previously reported from whole otoliths. Ages ranged from 23 to 76 years, with a mean age of 44 years. Even the youngest fish observed exceeds the reported maximum age by several years. Red bream thus appears to be slower growing and longer lived than previously assumed, which has important implications for management. Analysis of the mtDNR control region showed that eastern and western North Atlantic populations are genetically identical ($F_{ST} = -0.003$), suggesting that there is transatlantic gene flow occurring through passive drift of larvae or adult migration. The potential of a shared stock between the eastern and western North Atlantic will need to be considered if a directed fishery for red bream should develop in the United States.

**0678 Fish Ecology II, Salons A&B, Monday July 28, 2008; STOYE
ECOLOGY & ETHOLOGY**

The Effect of Hypoxia on Habitat Selection of Juvenile Estuarine Fishes

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TX, United States*

Hypoxic events where dissolved oxygen concentrations fall below 2 mg/l are becoming a wide-ranging phenomenon. However, there has been little research on the impact of hypoxia on habitat selection of juvenile fishes. We designed a series of mesocosm experiments to assess the relative influence of hypoxia and seagrass on habitat selection for three common estuarine species, Atlantic croaker (*Micropogonias undulatus*), pinfish (*Lagodon rhomboides*), and red drum (*Sciaenops ocellatus*). Experiments were conducted using a large mesocosm where a dissolved oxygen gradient was established. Artificial seagrass units (ASU's) and sand were used as habitat treatments. All three species could detect and respond to both the oxygen concentration and habitat treatments. The response between the habitat and oxygen concentration was hierarchical and interactive. In conditions where oxygen concentrations were <2 mg/l, fishes chose the region with the greatest oxygen concentration. However, at moderate levels of hypoxia (4 mg/l), habitat selection was primarily influenced by availability of the preferred habitat. Results indicate that hypoxic events may strongly affect habitat selection of juvenile fishes, and this may alter subsequent distribution patterns and biological interactions within estuarine communities.

0148 Poster Session I, Friday July 25, 2008

**Multiple Cryptic Species and/or Frequent Gene Introgression? A tale from
Three High Elevation Tibetan Megophryid Frogs**

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Frogs of the genus *Scutiger* are the dominant amphibian species at the eastern escapement of the Tibetan Plateau. *Scutiger boulengeri*, *S. glandulatus* and *S. mammatus* are the only three widespread species in the genus. Using DNA sequence data from both mitochondrial and nuclear genes, several cryptic species were identified. Allozyme electrophoretic data were also used for species identification. Moreover, several gene introgression events among the three species were also detected. This study illustrated the importance of incorporating information from nuclear genes in species delimitation.

0707 Poster Session III, Sunday July 27, 2008

South Nayarit, Mexico Commercial Marine Ichthyofauna Composition for (2007-2008)

Patricia Fuentes, Aurora Moreal, Eugenia Arenas, Laura de C lopez, Alejandro Liedo

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The present work carried in Bahía de Banderas south coast of the State of Nayarit, between Cabo Corrientes and Punta Mita during the construction of Marina La Cruz. The objective was to describe the composition of the marine fish for fishing system select the localities for fisheries. The commercial capture was studied in March of 2007, time considered as transition of ENSO-NEUTRAL to conditions The Niña and in March of 2008, time with more intense conditions of The Niña, and with the lowest TSM for the last 14 years. It was also studied the month of November of the 2007, considered transition to coldseason and when presented moderate intensity of conditions The Niña, period whwn *Lutjanus peru* prevailed (huachinango) and other spesces of the gender (pargos), captured together with *Nematistius pectoralis*, (rooster), *Scarus perrico*, (parakeet), *Euthynnus affinis* (tuna) and a group of 19 more species. The proportion varies between 50 and 65% of the goel especies against associate. The goal species objective in March 2008 was *Scomberomorus sierra* (sierra), and other eight species of high commercial value: *Paralichthys aestivalis*, *Ancylopsetta dendritica* and *Citarichthys gilberti* (soles), *Seriola peruviana* (pirriri), *Caulolatilus affinis* (conejo), *Hoplopagrus guentheri* (coconaco), *Lutjanus guttatus* (lunarejo) and *L. argentiventris* (yellow grunt), with a net meshes of a net of 3 ¼", then an average proportion of 60% (objective) 40% (associate). In these last ones the group of Carangidae, Haemulidae, Sciaenidae, Callyonimidae, Gerreidae, Mullidae, Triglidae, Polynemidae and Stromateidae, among other families, being on the whole 35 species.

Poster Session III, Sunday July 27, 2008

Four new *Amolops* species from Myanmar

Allison Fuiten

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We describe four new species of torrent frogs from the genus *Amolops* from the Kachin, Shan, Chin, Rakhaing, Tanintharyi and Mon states of Myanmar. Both species differ from all other described *Amolops* based on a unique combination of morphological characteristics such as the presence of vomerine teeth, presence of circummarginal grooves on all fingers, presence of vocal sacs on males, lack dorsolateral fold, lack of fringe of skin on third finger, lack of axillary glands, and lack of a distinct color pattern on the posterior aspect of the thighs. The four species groups were formed based on geographic distribution, variation of the body size (with significant ANOVA results), and presence or absence of banding on the limbs – all of which directly corresponded with the the distinct clades that resulted from a

molecular phylogenetic survey of the 16s ribosomal gene conducted on 40 out of the 218 studied frogs.

0470 Poster Session III, Sunday July 27, 2008

Pollutants as Limiting Factors on Wood Frog Use of Stormwater Ponds in a Suburban Watershed

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Stormwater ponds serve as potential aquatic habitat for breeding amphibians. To date, stormwater ponds are not constructed or managed as wildlife habitat, but rather to mitigate the effects of increasing impermeable surface on natural waterways. Since these ponds are designed to hold increased runoff and to accumulate a variety of pollutants with potential toxic effects, they may play a role in shaping amphibian distributions in urban and suburban landscapes. The purpose of this study was to investigate relationships between pollutant levels and the distribution of breeding wood frogs (*Rana sylvatica*) among stormwater ponds of the Red Run Watershed in Baltimore County, Maryland. We identified all stormwater ponds in the watershed using aerial photographs, LIDAR, and field visits. We randomly selected a subset of 69 ponds for sampling of wood frogs and pollutants. We used calling and egg mass surveys to determine wood frog use of ponds, and we determined heavy metal (zinc, nickel, copper, chromium, and lead) and chloride levels in sediment and water samples, respectively. An information-theoretic approach to modeling identified chloride (Cl), copper (Cu), and their interactions as limiting factors in wood frog use of ponds. At Cl levels less than 10 ppm, breeding wood frogs utilized ponds with a wide range of sediment Cu levels. At chloride levels greater than 10 ppm, wood frog breeding was restricted to ponds with sediment Cu levels at or below 50 ppm. Wood frogs did not breed in ponds with Cl levels exceeding approximately 200 ppm. Future work will involve relating adjacent land use and hydrological variation to pollutant levels and use by wood frogs.

0374 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Is There a Sustainable Turtle Harvest in Minnesota? Estimating Harvester Effort and the Impact of a Commercial Harvest on Painted Turtle Populations

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Painted turtles are captured in large numbers in Minnesota for the pet and biological supply trades. I will describe the scope and management of this harvest and its implications on painted turtle populations. I conducted fieldwork, using trapping methods comparable to those used by commercial harvesters, to approximate the proportion of a painted turtle population "harvested" given varying amounts of effort. Incorporation of this effort data into an age-structured matrix model, using

previously published population parameters, suggests there is the potential of long-term impact of commercial harvest on painted turtle populations. Minimal harvester effort can result in population declines in the model although increasing the time between harvest events allowed a larger portion of the population to be sustainably removed. Even allowing for infrequent harvest events, the typical range of harvester effort was enough to initiate population decline. I discuss how violations of modal assumptions may buffer the actual impact of commercial harvest in the field.

0376 Poster Session I, Friday July 25, 2008

Into the Light: Opsin Evolution and Multiple Origins of Diurnality in Geckos

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Geckos are a large and diverse group of lizards containing 1,100+ species in 108 genera. Most geckos are nocturnal but species in 15 genera are secondarily diurnal, that is, they have become adapted to diurnality from a nocturnal ancestor. We performed ancestral state reconstructions of diel activity across a multi-gene phylogeny of all gekkotan genera and recovered multiple, independent origins of diurnality in geckos. We sequenced opsin genes from multiple diurnal and nocturnal gecko species. Opsins are the light-sensitive proteins in the retina that convert light into an electrochemical signal. We found high levels of convergence in the opsin genes of independently derive diurnal gecko lineages suggesting strong selective pressure to fine-tune the eyes to their light environment.

0708 Poster Session I, Friday July 25, 2008

Genetic structure in epigeal population of *Astyanax mexicanus* at Mexican Atlantic slope and some biological data in blind forms.

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The Mexican tetra, *Astyanax mexicanus* is successful species with high capacity to dispersion and adaptation to different habitats, including aquifers. Along its range this species have two morph-types; a normal epigeal and other ones hypogeal blind and without pigmentation habiting aquifers in Northwestern of Mexico. The morphological monotony a long its range had raised confusion on specie's taxonomic status; however it is possible there is cryptic species. We are interested to know the genetic structure along the most part of its range along Mexican Atlantic slope and contribute to knowledge of life historic traits of blind morph is habiting on three caves of Northwestern Mexico. Here we are present the polymorphism of two microsatellite loci (Ast-01 y Ats-09) on seven epigeal populations of *Astyanax*

mexicanus form Coahuila (COA), Tamaulipas (TAM), San Luis Potosí (SLP) y Veracruz (VER). We studied a total of 203 individuals. The polymorphism observed was moderated; nine alleles were detected on Ast-01 and eight in Ast-09; average observed heterocigosity was of 0.79. We found a genetic differentiation ($F_{st} = 0.18$, $P = 0.001$) and an isolation by distance structure. We found three different groupings; Northern ones and very different (Cuatrociénegas, COA); other intermediate ones (San Fernando y Soto la Marina, TAM) and finally a southern ones (Pánuco SLP and Tuxpan, VER). Also we are presenting biological data (length and weight relationship, sex ratio, sexual maturation and food consuming) of 650 individuals studied from the caves Pachón, Sabinos y Tinajas.

0696 Fish Conservation, Drummond, Sunday July 27, 2008

Genetic Diversity of Native Populations of Largemouth Bass (*Micropterus salmoides*) in Northeastern Mexico

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Eight species are known in the genus *Micropterus*, two of which, the introduced Florida bass (*M. floridanus*) and native Northern bass (*M. salmoides*) are present in northeast of Mexico. Studies of genetic diversity in these species have never been done in Mexico. We collected 290 individuals from the Bravo (Grande), San Fernando and Soto la Marina basins to study morphological and genetic variation. Morphological characteristics did not differentiate *M. salmoides*, *M. floridanus*, or their hybrids. Thus, the specimens were identified using biochemical markers. We also evaluated polymorphism of 5 microsatellite loci and a fragment of 12S and 16S RNAs of mitochondrial DNA. The genetic data were analyzed to determine population structure and impact of introductions. The population in Vicente Guerrero (VG) reservoir within the Soto la Marina basin is a hybrid population. *M. floridanus*'s alleles and haplotypes decreased upstream from VG reservoir, and were not found in some headwater populations. Therefore, we consider these to be native population of *M. salmoides*. In Cuatro Ciénegas, a protected area well known for its endemic and endangered species, we found evidence of introductions of *M. floridanus*. We discuss the need to conserve this native population.

0342 General Ichthyology I, Drummond, Saturday July 26, 2008

They Eat with It, Breathe with It, and Hang on with It: A Kinematic Analysis of the Use of the Sucker Mouth in South American Catfishes (Loricariidae, Siluriformes)

Tom Geerinckx¹, Dominique Adriaens¹, Anthony Herrel²

¹*Ghent University, -, Belgium*, ²*Harvard University, Maine, United States*

The neotropical loricariid catfishes use their sucker mouth not just for respiration and feeding, they also use it to stay attached to the substrate, be it a rock or a submerged tree in a South American river, or an aquarium wall in the Ghent University. This represents a very useful and amazingly evolved ability, especially for those species living in fast flowing rivers. Following a morphological study of the armored suckermouth catfish *Pterygoplichthys disjunctivus* and several other loricariid species, to examine those internal structures involved in the mouth and head movements, a kinematic analysis of the focal species was done to establish which how the mobile parts are engaged in the respiratory processes during breathing free from any substrate, touching the substrate and powerfully adhering to the substrate. High speed video recordings of external and internal structures (using X-ray equipment) of several specimens were analysed to determine how respiration is adjusted or constrained during weak or powerful suction onto substrates. Apart from a close adhesion of the suction disc, the respiration rhythm is strongly affected: hyoid movements vary, the lateral inspiration openings (operated by the modified maxillary barbel) are minimized or only unilaterally used, and the gill openings stay closed as much as possible to maintain underpressure. The role of the oral valve or velum, unique in being muscularly controlled in these fishes, becomes critical. It appears that the functions of breathing and adhering can be combined in all but most extreme situations, in which suction fails, due to either muscle tiredness or impaired respiration.

0344 Poster Session III, Sunday July 27, 2008

The Fish that Scrapes its Food: A Kinematic Analysis of the Scraping Jaw Movements in the South American Suckermouth Armored Catfishes (Loricariidae, Siluriformes)

Tom Geerinckx¹, Anthony Herrel², Dominique Adriaens¹

¹*Ghent University, -, Belgium*, ²*Harvard University, Maine, United States*

Loricariidae or suckermouth armored catfishes possess upper and lower jaws that are ventrally oriented, and bear teeth that touch the substrate from which algae and other food items are scraped. The ventral orientation and the highly specialised morphology of the jaws, characterised by protrusible upper jaws and left-right decoupled lower jaws are observed in *Pterygoplichthys disjunctivus*. Kinematic data of the scraping feeding movements, obtained by external high-speed and X-ray recordings are used to test the hypothesis that the decoupling of the jaws has led to increased functional mobility and versatility. Results show that the mobility of the

jaws is indeed high. The upper jaws are able to perform a substantial degree of protrusion, unique for catfishes. The ventromedially oriented lower jaws with the teeth and the coronoid process at opposite sides of the jaw bones, display an even larger mobility: they rotate around the suspensorial articulation and around their longitudinal axis, resulting in an extended scraping movement thereby covering a large surface area. The lower jaws also show a left-right asymmetry in their movements during scraping. These results suggest that the extreme morphological specialisations of the jaws in loricariid catfishes have indeed resulted in increased mobility and functional versatility, allowing these animals to efficiently scrape algae off the substrates with irregular surfaces.

0452 Poster Session II, Saturday July 26, 2008; STORER ICHTHYOLOGY

Fish Community Persistence And Stability In The Pearl River: A Contemporary Study

Aaron Geheber

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The Pearl River is a diverse Gulf Coastal drainage in Mississippi and Louisiana. Approximately 119 species of freshwater fishes occur in the basin. Multiple environmental perturbations have occurred throughout the basin including river impoundments, stream channelization, and poor land-use practices. Quarterly surveys were conducted in the Pearl River at selected historically sampled sites from Monticello, Mississippi (Upper Pearl River survey: 8 sites) southward to Bogalusa, Louisiana (Lower Pearl River survey: 8 sites). The objective of this preliminary study was to assess persistence and community stability of fish assemblages over a two year time frame. The fish community was dominated by several species of cyprinids including *Cyprinella venusta*, *Notropis volucellus*, *Notropis longirostris*, and *Pimephales vigilax*. Indices of diversity show fish community persistence across seasons and years suggesting stability in the fish community throughout the basin. The implications of these results and future directions of this study will be discussed.

0404 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

Shark Pharming: Human Pharmaceutical Exposure and Uptake in Juvenile Bull Sharks (*Carcharhinus leucas*) Residing in Wastewater-impacted Freshwater Habitats

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Recently, there has been growing concern about the ecological and human health risks posed by pharmaceutical-related pollutants originating from human excretion. These compounds can have unexpected and often profound effects on non-target species because many drugs function by altering biological processes that are common in most organisms. Since these contaminants enter the natural environment primarily through domestic and industrial wastewater discharge, they pose their greatest threats to wildlife residing in aquatic habitats bordering highly populated regions. However, there has been very little research conducted on the exposure to and uptake of these pollutants in aquatic species. In this presentation, we discuss data on the presence and concentrations of nine widely prescribed human pharmaceuticals in juvenile bull sharks (*Carcharhinus leucas*) residing in wastewater-impacted Florida rivers. The compounds that were examined include the synthetic estrogen commonly used in human contraceptives, 17 α -ethynylestradiol (EE2); the antidepressants (Brand names listed in parentheses) citalopram (Celexa), fluvoxamine (Luvox), paroxetine (Paxil), sertraline (Zoloff), venlafaxine (Effexor), and fluoxetine (Prozac); the lipid-lowering compound, atorvastatin (Lipitor); and the impotence drug, sildenafil citrate (Viagra). Several of these compounds have been detected in surface waters of aquatic ecosystems and the tissues of aquatic organisms in previous studies. Two of these compounds, EE2 and fluoxetine, have also been shown to be capable of altering reproduction and/or embryonic development in aquatic vertebrates. Juvenile bull sharks depend on freshwater and brackish rivers as "nursery grounds," areas that are believed to provide young fish with protection from predators and abundant food to sustain high survival and rapid growth to maturity. Since these habitats are increasingly contaminated by wastewater-related pollutants including human pharmaceuticals, it is important to assess the risks that these contaminants pose to this unique species. By doing so, our larger study will contribute valuable data on a non-fishing related human activity that may adversely affect Essential Fish Habitat for *C. leucas*.

0750 Poster Session I, Friday July 25, 2008

Amplified Fragment Length Polymorphisms Reveal Population Structuring and Long Distance Dispersal in New Caledonian Insular Gecko Species (Reptilia: Diplodactylidae)

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Bavayia is a genus of diplodactylid geckos endemic to the South Pacific island of New Caledonia and its offshore islands. Recent molecular phylogenetic analyses show this group is far more speciose than previously thought and has yielded evidence of numerous instances of microendemism. Given this capacity for limited species range, a population of *Bavayia* restricted to the southern Ile des Pins and its surrounding satellite islets was identified as an additional putative species. The limited dispersal ability of *Bavayia* species and the relative isolation of this population from the main island of New Caledonia are consistent with this interpretation. Molecular phylogenetic analysis of a mitochondrial gene (ND2) reveals that the majority of individuals from the Ile des Pins and its surrounding islands form a well-resolved clade, representing a new *Bavayia* species. However, seven individuals collected from these islands were nested within two other nominal species (*B. crassicollis* and *B. robusta*). Examination of these populations using Amplified Fragment Length Polymorphisms (AFLPs) yields a cladogram supporting the reciprocal monophyly of each the nominal species as well as the Ile des Pins *Bavayia*. The seven aberrant individuals identified by mtDNA analyses present disparate evolutionary histories. Two individuals share mitochondrial and AFLP affinities with distant (>100km) gecko populations of *B. crassicollis* and *B. robusta*. The remainder have mixed mitochondrial and nuclear evolutionary histories and are likely descendants of past hybridization events between *B. robusta* and the Ile des Pins *Bavayia*. The presence of disparate organellar and genomic evolutionary histories within a population provides evidence for either incomplete lineage sorting of mitochondrial haplotypes or the introgression of mitochondrial haplotypes. Here, comparison of these disparate results and consideration of the phylogenetic position of these three taxa indicate multiple instances of mitochondrial introgression due to past hybridization, possibly attributable to ethnophoresy.

**0240 Fish Physiology, Salons 6&7, Sunday July 27, 2008; STOYE
PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY**

**Digestive Enzyme Activities in Wood-eating Catfishes: Sources and
Consequences**

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I measured the activities of 13 digestive enzymes in the guts of four species of loricariid catfishes representing xylophagy (wood-eating) and detritivory. Enzyme activities were measured from the hepatopancreas (representing fish enzymes), as well as from pelleted gut contents (representing microbial enzymes), gut fluid (representing fish and microbial enzymes), and rinsed gut wall (also representing fish enzymes) from three regions of the gut in wild-caught *Panaque nocturnus*, *P. panope*, *Hypostomus pyrineusi* (formerly of genus *Cochliodon*), and *Pterygoplichthys disjunctivus*. Cellulolytic and xylanolytic activities were low and largely restricted to the pelleted gut contents of the proximal intestine. α -glucosidase, α -mannosidase, and chitinase activities were each found in the pelleted gut contents and in the gut walls of the fish. However, the Michaelis-Menten constants (K_m) of α -glucosidase and chitinase from the gut walls of the fish were an order of magnitude lower than those of the pelleted gut contents, indicating that the fish more efficiently digest disaccharides than do microbes in the pelleted gut contents. All digestive enzymes decreased in activity moving distally along the intestine. Because the cellulolytic and xylanolytic activities were largely found in the pelleted gut contents of the proximal intestine, this suggests that the sources of these enzymes are microbes ingested with wood and detritus rather than an endosymbiotic community. Transmission electron microscopy has revealed no conglomerations of microbes in any region of the digestive tracts of the four species, and gut transit times for wood are less than four hours. I hypothesize that xylophagous catfishes of the genera *Panaque* and *Hypostomus* represent specialized detritivores among a detritivorous lineage of fish (family Loricariidae), all of which possess similar digestive machinery, and take advantage of decomposition already occurring in their environment.

0243 Poster Session I, Friday July 25, 2008; STORER ICHTHYOLOGY

**Evolution of Herbivory in a Carnivorous Clade of Minnows (Teleostei:
Cyprinidae): Effects on Gut Structure and Function**

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To investigate how evolutionary history affects digestion, we examined gut structure and function in eleven taxa composing sister clades of minnows with different dietary affinities: *Campostoma* are herbivorous whereas *Nocomis* are carnivorous. Additionally, *Nocomis leptcephalus* is carnivorous (Chatahoochee drainage) or herbivorous (Altamaha drainage) depending on collection locale. Thus, we were able to examine the effects of diet and evolutionary history on digestion among the clades

and within a single species. The species of *Campostoma* had longer guts, higher amylase and laminarinase activities, and lower chitinase activities than their carnivorous counterparts. This same pattern was observed among the populations of *N. leptocephalus*. Independent contrasts indicate that the evolution of diet and gut function are indeed correlated in these fishes. Trypsin and lipase activities followed no pattern relating to diet or phylogenetic history. Gastrointestinal fermentation, indicated by concentrations of short chain fatty acids, was found in representatives of both clades, and was not necessarily correlated with diet. Overall, the results of this study indicate that a longer gut and high amylase and laminarinase activities are associated with the evolution of herbivory, whereas a shorter gut and higher chitinase activities are associated with an insectivorous diet.

0241 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Anuran Sex Identification Using Hormone Metabolites in Urine

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A major problem facing many anuran research and conservation management projects is the lack of a non-invasive technique to sex monomorphic species. Recent work has led to the development of sexing techniques based on the monitoring of hormone metabolite concentrations in urine and feces for birds and mammals. This has also been achieved in two toad species using feces, but has never been attempted for anurans using urine, which can be taken in the field without holding animals in captivity. We aimed to develop enzyme immunoassays to measure hormone metabolites found within the urine of the *Litoria raniformis*, the Southern Bell frog, and upon doing so, test whether these hormone concentrations could be used to differentiate between males and females in this dimorphic species. Parallelisms between serially diluted *L. raniformis* urine and hormone standards were demonstrated for estrone conjugate, testosterone, and progesterone. Preliminary results show that there are significant differences between males and females sampled from the wild during breeding season in the urinary levels of estrone conjugate metabolites and that these can be used to differentiate sex in this species.

0102 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

A Comparison of Feeding Mechanics in a Generalist and a Specialist Shark Species

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Partitioning of resources within a community can be determined by the degree of plasticity or degree of specialization used in resource acquisition by the members. This research studies the feeding ecology, behavior and function of a trophic generalist, spiny dogfish, and a specialist, smooth-hounds, from Narragansett Bay, Rhode Island in order to investigate the interaction of these predators within the environment. A dietary specialist is expected to feed on a subset of available prey items while a generalist will feed on a wide range of available prey. A specialist will use a stereotyped behavior and jaw muscle function for prey capture and processing, however a generalist will modulate function and behavior dependent on prey type. These hypotheses were tested in performance tests of prey selection, temporal variation of feeding behaviors and asynchronous pairwise activation of the jaw muscles. In the absence of conspecifics, dogfish and smooth-hounds foraged optimally by selecting the prey item with the highest energetic return. However, smooth-hounds did not select crabs, the preferred natural prey. Dogfish modulated specific prey capture and processing behaviors by choosing the behavior that best corresponded to prey type. Smooth-hounds used a stereotyped ram capture behavior as well as a stereotyped crush processing behavior. Dogfish varied jaw muscle function between synchronous pairwise activation during capture to asynchronous pairwise activation during prey processing. In contrast, smooth-hounds used a stereotyped relatively synchronous activation pattern during prey capture and processing. Based on these comprehensive analyses, spiny dogfish are generalist predators that exhibit flexibility to feed on a variety of prey items. Although smooth-hounds did not show the same dietary specialization they do in the wild, the stereotyped behavior and function indicates these sharks are specialist predators. In a natural environment, smooth-hounds are constrained to feed on a specialized resource using morphological, behavioral and functional specializations.

0041 Poster Session II, Saturday July 26, 2008

Structure and Composition of Rocky Shore Fishes Across a Nearshore to Open Ocean Gradient in Southeastern Brazil

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São Sebastião Channel is a 25-km stretch along the coast of São Paulo (23°41' to 23°54'S and 45°19' to 45°30'W) situated between the continent and an island of the same name. The main goal of this study was to compare the structure, composition,

species richness, and fish diversity associated to rocky substrata at the two margins of the channel and at the outer margin of São Sebastião Island, facing the open sea (three regions; ten sites per region; 12 randomly samples per site). The comparisons are based on seasonally replicated quantitative samples using stationary procedures (388 visual censuses). Nine environmental variables were considered, and 210 hours of SCUBA dive efforts were logged; a fish inventory was also conducted. All of this information may be useful as a baseline for future assessments and monitoring in the area that includes the port of São Sebastião, which is also an important dock for petroleum and thus subject to many disturbances. Additional data is being collected in adjacent and more distant sites, such as Alcatrazes Archipelago, Búzios and Vitória islands. The rocky shore fish fauna from the study area consists of about 100 species, belonging to 39 families. The carnivore (62%) and diurnal (73%) fishes were predominant. *Haemulon aurolineatum* and *Abudefduf saxatilis* accounted for 48% of the total number of individuals, illustrating the numerical dominance of just a few species. Even though of no significant differences among the three regions (one-factor ANOVA: $F=0.17$; $p=0.85$), the two margins of the channel were more similar in terms of species composition and taxa overlap, whereas the sites turned to open sea were richer and less impacted. The occurrence and abundance of the studied species were correlated to environmental variables, and the main influential variables were depth, distance from coast, water transparency, and type of bottom substrate.

**0520 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008;
STOYE GENETICS, DEVELOPMENT & MORPHOLOGY**

**The transition from water to sand and its effects on undulatory locomotion
in sand lances (Actinopterygii: Ammodytidae)**

Nicholas Gidmark

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Sand Lances, *Ammodytes spp.*, exhibit a peculiar burrowing behavior in which they swim rapidly into the substrate. This genus of small, schooling fishes uses this behavior for hibernation and predator avoidance. While burrowing, sand lances experience a physical transition from water, a relatively inviscid Newtonian fluid, to a mix of sand and water, a relatively more viscous, non-Newtonian granular fluid. This system allows for a novel investigation into the mechanics of undulatory locomotion. Although anguilliform and serpentine undulatory locomotion have both been well studied, naturally-occurring transitions from one of these to the other are scarce, which results in a paucity of study in this area. I used standard high-speed video and high-speed x-ray video to investigate three-dimensional kinematic behavior throughout the burrowing process of three species of sand lances. Burrowing can be divided into three discrete stages: (1) typical anguilliform swimming; (2) the main aquatic propulsive stage of the burrow (in which amplitude and frequency of undulatory waves increases); and (3) a transition to subterranean propulsion. From an above-ground view, this last stage involves the tail becoming still, appearing to glide effortlessly into the sand. As is typical of anguilliform locomotion, the undulatory wave travelling along the body moves posteriorly in both an organism-based coordinate system as well as a world-based one in the

above-ground portion of the animal throughout all three stages. The waves travelling along the subterranean portion of the body move posteriorly in an organism-based coordinate system but not a world-based one. Throughout this process, sand lances appear to be using an anguilliform mode of locomotion above ground and a serpentine mode of locomotion below ground. I propose that this change is the result of a switch in locomotor style necessitated by changing environmental conditions.

0517 Fish Morphology & Histology II, Salons 6&7, Saturday July 26, 2008

Cyclicity and Stereotypy in Teleosts Chewing Compared with Tetrapods

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Prey-processing in teleost fishes has been extensively examined, but the variation existing across a broad phylogenetic range of vertebrates has received minimal attention, which is perhaps why the ubiquity of chewing in fishes has never been made evident. To quantify the variation in stereotypy and cyclicity of chewing in teleosts compared with other vertebrates, we used EMG from the adductor mandibulae of a wide diversity of teleosts: the bowfin (*Amia*), three bony-tongue (Osteoglossomorpha), four salmonid (Salmonidae) and two pike species (Esocidae). All taxa were found to process prey using a distinct open-mouth chewing behavior, which in all species except for *Scleropages jardinii* occurred in repetitive trains - a pattern that at least superficially resembles chewing in tetrapods. Cyclicity of AM activity, or the duration from the onset of one chew to the onset of the next, was transformed into coefficients of variance (CVs). The degree of chewing cyclicity among fishes was intermediate to that reported for lepidosaurians and mammals. Chewing stereotypy, or the duration from onset to offset of AM burst activity, (also in CVs) was compared between basal and derived species within each of the osteoglossomorph and salmonid lineages, and between basal (*Amia* and bony-tongues) and more derived groups (salmonids and pikes). While chewing stereotypy is conserved in salmonids, it varies significantly among the osteoglossomorphs we examined. We discuss how our data contributes to emerging evidence that the origin of prey-processing feedback control predates the differentiation of tetrapods and fishes. Supported by NSF IOB 0444891, DBI 0420440.

0400 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

**Antipredator Behavior of the Cottonmouth (*Agkistrodon piscivorus*):
Synthesis and Perspectives**

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The cottonmouth (*Agkistrodon piscivorus*) has become a favorite study organism to address questions relating to the defensive behavior of venomous snakes. At least two reasons account for this interest: first, cottonmouths display a large repertoire of defensive behaviors, including mouth gaping, tail vibrating, musking, body flattening, as well as bluff and defensive striking. Second, cottonmouths can be fairly abundant in many areas allowing researchers to circumvent the problem of low sample size often associated with studying snakes. Studies conducted in the field and laboratory have characterized several aspects of cottonmouth defensive behavior. These studies include the examinations of the effect of threat level, the association between warning displays and defensive striking, as well as quantification of intraspecific variation in antipredator behavior and habituation to non-harmful predatory stimuli. Collectively, these studies demonstrate that (1) cottonmouths are reluctant to bite, even when physically restrained; (2) snakes that use warning displays (i.e., mouth gaping) are more likely to bite than those that do not; and (3) cottonmouths' defensive behavior can vary as a result of body size, body temperature, reproductive condition, and experience. For example, smaller snakes (i.e., neonates, juveniles) are more defensive (e.g., strike more often) and exhibit more consistent behavioral responses than larger snakes, a pattern that may be related to the higher predation pressure faced by the former; in addition, gravid females react more defensively than post-partum females, possibly a consequence of the decreased locomotory performance associated with pregnancy. Altogether the results of these studies emphasize the complexity of the antipredator behavior of this species. We synthesize the results of these investigations and provide hypotheses that could form the basis for future research on the defensive behavior of animals.

0606 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

**Highly Site Specific Philopatry Displayed by Female Lemon Sharks
(*Negaprion brevirostris*)**

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Reproductively active female lemon sharks (*Negaprion brevirostris*) show strong philopatry to the nursery areas of Bimini, Bahamas, with females returning biennially for parturition. The present study assessed whether returning females give birth over successive years at specific sites, or at random locations around the island. To this end, 1558 genetic samples were obtained during the years 1995 to 2007. Genetic materials were collected during exhaustive sampling held annually at Bimini from juvenile lemon sharks caught in gillnets. Additional samples were collected opportunistically throughout the year with gillnets, rod and reel, or longlines. Recently developed genetic methods were used to: 1) identify full and half-sibling groups within and between years (*i.e.*, litters) using the program COLONY v 1.2; 2) assign sampled adults as parents to offspring (using CERVUS v 3.0); 3) reconstruct parentage from the juvenile DNA samples for all other unsampled adults; and 4) create a complete population pedigree. One-hundred-twenty dams and 480 sires were thus identified for all sampled offspring, representing 181 litters over 16 years. Using this pedigree we then compared the birth location of offspring from each sampled or reconstructed adult female, over all years. The information gathered from these results can then be used to determine whether specific sites within a small island system, may be separate primary nursery grounds and whether females select a specific site for their offspring over time. This is important from a conservation perspective, as a lack of nursery connectivity might limit the recovery of particular nursery site from degradation. Funded by the NSF, BBFS and PIOS.

0225 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Stream Community Responses to Riparian Recovery in an Agricultural Watershed

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Intensive agricultural practices have long been critical for providing the food resources required by a growing national and world human population. While these practices have undeniably altered stream ecosystems within agricultural watersheds, there has been some progress in recovering riparian function through directed efforts (e.g., restoration and best management practices) as well as incidental improvements occurring when lands are no longer farmed. However, the spatial extent of these improvements can be quite limited, and riparian recovery may not reflect concomitant recovery of stream communities in adjacent streams. I used existing condition riparian reach treatments and *in situ* artificial shade treatments to evaluate

the extent to which stream communities track with riparian improvements in an agricultural watershed. The reach treatments reflected differing levels of shade (a local factor) and sediment-nutrients (a local and larger-scale factor) as main effects expected to influence stream communities. Most measures of fish and benthic macroinvertebrate community integrity were not different between high and low shade regimes. Within the benthic community, only grazing taxa responded to changes in shade regime. Fish community integrity was different between sediment-nutrient regimes of local sites, although the only macroinvertebrate community integrity measure that was related to sediment-nutrient regime was Family Biotic Index. The higher incidence of relations between community measures and sediment-nutrient regime compared to shade regime suggests that local stream communities are likely more responsive to multi-scale environmental properties than highly localized riparian properties. This, in turn, suggests that highly localized and fragmented riparian recovery may have little benefit for stream biota and ultimately agricultural sustainability. However, more specific measures of taxonomic response or alternative measures of community integrity may indicate more localized responses, and hence greater benefits of localized riparian recovery for stream communities.

0709 Herp Stressors/Snake Conservation, Salons 6&7, Monday July28, 2008

Ecology and Conservation of the King Cobra (*Ophiophagus hannah*) in the Western Ghats of India

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We conducted the first-ever study of wild King Cobras (*Ophiopagous hannah*) in the Western Ghats of India, near Agumbe Rainforest Research Station, in the district of Shimoga, state of Karnataka. We implanted snakes with radiotransmitters and followed them continuously during their diurnal activity phase. We also made numerous behavioral observations of non-telemetered King Cobras. We observed a variety of reproductive behaviors, including combat, mate guarding by males, courtship, copulation, and nest guarding by females. We also observed King Cobras chasing, capturing and consuming snake prey. We present data on activity and movement patterns, and habitat use. Both males and females moved long distances during the pre-monsoon mating period. We often observed snakes climbing and resting high up in the forest canopy. We discuss our results in the context of ongoing conservation concerns, emphasizing potential effects of habitat fragmentation, and translocation of snakes “rescued” from human habitations. We also discuss plans for long-term conservation of King Cobras, the entire herpetofaunal community, and the habitats on which they depend.

0160 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

Spatial-Temporal Habitat Heterogeneity Facilitates Species Coexistence of Two Agamid Lizards in the Great Victoria Desert, Western Australia

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Deserts of interior Australia support the most diverse lizard faunas of any place on Earth. Understanding how species diversity is maintained requires knowledge of how potentially competing species coexist. A simplified niche-based model might argue that species coexistence is facilitated through partitioning resources along three gradients (habitat, time, and diet). We examined changes in spatial, temporal, and dietary resource use in sympatric populations of the military dragon (*Ctenophorus isolepis*) and the central netted dragon (*Ctenophorus nuchalis*) of the family Agamidae to determine environmental characteristics that facilitate species coexistence of these congeners. We analyzed seasonal records of capture rates over eleven years and stomach contents of individuals from the same habitat to measure the amount of divergence in time, space, and diet niche dimensions. Our data indicate that differential habitat use contributes largely to coexistence of these species. *C. isolepis* utilizes habitat near spinifex tussocks, while *C. nuchalis* utilizes open habitat. We reject the hypothesis that differential use of dietary resources contributes to coexistence, concluding that diet composition overlaps widely between species (85% overlap) and that annual change in diet within species may be more variable than interspecific differences. The importance of temporal habitat heterogeneity is reaffirmed by repeated observations of shifts in species composition at a site disturbed by wildfire. Fire created more open habitat that resulted in immediate reduction of the formerly abundant *C. isolepis* and replacement with *C. nuchalis*. Understanding temporal change attests to the importance of long-term ecological monitoring for understanding population and community dynamics.

0598 Herp Genetics, Salons A&B, Sunday July 27, 2008

Landscape Genetics of the Mojave Fringe-toed lizard, *Uma scoparia*: A multi-locus Coalescent Approach

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The Mojave fringe-toed lizard, *Uma scoparia*, is restricted to sand dunes and fine windblown sand habitats in the Mojave Desert of California and extreme western Arizona, resulting in a fragmented and geographically complex distribution. Previous molecular genetic research using mitochondrial DNA suggests the existence of a previously unrecognized distinct population segment in the Amargosa River basin (Murphy *et al.* 2006). Here, we describe findings using multiple independent and selectively neutral loci in a statistical-coalescent framework to estimate gene flow between these and other populations of *U. scoparia*. Moreover,

geographic information systems software is being used to develop landscape-based models to explain gene flow and genetic subdivision among these populations. The implications of our findings with respect to present efforts by government agencies to evaluate the endangered species status of these lizards will be discussed.

0498 Herp Behavior, Salons A&B, Thursday July 24, 2008

Time, Temperature and Depth Profiles for a Loggerhead Turtle (*Caretta caretta*) Captured with a Pelagic Longline

Mark Grace, John Watson, Dan Foster

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During a pelagic longline pilot study conducted by NOAA/NMFS SEFSC Mississippi Laboratories (MSL) along the U.S. Atlantic Ocean coast (NOAA Ship OREGON II OT-06-02-269), a loggerhead turtle was captured with longline gear equipped with time-temperature-depth recorders (TDR) attached in proximity to the hooks. TDR data documented changes in hook depth and water temperature, and reflected the behavior of the loggerhead turtle (rates of descent and ascent, time at depth, time near surface). NOAA/NMFS sea turtle mortality mitigation recommendations for pelagic longline gear proved effective for the loggerhead turtle capture since there were successive ascents to surface, and the viability status was good after landing.

0312 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Site Fidelity and Movements of Juvenile Manta Rays in the Gulf of Mexico

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Manta rays (*Manta birostris*) are the world's largest batoid and little is known about its population or behaviour throughout its broad distributional range. We present the first information on manta ray populations and behaviour in the Gulf of Mexico. Using the photo identification catalogue compiled by the Flower Garden Banks National Marine Sanctuary staff, we used distinct ventral spot patterns to identify a minimum of 32 individual manta rays that have visited the banks over three decades. Mantas have been resighted between years indicating site fidelity to the sanctuary banks. Additionally, we conducted an 18 month study of the site fidelity and inter bank movements of mantas at the Flower Garden Banks National Marine Sanctuary. We tagged eight mantas with coded acoustic tags and placed receivers on the three banks encompassed by the marine sanctuary. Mean disc width of tagged mantas was 1.8 m, suggesting that all animals tagged were juveniles. Based on time recorded at the receiver, manta site fidelity was highest on the East Flower Garden Bank. Three

mantas undertook inter-bank movements ranging from 18 km to 67 km distance and provide proof of connectivity between the distant banks that comprise the sanctuary.

0395 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT SYSTEMATICS/EVOLUTION

A Test of the Ecomorph Hypothesis: The Phylogenetics and Biogeography of *Eurycea aquatica*

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¹*Auburn University, Auburn, AL, United States*, ²*University of Tulsa, Tulsa, OK, United States*

The Appalachian Mountains of eastern North America are characterized by high faunal diversity and many endemic species; especially in the unglaciated southern latitudes where lineages have been accumulating for tens of millions of years. The brownback salamander, *Eurycea aquatica*, is an enigmatic species that dwells in unique springs in isolated locations in southeastern North America. Brownback salamanders have often been dismissed as simply a robust spring-adapted ecomorph of the widespread and more gracile species *Eurycea cirrigera*. We sequenced mitochondrial and nuclear genes from *E. aquatica* across their presumed distribution and compare them to *E. cirrigera* from nearby populations. We explicitly test if *E. aquatica* is simply a local spring-adapted ecomorph of *E. cirrigera* or a single lineage that resulted from fragmentation of (or dispersal to) isolated spring habitats. We discovered that brownback salamanders are a well-supported monophyletic group that is nested amongst *Eurycea cirrigera*, *E. wilderae*, and *E. junaluska*. Furthermore, we uncovered three very divergent lineages of brownback salamanders that we estimate have been diverged for several million years and may represent distinct species. The first clade, centered in springs in the Birmingham Valley, includes the type locality of *Eurycea aquatica*. Clade two extends from northeastern Alabama through northwest Georgia into Tennessee. Finally, clade three occurs in northern Alabama and includes the "cole springs" morph described in early taxonomic treatments. Springs checker the sedimentary regions of the southern Appalachians and may represent relictual habitat for an unexpected diversity of unrecognized endemic species that are currently threatened by development.

0082 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

How Amphibians Conquered the North

David M. Green

McGill University, Montreal, Quebec, Canada

Ten thousand years ago, the northern half of North America, including virtually all of present-day Canada, was covered by the great Cordilleran and Laurentian ice sheets. All of the amphibians currently inhabiting this region arrived at their present locations by means of dispersal following the retreat of the ice. The process could not have been a smooth one as the retreat of the ice resulted in pro-glacial lakes and other transient barriers in company with changes in climate and habitats. Increasingly, though, the post-Pleistocene range dynamics of re-colonizing North American amphibians are being better understood through the reconstruction of phylogeographic histories using molecular, primarily mitochondrial, genetic markers. Such studies provide evidence that from regions south of the ice, amphibians followed numerous routes northward, skirting obstacles and crossing regions currently closed to them. As conditions changed over time, later arrivals encountered conditions and obstructions substantially different from those faced by earlier colonizers. Furthermore, our understanding of the dispersal abilities of amphibians is improving, too. Thus the present distributions, and distribution histories, of northern amphibians reflect the nature and timing of post-Pleistocene climatic events as well as the movements of animals. It is highly likely that the northern limits of many species have not yet been reached.

0513 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Sources of Spatial Variation in the Cottonmouth, *Agkistrodon piscivorus*

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The use of space is one of the most important aspects of snake ecology because it is affected by a multitude of factors. Understanding variation in snake home range size and movement patterns has been a common objective of numerous radiotelemetry studies which have often revealed proximate influences of resource distribution and behavioral interactions on spatial patterns. Recent studies on the cottonmouth have indicated that spatial variation, both within and among populations, may be explained by a combination of ecological factors. Prey distribution appears to be an important influence on home range size and location in several locations. In a southwest Missouri cottonmouth population, distinct spatial differences among adult snakes were attributed to differences in their foraging ecologies and thermoregulatory needs. Adult male home ranges were always centered on grassland habitat patches that contained preferred prey while gravid females typically associated with very small rocky outcroppings that provided optimal

thermal regimes for gestation. Differences in the location and dispersion of key resources and physiological challenges in different environments should help elucidate the ecological causes of spatial differences in comparative studies. Additionally, recent studies in cottonmouth neural biology have begun to investigate correlations between brain anatomy and activity with movement patterns. Plans to further this research by integrating cognitive approaches to cottonmouth spatial ecology are ongoing and will be suggested to provide new directions for future research.

0713 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Simple Landcover Models Reliably Predict Genetic Isolation of Salamanders in a Fragmented Landscape

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Amphibians worldwide are facing rapid declines due to habitat loss and fragmentation, disease, and other enigmatic causes. Where habitat alteration is implicated, spatially explicit conservation plans should be developed. Geographic Information Systems (GIS) models are frequently used to inform such planning. Here, we explore the potential for using GIS models of functional landscape connectivity as a reliable proxy for genetic data. We examined the effect of habitat composition on movement patterns between marbled salamander (*Ambystoma opacum*) breeding ponds in southeastern Ohio. We quantified landcover types surrounding each pond and characterized pond isolation using genetic assignment tests. Our goal was to evaluate whether the relative amount of modified habitat around each pond was a reliable indicator of genetic isolation. On a small (300m radius) scale, amount of agricultural land was negatively related to movement into local populations. A model including agriculture and pond size explained nearly three quarters of observed variation in dispersal. On a larger (1km radius) scale, amount of deciduous forest was a strong positive predictor of connectivity. Together with pond size, this model explained over two thirds of observed variation. A resampling analysis confirmed that these habitat variables were consistently good predictors of genetic isolation. Used judiciously, simple GIS models with key landcover variables could serve as cheap, reliable proxies for population isolation in conservation planning.

0219 Poster Session II, Saturday July 26, 2008

Non-native Fishes of South Florida as Predators of Native Larval Anurans

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Introductions of non-native fishes have been implicated as one of the major causes of amphibian population declines. South Florida is home to a large number of predatory non-native fish; however, information on tadpole predation is scarce. In this study, we examined predation by three non-native fish species, Black Acara (*Cichlasoma bimaculatum*), African Jewelfish (*Hemichromis letourneuxi*) and Mayan Cichlids (*Cichlasoma urophthalmus*) on tadpoles of Southern Leopard Frogs (*Rana sphenoccephala*), and the native Mosquitofish (*Gambusia holbrooki*). We also examined predation on tadpoles of American Bullfrogs (*R. catesbeiana*) by Black Acara and Mayan Cichlids. Tadpole species were exposed, both separately and with *Gambusia* to each predator species. When Southern Leopard Frog tadpoles were exposed without *Gambusia* present, all three species consumed tadpoles; however, Black Acara consumed tadpoles at a higher rate than either African Jewelfish or Mayan Cichlids. When Southern Leopard Frog tadpoles were exposed with *Gambusia* present, they were significantly more susceptible to predation by Black Acara than were the *Gambusia*. There was no difference between consumption of Southern Leopard Frog tadpoles or *Gambusia* by Mayan Cichlids or African Jewelfish. Mayan Cichlids and Black Acara both consumed American Bullfrog tadpoles. Black Acara consumed Southern Leopard Frog tadpoles at a higher rate than American Bullfrog tadpoles, whereas Mayan Cichlids consumed both species equally. Gastric evacuation experiments are currently underway to examine the rate at which these non-native fishes digest tadpoles. This information might account for the lack of tadpole biomass found in diet studies. Further evidence is needed to understand how these predators are affecting amphibian populations, but it is clear that these non-native fish do consume tadpoles.

0746 Poster Session III, Sunday July 27, 2008

Spermatid Ultrastructural Changes during Spermiogenesis within the Western Cottonmouth (*Agkistrodon piscivorous leucostoma*)

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Cottonmouth testes were examined ultrastructurally to determine the distinct morphological changes that spermatids undergo during spermiogenesis. Testicular tissues from cottonmouth snakes (n=22) were collected year round from Hammond, Louisiana. The tissues from the months of April, May, October, and November, which demonstrated heavy spermiogenesis, were washed with cacodylate buffer, treated with osmium tetroxide, dehydrated through a graded series of ethanol

solutions, embedded in epoxy resin, sectioned with an ultramicrotome and diamond knife, stained with both uranyl acetate and lead citrate, and analyzed using a transmission electron microscope. A distinct set of morphological changes can be seen during the development of spermatids. The acrosomal proteins are delivered to the developing germ cells from the golgi during the early stages of spermiogenesis. An outer layer of membrane proteins, which were absent in the previously studied swamp snake, lines the inside of the acrosome. As the spermatids mature, the acrosome granule flattens and the acrosome extends dorsally along the developing spermatids. The chromatin condenses and adopts a spiral formation, which is different than that seen in the swamp snake. Distinct microtubules, termed the manchette, run parallel to and assist in the elongation of the nucleus. The microtubules that run perpendicular to the elongating nucleus, which are present in the swamp snake are absent in the cottonmouth. Two centrioles align perpendicular to each other at the base of the elongated nucleus and demonstrate the conserved 9+2 microtubule arrangement. The distal centriole elongates and makes up the body of the flagellum. This is the first study to describe the complete ultrastructural events that occur during spermiogenesis within a temperate crotalid. The morphological similarities and differences that can be seen during germ cell maturation may help to determine future evolutionary relationships among the large clades of reptiles.

0309 Herp Systematics, Drummond, Friday July 25, 2008

Preliminary Phylogeography of *Leiolepis belliana* and *Leiolepis reevesii*

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The southeast Asian lizard genus *Leiolepis* has seven species, of which *L. belliana* and *L. reevesii* have the broadest distributions. *Leiolepis belliana* ranges from Peninsular Malaysia northward through out all of Thailand and eastward through Cambodia, and *L. reevesii* ranges from southern China southward throughout Vietnam and southern Laos and westward through Cambodia. The taxonomy of *Leiolepis* has long been problematic. Much of this is seeded in the high degree of morphological variation in the two most wide spread species, *Leiolepis belliana* and *L. reevesii*. These species have been considered distinct from one another and to date all studies involving these species have use specimens from the distant ends of their distribution (where their morphologies are distinct from one another) adding to the evidence that these species are distinct from one another. Recent expeditions in southern Cambodia have revealed a contact zone between these two species. Morphological data in Cambodia suggests that these two species are conspecific and morphologically grade into one another. A phylogenetic analysis was preformed to test the specific status of *L. belliana* and *L. belliana*. If there is, in fact, only one species, throughout the range this would suggest that all other species of *Leiolepis* have arisen from one wide-ranging species.

0210 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Assessment of the Effects of Roads and Crabbing Pressures on Diamondback Terrapins on Georgia's Coast

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Commercial and residential development of coastal habitats places significant pressure on wildlife. The diamondback terrapin, *Malaclemys terrapin*, is one of Georgia's "high-priority" species for conservation attention in coastal habitats. In Georgia, vehicle induced mortality has been proposed as a potentially important factor contributing to terrapin population declines; however, studies in other states suggest that bycatch mortality from neglected or abandoned crab pots may explain the declines in terrapin populations in coastal environments. The objective of our project is to assess whether road density or historic crabbing pressure is correlated with the current abundance of terrapins in tidal creeks along Georgia's coast. We used GIS to characterize road density and crabbing effort in all of Georgia's tidal creeks, grouped creeks into one of four classes (no roads:no crabbing, high roads:no crabbing, low roads:high crabbing, and high roads:high crabbing), and then selected 24 creeks for study using a stratified random design. We seined each creek 5 times over a 100 day period between April and June, and all terrapins captured were aged, measured, and marked uniquely. We used general linear models and standard regression techniques to examine the relationships between road density and crabbing pressure on closed population estimates of terrapin abundance.

0476 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

A Comparison of Diel Vertical Movements of Bluntnose Sixgill Sharks (*Hexanchus griseus*) in the Atlantic and Pacific Oceans

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The bluntnose sixgill shark (*Hexanchus griseus*) occurs worldwide in tropical and temperate seas. *H. griseus* often associate with geomorphological features (e.g. submarine canyons) between continental and insular shelf edges and slopes where they are top predators and scavengers. While *H. griseus* have been captured from the surface to depths of 1,875 meters, very little is known about their movements and behavior. These sharks typically occur deeper than 200 m, though they are common much shallower in some areas where waters remain cool year-round (e.g. Puget Sound). Much of what is known about the movements and behavior of *H. griseus* has been gleaned from submersible and baited camera sightings and from a single, short-term telemetry study. We used modified longlines from small vessels to capture adult *H. griseus* (267 to 451 cm total length) at depths of 250-500 m near submarine canyons off Hawaii (Central North Pacific Ocean) and Virginia (Northwest Atlantic Ocean). A subset of the sharks were fitted with high-rate, archiving, pop-off satellite transmitters to 1) assess survivorship and recovery time following capture, 2) examine patterns of vertical movements, and 3) compare patterns of vertical movements between locations. Results to date indicate *H. griseus* have high post-release survivorship, but require 48 to 72 hours recovery time until resuming what we interpret as normal behavior. Swimming depth and water temperature ranges were 196-839 m and 4.9-17.3°C for *H. griseus* tagged offshore of Hawaii and 171-623 m and 5.2-14.3°C for *H. griseus* tagged offshore of Virginia. Following recovery, all *H. griseus* displayed obvious diel patterns in vertical movements. Offshore of Hawaii, swimming depths were 500-700 m (6-7°C) during day and 225-325 m (13-16°C) during night. Offshore of Virginia, the diel pattern was shallower, with swimming depths of 250-300 m (10-12°C) during day and 175-225 m (12.5-13.5°C) during night.

0179 Fish Systematics III, Drummond, Saturday July 26, 2008

Ontogeny, Variation and Homology in Salmonid Caudal Skeleton

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Skeletal ontogenetic data are highly relevant in defining homologies, interpreting skeletal variation, and inferring atavisms. Over the years, the actinopterygian caudal skeleton has generated a great deal of controversies concerning the homology and the development of its elements. Furthermore, some of these features have phylogenetic significance; the presence of uroneurals (i.e., modified elongated ural neural arches) has been recognized as a teleostean synapomorphy (homoplastic with respect to the Cretaceous aspidorhynchiform *Vinctifer*), and six hypurals or less has been considered as a clupeocephalan synapomorphy (seven hypurals are present in the Jurassic teleost *Orthogonikleithrus*). Considering this disparity among teleostean clades, it becomes important to investigate the interrelationships of these elements (e.g., uroneurals, hypurals) with their respective centra. An ontogenetic series of Arctic charr (*Salvelinus alpinus*) was reconstructed based on 448 clear-and-stained larval and juvenile specimens ranging in size between 12.8-45 mm of standard length (SL). We demonstrate the presence of caudal skeletal elements never reported previously in adult salmonids. Instead of three uroneurals (considered a generalized salmonid condition), a fourth uroneural has been identified bilaterally or unilaterally in 156 specimens. The earliest occurrence of a fourth cartilaginous uroneural is found in a 21-mm SL specimen. A fourth uroneural is also present in some of our largest studied specimens; thus, there is no indication of ontogenetic resorption. In contrast to the generalized condition of six hypurals, a seventh hypural has been found in 12 specimens suggesting atavism. The skeletal variation observed in our study calls for reinterpretation of previously proposed relationships of caudal elements with their centra in salmonids. These data corroborates the development of a polyural caudal skeleton in a teleost homocercal tail with a one-to-one relationship between centra and their associated elements.

0407 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Assessing the Utility of Nuclear Markers to Examine Phylogeography of *Agkistrodon piscivorus*

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We have identified two mitochondrial lineages of the cottonmouth (*Agkistrodon piscivorus*) and three mitochondrial lineages of the copperhead (*A. contortrix*) using both likelihood and Bayesian methods (Guiher and Burbrink, in press). Using 'relaxed phylogenetics' methods we estimate a Late Pliocene/ Early Pleistocene origin for all five lineages and unique demographic responses to Pleistocene glacial cycles based on coalescent methods. The current focus of this study is to corroborate the mitochondrial lineages or offer competing phylogeographic hypotheses, better define contact zones and identify putative hybrid zones using multiple independent nuclear loci. We have assessed the utility of nuclear loci obtained from several sources including an anonymous loci library, markers used in diverse vertebrate taxa taken from the literature, and a collaboration that has used high throughput sequencing to produce genomic data for a variety of snake taxa. Increased sampling, while adding unlinked loci will allow us to more concisely define the current distribution of each lineage and improve estimates of demographic histories. In addition, it will be possible to estimate immigration rates and the degree to which these lineages hybridize.

0550 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Mitochondrial Haplotype Analysis of the Bull Shark, *Carcharhinus leucas*, (Valenciennes, 1839) Control Region

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The bull shark, *Carcharhinus leucas*, is known for its wide distribution, along the coastal areas of tropical and subtropical seas, and its ability to penetrate freshwater systems. This species is usually found close inshore in marine habitats, in water less than 30m deep and occasionally less than a metre. These characteristics combined with its distribution bring this elasmobranch into contact with humans on a regular basis and make it especially susceptible to anthropogenic effects. The bull shark is considered an important fisheries species and although mainly sought for its fins for shark-fin soup, it is also utilised fresh, fresh-frozen or smoked for human consumption. Knowledge of the genetic structure is essential for effective fisheries management and comparative phylogeography, using mitochondrial DNA (mtDNA), has become a powerful tool in the study of populations. An 820 base pair fragment was sequenced from the control region of 102 samples from Eastern

Australia ($n=51$), South Africa ($n=19$) and the United States ($n=32$). Seven samples included in the analysis were previously sequenced (Nova Southeastern University, Florida). The sequences were aligned and analysed, yielding 18 haplotypes (diversity 0.831, standard deviation ± 0.024). A preliminary analysis of molecular variance (AMOVA) indicates significant differences among sample sites across ocean basins (77.3% variation, Φ_{ST} 0.773, $p < 0.00001$). These early results indicate the presence of at least three separate stocks, with the likelihood that U.S. East Atlantic coast and Gulf of Mexico form a single population. More samples are required to explain the low genetic diversity in Eastern Australia and make firm conclusions on the structure of these stocks, and their potential vulnerability.

0306 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008; GRUBER

Social, Size and Species Group Living Preferences in Juvenile Lemon Sharks, *Negaprion brevirostris*

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Group living in sharks is a widespread phenomenon but relatively little is known about the composition and organization of these groups. Using 40 juvenile lemon sharks, *Negaprion brevirostris* caught in the South Bimini, Bahamas nursery area a range of choice tests were conducted to determine whether individual lemon sharks make non-random grouping decisions. Results of the trials revealed that juvenile lemon sharks exhibit a strong preference to behave socially even when the conspecific stimulus group was reduced to a single lemon shark (Wilcoxon matched pairs, $n = 8$, p -value = 0.015). Additional size-preference trials indicated that during the juvenile phase of the lemon shark's life cycle there was evidence for association (t test, $t = -2.37$, $n = 10$, p -value = 0.038) with size-matched groups of lemon sharks. Further species-preference testing using juvenile nurse sharks, *Ginglymystoma cirratum* also demonstrated that lemon sharks have a strong preference to group with conspecifics (Wilcoxon, $n = 10$, p -value = 0.00013). Implications of these social preferences for group living of wild sharks are discussed, along with the potential factors that may contribute to the development of non-random grouping behaviours. Supported by the Leverhulme Trust, University of Leeds, Hoover Foundation and Bimini Biological Field Station.

0548 Poster Session I, Friday July 25, 2008

Morphological Variation in the Dwarf Round Ray *Urotrygon nana* (Miyake & McEachran, 1988) from the Gulf of Tehuantepec, Mexico

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In order to describe morphologic variation in the dwarf round ray *Urotrygon nana* we examined 468 individuals from the shrimp trawl fishery of the Gulf of Tehuantepec. We determined the sex and state of maturity, and 9 morphometrics measures: total length (TL), disc length (DL), disc width (DW), preorbital length (POL), interorbital distance (IOD), preoral length (Porall), internasal distance (IND), tale length (LC) y mouth length (LB) for each sampled individual. The number and total length of embryos was determined for pregnant females. Factor analysis was used to identify the meristics responsible for variation in body shape. Additionally three statistical models were tested to analyze for allometry in morphometrics relationships; the potential model produced the best fit in the majority of cases (R^2 greater value). Discriminant analysis was used to identify sexual dimorphism in adults. Females ranged between 8.2 and 37.6 cm TL, and males between 8.0 and 29 cm TL. The shape of the dwarf round ray is determined by three dimensions (factors, 70% of the total percentage of the explained variance) related to disk (24.8%), eye-mouth-nose region (50.9%) and mouth width (69.8%). Most morphometric relationships showed negative allometry significant. *Urotrygon nana* presents sexual dimorphism in total length ($\lambda_p = 0.620$), disc width ($\lambda_p = 0.598$), internasal distance ($\lambda_p = 0.592$), interorbital distance ($\lambda_p = 0.579$), preoral length ($\lambda_p = 0.578$) and dentition morphology. Females have molariform teeth, but neonate and young males present cuspidate teeth and adult males acute cuspidate teeth.

0406 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Influence of Forest Salamanders on Invertebrate Populations, Leaf Litter Decomposition, and Nutrient Flux

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Understanding nutrient cycling dynamics is an essential aspect of sustainable forest management. In particular, the forest floor represents a key source of organic matter that is carbon and nitrogen rich as well as containing many other essential nutrients. Changes in the rates of inputs (litterfall) and loss (decomposition) following natural or anthropogenic disturbances can significantly alter forest nutrient cycles. Invertebrates in the forest floor play an important role in forest nutrient cycling, both directly and indirectly, based on their feeding habits. As major predators of soil invertebrates, salamanders may alter leaf litter decomposition and in turn nutrient

cycling rates in forest ecosystems. We examined the impacts of changes in salamander abundance on mixed-oak forest floor decomposition rates and nutrient mineralization in a two-year mesocosm experiment using *Plethodon cinereus* and with data from plots from a stand-level silvicultural manipulation. There are challenges in designing an enclosure that can serve as a barrier to salamander movement but not water or nutrient flux. Using primarily oak leaf litter, we did not detect differences in decomposition rates across the salamander density treatments. Invertebrate populations did not show strong response to the density treatments, either. However, we did see an initial decrease in NO_3^- in the soil of mesocosms with higher salamander densities. Because soils in southern Appalachian hardwood forests have a net cation exchange capacity, monovalent anions such as NO_3^- often leach readily through the soil profile, often resulting in base cation leaching. Lower NO_3^- concentrations may serve to retain base cations in the system. In 2006, the most abundant items in stomach content analyses of red-backed salamanders in the mesocosms were insect larvae, collembola, and mites. Worms and larvae accounted for the greatest volume. Abundance of collembola was higher in 10-year old clearcuts than in control (over 90 year old) stands.

0201 AES Age & Growth/Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Comparative Life History Characteristics of the Aleutian skate, *Bathyraja aleutica*, in Two Alaskan Ecosystems

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The Aleutian skate (*Bathyraja aleutica*) is a large deep-water species that commonly occurs in bycatch of Alaskan trawl and longline fisheries. Although prominent in the skate biomass of both the eastern Bering Sea (EBS) and Gulf of Alaska (GOA) ecosystems, minimal biological information exists for this species. This is of concern, because skates often exhibit *k*-selected life history characteristics that make them susceptible to fishery exploitation. To increase our understanding of this potentially vulnerable species, and address the possibility for two separate populations in Alaskan waters, the age, growth, and reproductive biology of *B. aleutica* was studied. In total, 1,281 skates were collected since 2004 in the EBS and GOA during exploratory trawl surveys, by fisheries observers, and from fishery landings. Gonads were examined using visual and histological analysis, and compared with external morphology to determine maturity stage and reproductive seasonality. Vertebral thin sections were examined for age determination, and multiple growth models were used to evaluate growth characteristics. Median sizes at maturity were similar between sexes, but significantly different between areas. TL_{50} was 124.4 cm TL for females and 122.8 cm TL for males in the EBS, and 120.7 cm TL for females and 117.7 cm TL for males in the GOA. The presence of males with mature spermatozoa and gravid females indicated reproductive capability during all months sampled (April – September). For skates from the EBS, maximum age estimates were 16 and 17 years for males and females, and the three-parameter von Bertalanffy growth functions

generated estimates of $k = 0.11 \text{ yr}^{-1}$ and $L_{\infty} = 172.6 \text{ cm TL}$. Age determination is nearing completion, but estimates thus far indicate skates from the GOA attain greater ages. Final age estimates and growth parameters will be presented. These data suggest *B. aleutica* is a moderately slow-growing and late-maturing species.

0533 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Theoretical Calculations of Feeding Biomechanics in Bull Sharks over Ontogeny

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Bull sharks (*Carcharhinus leucas*) are one of the most aggressive coastal shark species inhabiting subtropical and tropical seas worldwide. Although a very broad head, robust jaws, and large serrated teeth are obvious and notorious features of *C. leucas*, the feeding biomechanics of this species have scarcely been investigated. The goal of this study is to describe the functional morphology of the jaw apparatus and investigate ontogenetic changes in bite performance in this top level predator. Theoretical calculations of jaw leverage and bite force were performed for an ontogenetic series of ten individuals using a three dimensional static equilibrium model. Values of theoretical bite forces ranged from 68 to 1023 N at the most anterior tooth of jaw and from 194 to 3721 N at the corner of the jaw in a range of sizes of 73-258 cm, TL. Although little is know about the feeding ecology for this species, dietary literature suggests that bull sharks exhibit an ontogenetic dietary shift where type of prey ranged from bony fishes to elasmobranchs and mammals at approximately 140 cm TL. Bite force as measurement of performance could provide a better understanding of the feeding ecology and foraging capabilities of this apex predator over ontogeny.

0180 Herp Genetics, Salons A&B, Sunday July 27, 2008

Genetic Structure of a Hybrid Zone Between Two Lizard Species: Differences in Patterns of mtDNA and Nuclear Genes

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An important question in evolutionary biology is how species identity is maintained when interbreeding occurs between sister species in zones of secondary contact. Hybridization between Long-tailed brush lizards, *Urosaurus graciosus*, and Common tree lizards, *U. ornatus*, was found using mtDNA sequences from populations where their ranges overlap in western Arizona. MtDNA sequence analyses showed *U. ornatus* type mtDNA in individuals with *U. graciosus* morphology, but not the reverse, indicating only matings of *U. graciosus* males and *U. ornatus* females occurred. I examined variation in genomic DNA markers (microsatellites) to determine if individuals with *U. graciosus* morphology from the geographically intermediate populations: (1) grouped between the two parent species, indicating hybridization is currently ongoing with F1s present and/or symmetrical backcrossing, (2) grouped with the “paternal” species *U. graciosus*, indicating matings with female *U. ornatus* were rare and hybrids tended to backcross successfully only with the paternal species, or (3) grouped with the maternal species, *U. ornatus*, indicating a bias for hybrids only successfully backcrossing with this species. Genetic structure across the hybrid zone was determined for at least three microsatellites in two populations on each side of the area of geographic overlap and three geographically intermediate populations. The program STRUCTURE was used to estimate population assignment based on allele frequencies. Two “populations” were clearly delineated from the microsatellites with individuals from outside the zone of contact forming distinct groups of their respective species. Individuals with *U. graciosus* morphology (but *U. ornatus* mtDNA) from intermediate locations all grouped within the *U. graciosus* population genetic structure with no indication of admixture with *U. ornatus*. It appears that in the intermediate populations, little if any current hybridization is occurring and hybrid individuals have backcrossed with the paternal species such that their nuclear markers are currently indistinguishable from those of the paternal species.

0438 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY

A Multi-gene Phylogeny of the *Etheostoma zonale* Species Group: Patterns of Diversification in the Central Highlands of North America

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Detailed phylogeographical histories are required to unravel the complex biogeographical relationships of freshwater fishes in the Central Highlands of North America (the Appalachian, Ozark, and Ouachita mountains). I have recovered such a

phylogeography for the *Etheostoma zonale* species group in an attempt to shed light on this area. The Banded Darter, *Etheostoma zonale*, and its sister species the Brighteye Darter, *Etheostoma lynceum*, together form a clade that is widespread throughout the Central Highlands and nearby lowland areas. *Etheostoma zonale* is one of the more wide-ranging species in the species-rich darters (Acanthomorpha: Percidae: Etheostomatinae). I have obtained DNA sequences for approximately 150 individuals of the species group from throughout their range, for both the mitochondrial cytochrome b gene and the nuclear S7 ribosomal protein first intron, and obtained phylogenies using the maximum parsimony, maximum likelihood, and Bayesian methods. Variation within the group is strongly partitioned geographically, with approximately 15 clades evident in a tree based on the cytochrome b data, and a smaller number in an S7 tree; these clades generally corresponding to drainage basins within the Central Highlands. The different methods of analysis retrieve the same clades, but show some variation in their branching order. A biogeographical comparison with the phylogenies of other taxa from the same region shows some correspondences, but a substantial number of taxon-area relationships within the *E. zonale* group is incongruent with other taxa. This suggests that unique events may be responsible for the spread of *E. zonale* throughout its range, or that lineage sorting events, or multiple cycles of colonization and extinction, have obscured the true phylogeographic history of the species group.

0506 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

The Coachwhip Selects Scrub: Is It for the Grub?

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The use of space by individual animals strongly influences the spatial extent, abundance, and growth rates of their populations. We analyzed the spatial ecology and habitat selection of the Coachwhip (*Masticophis flagellum*) at multiple spatial scales to determine which habitats are most important to this species. Home ranges and mean daily displacements of the Coachwhip were large, even for this vagile species. Individual home ranges contained a greater proportion of xeric Florida scrub habitat than did the study site, and individuals positively selected Florida scrub within their home ranges. Mesic cutthroat seep and hydric swamp habitats were avoided at both scales of selection. Several non-mutually exclusive mechanisms, including prey abundance, availability of refugia, thermoregulatory opportunity, and structural attributes of Florida scrub may underlie the positive selection of Florida scrub by the Coachwhip. Historic rarity and anthropogenic loss and fragmentation of Florida scrub, coupled with the long-distance movements, large home ranges, and positive selection of Florida scrub by the Coachwhip, indicate that large contiguous tracts of land containing relatively open-canopied, xeric habitats will be essential for the persistence of the Coachwhip in central Florida.

0737 Poster Session III, Sunday July 27, 2008

Taxonomy and Phylogeography of *Hippocampus kuda* in Papua New Guinea

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Over 14 synonyms exist for the “Common Seahorse”, *Hippocampus kuda*. Putatively found from the Hawaiian Islands to the coast of East Africa, it may be the most widely distributed seahorse species. A previous cytochrome *b* phylogeographic analysis focused on Southeast Asian populations of *H. kuda* found significant population structure across this portion of their range (Lourie *et al.* 2005), but no evidence for cryptic species. In Papua New Guinea, at least two distinct morphotypes of *H. kuda* are distinguished by meristic measures, prompting examination of the validity of *H. taeniopterus*, currently recognized as one synonym for *H. kuda* in Indonesia, Papua, and northern Australia. We investigate the geographic distribution of *cytb* variation in two morphotypes of *H. kuda* distributed among 3 populations, from northern, southern and eastern New Guinea. In addition, we include populations from Palau and Fiji, extending the northern and eastern range of sampled *H. kuda* sequences. Twenty-one haplotypes were defined by 688 bases of *cytb* analyzed for 69 specimens from 6 populations. A deep phylogenetic split defines two clades of PNG haplotypes, with all Fiji samples related to one clade and all Palau samples allied with the second. Both morphotypes are found in each PNG clade, indicating a lack of concordance between morphological and genetic differentiation. While results indicate substantial genetic structuring ($F_{st} = 0.28$), geographic distance is a poor predictor of genetic distance. Over 70% of genetic variation found within populations, with only 29% found between populations. Nucleotide diversity is an order of magnitude higher in PNG populations than in Fiji and Palau. These results suggest a relatively deep and complex history for *H. kuda* in the eastern edge of the coral triangle, and the presence of substantial intraspecific morphological variation. Pending more robust evidence, we suggest *H. taeniopterus* remains a synonym of *H. kuda*, and that comparative analysis of debated synonyms such as *H. hilonis*, *H. moluccensis*, and *H. tristis* will further clarify the status of *H. kuda*.

0069 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

An Introduction to FISH-BOL, the Fish Barcode of Life Initiative

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The Fish Barcode of Life initiative (www.FISHBOL.org) is an international research collaboration dedicated to assembling a standardized reference sequence library for all fishes. New primer cocktails have been developed targeting 650 bp of the 5' end (e.g. the "Folmer" region) of the mitochondrial cytochrome *c* oxidase I (COI) gene enabling broad amplification of fishes. The resulting sequence profiles or "DNA barcodes" conform to standards established by the Consortium for the Barcode of Life (CBOL) and are typically derived from expert-identified voucher specimens archived in accessible reference collections. The Catalog of Fishes, FishBase and ITIS contribute to a taxonomic authority file for the initiative, while FISH-BOL serves as a conduit of communication for ichthyologists to provide information updates back to the aforementioned community resources. More than 4500 species have already been barcoded, with an average of five specimens per species. Current results indicate that barcodes separate >98% of previously described fish species that have so far been analyzed. Several genetically divergent specimens have also been confirmed by integrative taxonomic analysis as new species. The benefits of barcoding fishes include the global disambiguation and reconciliation of names, highlighting cases of range expansion for known species, flagging previously overlooked species and, enabling identifications where traditional methods cannot be applied. In this respect, DNA barcoding democratizes access to species level identifications: unknown sequences, from any fish or its fillets, fins, eggs and larvae can be matched against these reference sequences using BOLD: the Barcode of Life Data System (<http://www.barcodinglife.org>).

0608 Poster Session II, Saturday July 26, 2008

The Effect of Light Intensity on Predatory Luring by *Nerodia clarkii compressicauda*

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Mangrove Saltmarsh Snakes are reported to be largely nocturnal but often active during the day. To aid in determining if these snakes might exhibit lingual luring during particular times of the day, we observed 27 juveniles in the presence of fathead minnows, *Pimephales promelas*, for 15 min under each of three different light intensities: 8.6, 70.0, and 285.2 lx. Ten subjects exhibited lingual luring during 23 trials. There was no significant difference in the number of snakes luring at the different light intensities. Thus, it seems likely that these snakes might lure prey at any hour of the day.

0605 Herp Behavior, Salons A&B, Thursday July 24, 2008

Stimulus Control of Predatory Luring by *Nerodia clarkii compressicauda*

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In order to better understand the ecology of a particular behavior, it is helpful to know the importance of the various stimuli likely to be involved in eliciting that behavior. I sought to determine the relative importance of chemical and visual prey stimuli to the exhibition of lingual luring by the piscivorous Mangrove Saltmarsh Snake. Subjects (N=23) were observed for 15 min in the presence of four different prey-stimulus treatments: chemical cues only, visual cues only, both chemical and visual cues together, and control (no prey cues). While chemical and visual cues were each by themselves sufficient to elicit luring in the absence of other prey stimuli, they did so infrequently; the number of snakes luring in the presence of chemical cues only and visual cues only did not differ significantly from each other or from the number of snakes luring in control trials. The combination of visual and chemical cues, however, was highly effective in eliciting luring; the number of snakes luring in the presence of both chemical and visual cues together differed significantly from all other treatments. These snakes thus appear to rely heavily on multimodal information for positive prey identification.

0331 Poster Session I, Friday July 25, 2008; CARRIER

Assessing the Ultrastructure of the Elasmobranch Retina: The Application of Microwave and High Pressure Freezing Techniques

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Numerous studies have examined the ultrastructure of the vertebrate retina. However, few have examined the retina in elasmobranchs, an ancient group that has existed for more than 400 million years. In order to trace the evolution of the vertebrate retina and optimise the ultrastructural detail that has been lacking in previous studies, we examined the retina of the brown banded bamboo shark (*Chiloscyllium punctatum*) using a range of techniques including standard chemical fixation (CF), microwave chemical fixation (MCF) and high pressure freezing (HPF, using either a Leica EM PACT2 or a Bal-Tec HPM 010). Following anaesthesia with MS222 (1:2,000 in sea water), the eye was enucleated and retinal tissue was immediately extracted. For HPF, retinal samples were rapidly processed in hexadecene, elasmobranch Ringer, DMEM (Dulbecco's Modified Eagle's Medium) Ringer, or with no preincubation, with and without prior oxygenation. HPF samples were freeze substituted with 2% OsO₄ + 0.5% uranyl acetate in 100% acetone (dry). CF and MCF fixed samples were fixed in Karnovsky's fixative and post-fixed with 1% OsO₄. The quality of the retinal ultrastructure after the various fixation processes

was assessed based on the integrity of cellular organelles, membrane contrast and fixation artefacts (if present). The ultrastructural definition of cone photoreceptors was of particular interest, since traditional histological processing has previously revealed substandard morphology. Various trials resulted in the elasmobranch Ringer being the most effective with or without oxygenation. MCF and HPF using the Leica EM PACT2 proved to be the most effective techniques for revealing superior ultrastructure. Membrane contrast was best using HPF, and mitochondria with visible cristae and Golgi complexes were clearly discernible using only this technique. MCF using DMEM Ringer resulted in large gaps in the tissue and very low membrane contrast. The Bal-Tech HPF technique and HPF with no ringer proved to be ineffective methods.

0170 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

The Development of Visual Function in the Embryonic Brown Banded Bamboo Shark, *Chiloscyllium punctatum* (Elasmobranchii)

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Anatomical studies have shown that the retina of the oviparous brown banded bamboo shark, *Chiloscyllium punctatum*, is fully differentiated about 30 days prior to hatching (158 days post deposition, dpd). However, it is not known whether the retina is physiologically capable of vision at this early stage and, if so, why. To assess the onset of retinal function, we used microspectrophotometry (MSP) to measure the presence of visual pigment in photoreceptor outer segments and electroretinography to assess light sensitivity. MSP revealed the presence of a vitamin A₁-based (rhodopsin) visual pigment (wavelength of peak absorbance, λ_{\max} 500 nm) in the rods as early as 115 dpd, providing the fundamental basis for light detection. Retinal sensitivity to light and temporal resolution (indicated by flicker fusion frequency, FFF) were recorded electroretinographically from whole animals and isolated eye-cup preparations using a graduated series of light intensities and flicker frequencies in embryonic sharks from 110 dpd (50 days pre-hatch) to hatched sharks up to one year old. The youngest shark that produced a measurable response to light was 127 dpd, which correlates well with the timing of the appearance of retinal synaptic connections. Peak voltage responses to light were observed in animals at the time of hatching (just prior to, or within 24 hours post-hatch). Temporal resolution (FFF) ranged from 6 Hz to 22 Hz, which is relatively slow compared to other aquatic predators. This study shows that the retina of *C. punctatum* is both anatomically mature and physiologically functional prior to hatching. The behavioural advantage of a functional visual system early in embryonic life is unclear, especially for an animal that develops in an opaque egg case, but we suggest it may allow time for fine-tuning of the system prior to birth, providing the animal with optimised vision upon hatching.

0449 Fish Systematics II, Salons A&B, Friday July 25, 2008

Cypriniformes Tree of Life: Phylogenetic Relationships of the Catostomidae, with Emphasis on the Catostominae, based on Mitochondrial and Nuclear Gene Sequences

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Our previous studies have focused on relationships among basal-lineages within Catostomidae, and relationships within the Moxostomatini. While both studies contributed to our understanding of relationships among suckers, questions remained regarding the validity of some resolved relationships, especially in light of resulting biogeographic patterns. Herein, we present a phylogeny of the Catostomidae, with emphasis on the Catostominae, based on complete mt cytochrome b and ND2 and nuclear IRBP and S7 gene sequences. A phylogeny of 126 taxa resolved intrafamilial relationships consistent with those previously proposed by Harris and Mayden (2001). Within Catostominae, parsimony analysis recovered a trichotomy of Erimyzonini, Catostomini, and Moxostomatini plus Thoburniini. Within Catostomini, *Catostomus* (*Pantosteus*) was recovered as monophyletic, and sister to a clade containing the remaining taxa in this tribe. *Deltistes* was sister to *Chasmistes* and *Catostomus* from the Klamath Basin. *Xyrauchen* was embedded within *Catostomus* and resolved as part of a clade containing *C. insignis* and *C. latipinnis*. *Thoburnia* was always resolved as paraphyletic, with *T. rhothoeca* sister to *Hypentelium roanokense*. Species relationships within Moxostomatini are consistent with Harris and Mayden (2001), with 'Scartomyzon' being embedded within *Moxostoma*. In both tribes, species relationships in terminal clades exhibit strong geographic concordance.

0071 Poster Session I, Friday July 25, 2008

Ecological Aspects of the Whale Shark (*Rhincodon typus*) at Saint Peter and Saint Paul Archipelago, Brazil

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The first record of a whale shark in Brazilian waters was in the coast of Bahia State in 1921. Since then, additional sightings have been reported along the Brazilian coast, but knowledge on the species biology and ecology in the region has remained poor. Whale sharks are most frequent observed at the Saint Peter and Saint Paul Archipelago (SPSPA), a small group of rocky islands located on the mid-Atlantic Ridge, just north of the Equator. In July 1998, the Brazilian Navy established a scientific research station in the Archipelago, which allowed researchers to remain in

the area for more extended periods and enabled the study of local whale sharks. After compiling all existing data on the whale sharks recorded in the SPSPA, we proceeded to observe locations of occurrence, estimated the lengths of those sharks, analyzed the trends in occurrence over the last nine years, and investigated possible ecological factors that might influence their distribution and seasonal occurrence. Sharks ranged in total length from 2.0-14.0 m and sightings were most common from January to March. The higher density of whale sharks in the Archipelago during this time period appears to be associated with an increase in the abundance of eggs and larvae of flying fish (Exocoetidae), which spawns in the area at this time of year.

0538 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Why is there Multiple Paternity of Nurse Shark?

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Multiple paternity has been demonstrated in several shark species including placentally viviparous hammerhead and requiem sharks and the lecithotrophic nurse shark (*Ginglymostoma cirratum*). Cited reasons for multiple paternity in sharks include indirect genetic benefits or convenience polyandry. Most studies either dismiss or do not mention fertility assurance as potentially important. Nurse sharks produce very large energy-rich eggs that slowly pass through the reproductive tract one at a time, precluding rapid fertilization of multiple eggs. Because nurse sharks do not store sperm, they likely require multiple matings to fertilize all egg clutches in a litter. Based on nurse shark mating behaviors, reproductive anatomy, and genetic analysis of clutches, we believe that fertility assurance is the most parsimonious explanation for multiple paternity in nurse sharks. We examined three complete nurse shark litters and found that each had six to seven sires with the number of pups per sire ranging from one to 17. The mean number of pups per sire was five. We have observed hundreds of copulations and failed copulations in nurse shark as well as cooperative breeding behavior among males. Female nurse sharks can usually control copulation by refuging and successfully avoid mating with pursuing males and even groups of males. Because clutch sizes are small, we cannot invoke kin selection to explain the more successful group mating behavior among males and instead hypothesize that male cooperation is a strategy of less dominant males to overcome a female's ability to avoid mating. Fertility assurance may be less important for viviparous species with many pups because there is less energy invested in an unfertilized egg. Because most sharks are either oviparous or ovoviviparous, fertility assurance has important consequences for elasmobranch conservation.

0020 General Ichthyology I, Drummond, Saturday July 26, 2008

Genetic Divergence in Life History, Body Shape, Swimming Performance, and Mating Behaviour Between Lake and Stream Stickleback

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Threespine stickleback in Misty Lake and its inlet stream show dramatic differences in a number of phenotypic traits. We used common-garden experiments to determine the genetic basis for observed differences in life history (egg size and number), body shape (geometric morphometrics and univariate traits), swimming performance (burst and sustained), and male inter-sexual behavior. We find that many of these traits strongly differ between lake and inlet fish reared for their entire lives in a common-garden laboratory environment. These results show that the two ecotypes show considerable genetic differences in a wide suite of phenotypic traits. These differences likely reflect adaptive divergence and may influence the evolution of reproductive isolation.

0289 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

What REALLY Makes Long-lived Species more Susceptible to Overexploitation?

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Overexploitation of long-lived fishes, reptiles, and other species is more common than in short-lived species, such that long lifespan is assumed to be a direct, or at least indirect, driver of susceptibility to extinction. While a long adult lifespan is naturally a direct result of low natural mortality, this does not in itself provide the direct cause of overexploitation because population processes such as density-dependent compensation should still occur in these species. And because long adult life is positively correlated with age at maturity, it would seem that the large number of age classes in these species could reduce their probability of extinction by allowing them to persist over many bad years. I explore the following hypotheses for the apparent increased vulnerability of long-lived fishes and reptiles: a) their life histories and population dynamics are fundamentally different from short-lived species, or at least from those assumed by the simplified models that are used to determine harvest levels, b) management actions are inadequate to respond to exploitation that targets long-lived species, due to time lags or other factors, or c) data collection and analysis for long-lived species fails to provide the correct signals of population status, thereby leading to overestimates of allowable harvest levels or underestimates of extinction risk. Case studies of sturgeon, dogfish, and sea turtles

suggest that all three of these may be viable alternative explanations, but all indicate a need for greater precaution in management.

0097 Poster Session III, Sunday July 27, 2008

Origin and Development of the Palatal Organ: Using Zebrafish to Investigate the Development of Trophic Morphological Novelties

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Exploiting the conserved developmental mechanisms seen in vertebrates, the zebrafish has become a popular model organism within the field of biomedical research. Yet, by ignoring what makes this cypriniform fish unique we are overlooking a powerful model organism for investigating the origin and development of morphological novelty. The trophic diversity that characterizes cypriniform fishes includes a unique feeding mechanism whereby small food particles often encountered in benthic feeding are extracted. The structure that plays a key role in separating edible from inedible prey items during benthic feeding is the palatal organ. Located in the anterior pharyngeal roof, the palatal organ is a muscular cushion composed of a highly disorganized mass of differently sized muscle fibers covered by an epithelium studded with mucous cells. During feeding the palatal organ secretes mucus to entrap food and the muscles work to entrap and move the food along to the pharyngeal teeth. Functionally, and indeed even in histological sections the palatal organ strongly resembles a small mammalian tongue. There is little, if any, data addressing either the embryological origin of this muscular organ or the ontogenetic stage at which it first develops. Here we describe the ontogeny of the palatal organ in several ontogenetic stages of the zebrafish. The palatal organ, while less well-developed in zebrafish than in other cypriniforms, is apparent from very early larval stages. Moreover, the combination of muscle fiber types seen in the adult may reflect the complex embryological origin of this organ. Identifying the developmental mechanisms responsible for the origin of this feeding adaptation may enhance our understanding of how functional novelties arise and evolve.

0087 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

Turning a Model on its Head: Using Zebrafish to Investigate the Origin and Evolution of Morphological Novelty

L. Patricia Hernandez

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Exploiting the conserved developmental mechanisms seen in vertebrates, the zebrafish has become a popular model organism within the field of biomedical research. Yet, by ignoring what makes this cypriniform fish unique we are overlooking a powerful model organism for investigating the origin and early

development of morphological novelties. As cypriniforms, zebrafish possess a number of poorly investigated adaptations associated with feeding: enlarged pharyngeal jaws opposed to an enlarged basioccipital process of the neurocranium instead of upper pharyngeal jaws; a muscular palatal organ found on the roof of the buccal chamber; and the kinethmoid, a rostral ossification associated with premaxillary protrusion. Taking advantage of some of the molecular tools used by developmental biologists we describe the early development, growth and possible evolutionary fates of some of these novel structures. The palatal organ, while less well-developed in zebrafish than in other cypriniforms, is apparent from early ontogenetic stages. Vertebrate morphologists have long examined premaxillary protrusion and pharyngeal jaw function in Perciformes, however appreciably less emphasis has been placed on investigating the convergent acquisition of these functions in Cypriniformes. Given that cypriniform fishes lack oral jaw teeth, there must exist significant selection for efficient pharyngeal jaw processing in these species. The speciose Cypriniformes possess a novel median bony element, the kinethmoid, which allows for a unique mechanism of premaxillary protrusion. We have examined the development of this important feeding innovation. Identifying the developmental mechanisms responsible for the origin of these feeding adaptations will enhance our understanding of how functional novelties arise and evolve.

0390 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Trait Mediated Effects of the Salamander, *Plethodon cinereus*, on Large Invertebrate Predators in a Terrestrial Detrital Food Web

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Evidence suggests that the terrestrial salamander, *Plethodon cinereus*, plays an important role in forest-floor food webs by regulating the abundance of mesofauna prey, and the rate of leaf litter decomposition. Most detrital food web studies focus on the direct and indirect effects of trophic interactions among pathways in a web, or on total web dynamics. There is, however, a growing body of literature centering on non-trophic effects that may influence the ecology of organisms in food webs. Because *P. cinereus* is territorial, we expect aggression toward guild members. This makes *P. cinereus* a model organism to address questions about how different taxa respond to each other within a trophic level, and how that response affects trophic cascades. We conducted a four year, open field plot, study in the Cuyahoga Valley National Park (NE Ohio, USA) to explore how organisms in the forest-floor food web respond to density manipulations of *P. cinereus* and large invertebrate predators. Our results suggest that *P. cinereus* has a strong negative effect on spiders and on lithobiomorph centipedes but has a positive effect on carabid beetles. Spiders and centipedes were most abundant in salamander removal treatments compared to controls. Carabid beetles were most abundant in treatments with the most salamanders and least abundant in treatments where salamanders were removed. Additionally, some macrodetritivores were positively correlated with the presence of

P. cinereus. Previous research investigating intraguild predation on centipedes and spiders by *P. cinereus* suggests that adults of *P. cinereus* do not prey upon adults of either of these two predators. Based on our results it is likely that trait-mediated effects of *P. cinereus* on other forest-floor predators are quite strong and are potentially attenuating the effects of predation on trophic cascades in this system.

0075 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Osteology of *Parastromateus niger*, with Comments on Its Systematic Affinities and the Gill Arches of the Family Carangidae

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The monotypic Indo-Pacific genus *Parastromateus* is morphologically peculiar among carangid fishes in its overall body form. Historically, this peculiarity was emphasized and *Parastromateus* was separated out as a member of the monotypic family Apolectidae (Formionidae), although it has more recently been conclusively demonstrated to be a member of the family Carangidae based on the presence of shared derived characters, including the separation between the second and third anal fin spines. Within the family Carangidae, it has been considered to be a member of Carangini due to the presence of scutes on the caudal peduncle (albeit weakly developed), although the understanding of its relationship to other carangids has been hindered due in part to a lack of detailed anatomical data available for this species. In this presentation, we will describe the osteology of *P. niger* based on cleared and stained and dry skeletons representing a broad ontogenetic range (11-325 mm SL). Many aspects of its skeleton are clarified (e.g., structure of the skull, ontogenetic reduction in the pelvic fin rays while retaining a robustly developed pelvic girdle). In particular, the gill arches of *Parastromateus* are very distinctive among carangid fishes, in part because of the greatly elongated, nearly filamentous teeth that are associated with all pharyngeal toothplates and gill rakers. There is also a toothplate that bridges the epibranchial 4-ceratobranchial 4 articulation; this toothplate was only otherwise found in *Hemicaranx* among all carangid genera surveyed and may be reflective of common ancestry. Alternatively, *Parastromateus* shows remarkable similarity to the genus *Paratrachinotus* from the Eocene Monte Bolca Formation in terms of a high number of dorsal pterygiophores in the first interhaemal space (7-11 and 7, respectively) and loss of (obvious) pelvic fin rays in juvenile and adult specimens.

0434 Poster Session III, Sunday July 27, 2008

Headstarting Gopher Tortoises (*Gopherus polyphemus*) in Southern Mississippi

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Telemetry studies of neonate gopher tortoises (*Gopherus polyphemus*) in Mississippi and Florida have shown that 90 - 100% of tortoises die within the first two years, and mortality is almost always attributable to predation. Additionally, burrow surveys in southern Mississippi usually reveal a disproportionately low percentage of hatchling and juvenile burrows, possibly indicating low recruitment. To investigate whether the same mortality rates apply to yearling and young juvenile tortoises, we initiated a headstarting study in 2006 on the Camp Shelby Joint Forces Training Center in southern Mississippi. Hatchlings were obtained from naturally incubated eggs and from eggs artificially incubated in a laboratory. In October 2006, 31 gopher tortoise hatchlings were placed in an enclosure designed to prohibit predation by mammals, fire ants, snakes, and raptors. Objectives of the study are to release part of the population each year, radio-track them, and recapture them biannually in order to gather information on: 1) growth; 2) home range; 3) burrow use and construction; 4) movement patterns; 5) site fidelity; and 6) causes and extent of mortality. In September 2007, ten yearling tortoises with transmitters were released back to the burrows where they were originally oviposited, and to date are all still alive. Laboratory incubation of eggs was repeated in 2007 to add to the population residing in the enclosure, and the current plan is to incubate more eggs in the summer of 2008, and release hatchling, one-year-old, and two-year-old tortoises at the same time in the fall of 2008. By monitoring different-aged tortoises over several years, we should begin to determine when tortoises reach size or age thresholds that make them less susceptible to certain types of predation.

**0540 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY**

Dating the Cypriniformes Tree of Life

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Cypriniformes is a large group of primarily freshwater fishes containing more than 3,500 species in eight families and are found in Africa, Asia, Europe, and North America. Previous studies have used biogeography to estimate divergence times within Cypriniformes but I present the first large-scale analysis of divergence times of cypriniform families and subfamilies, as well as an estimate of the divergence of cypriniforms from the other ostariophysans using fossil calibrated molecular phylogenies. The oldest cypriniform fossils date to the Early Paleocene, approximately 62 million years ago, although there is speculation that the order originated in the Cretaceous or even earlier. We used the mitochondrial protein-coding gene, cytochrome *b* (1140bp) to infer interrelationships among cypriniform families and subfamilies using Maximum Likelihood and Bayesian methods. In the future, additional mitochondrial and nuclear loci will be added to better resolve the tree and to give more precise estimates of divergence times. Taxon sampling included representatives from all eight cypriniform families, all subfamilies, and representatives from other ostariophysan orders. Minimum ages for nodes on the molecular phylogeny were determined from known fossils from each of the following cypriniform families; Catostomidae, Cobitidae, Cyprinidae, and Nemacheilidae, and from outgroups. Estimates of the divergence time of Cypriniformes from the other ostariophysans, as well as the divergence times of the families and subfamilies within the order, were calculated using penalized likelihood.

0162 Poster Session III, Sunday July 27, 2008

The Effects of Natural and Anthropogenic Disturbance on Red-backed Salamanders in Northern Hardwood Forests

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A significant body of literature exists on the effects of silvicultural practices on wildlife populations; however, research on wildlife responses to natural disturbance events occurs less frequently. Further, research comparing natural and anthropogenic disturbances is rare in forested ecosystems. However, one common goal of ecosystem management is to replicate natural disturbance regimes. Thus, understanding the degree to which silvicultural practices compare with natural disturbance processes is needed for informing ecosystem management approaches. We compared the initial effects of even- and uneven-aged timber management, and ice-storm damage on red-backed salamanders. This study was conducted within

northern hardwoods in the White Mountain National Forest, New Hampshire, U.S.A. The abundance of salamanders on the forest floor was estimated using artificial cover boards and area constrained searches. In addition, we measured the effect of disturbance on microhabitat characteristics and the influence of microhabitat characteristics on salamanders to identify how changes in abiotic characteristics due to forest disturbance influence red-backed salamander populations. Even-aged harvests had a greater effect on salamander abundance than did either uneven-aged management or ice-storm damage. Salamander abundance was similar in natural disturbance and uneven-aged management habitats. Although abundance of salamanders was lower at ice-storm damage and single-tree selection sites compared to undisturbed sites, differences were not statistically significant. Among forest disturbance types, soil temperature and characteristics of leaf-litter predominantly influenced salamander distribution. Overall, even-aged management had greater initial effects on salamander abundance than uneven-aged management. However, to obtain a similar volume of timber uneven-aged harvests require a greater area of land than even-aged harvests. As such, the additional area of forest impacted under uneven-aged management practices may or may not counter the relatively small impact that this type of harvesting has on red-backed salamanders.

0161 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Initial Effects of Experimental Forest Management on a Terrestrial, Woodland Salamander in Missouri

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Concerns have been raised regarding widespread declines of *Plethodon* salamanders over the past 15 years. Forest management is certainly not a universal cause of these declines, however, there is evidence that timber harvest significantly reduces amphibian populations. Clearcutting creates hotter, drier conditions that can deleteriously affect salamanders through desiccation and altered energy budgets. While clearcuts have been shown to be generally detrimental, few studies have examined the effects of alternative silvicultural techniques on salamanders. We established four experimental forest treatments at each of four sites in 2004-2005. The treatments were two clearcuts, a thinning cut, and an unmanipulated control. In February 2007, one of the clearcut treatments at each site was burned to simulate a timber management technique of regional interest. At three replicate sites, we placed sets of coverboards in two transects through each treatment. We checked coverboards for salamanders once every 7-10 days from April - October 2007. We captured a mean (SE) of 4.0 (1.9), 0.3 (0.4), 13.7 (9.3), and 15.3 (5.9) salamanders in the burn, clearcut, partial, and control treatments, respectively. Additionally, 75% of individuals captured in the burned treatments were juveniles, compared with 31% and 38% in the partial and control treatments. While the burn and clearcut

treatments did dramatically reduce salamander captures, there were no apparent differences among the partial and control treatments. Our data suggest that thinning and single tree selection silvicultural practices may not have strong impacts on woodland salamanders. Finally, initial results indicate that burning following clearcut logging may not be more detrimental to salamanders than clearcutting alone. Continued monitoring is necessary to determine if habitat changes associated with burning, including the removal of coarse woody debris, have longer term effects on *Plethodon* salamanders.

0436 Poster Session II, Saturday July 26, 2008

A Hybrid Technique Using Visual Implant Elastomer and Toe-clipping to Individually Mark Anurans

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Here we report on the use of a hybrid marking technique (VIE-C) combining Visible Implant Elastomer (VIE) marks with toe-clipping to mark individual treefrogs (Hylidae). Our marking strategy entailed injecting elastomer into the plantar surface of the digits and clipping only one toe. This method allows large numbers of frogs to be individually marked without clipping multiple toes, and minimizes the frequency of elastomer migration from the injection site, a common problem with VIE marks on the body or limbs. We found retention rates of VIE marks in the digits to be similar those for toe-clipping, indicating that VIE provides a satisfactory alternative to multiple toe-clips. In addition, cost of materials, frog handling time, and ill effects were minimal. We recommend this marking scheme to researchers considering techniques for marking anurans, as it reduces potential negative effects of clipping multiple toes, and provides inexpensive and long-lasting marks that can be easily and quickly read in the field by trained observers.

0301 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Seasonal Temperature Habitats of Skate Species off the Northeast Coast of the U.S.

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The role of temperature in affecting seasonal distribution patterns of skate species off the Northeast coast was investigated using Northeast Fisheries Science Center spring and autumn trawl survey data. Survey data on (a) skate catches and catch locations and (b) bottom water temperatures were analyzed to identify seasonal habitats and temperature preferences of juveniles and adults of each species, and to determine habitat overlaps. Temperature habitats differed among species, and some species exhibited partially overlapping habitats. Autumn and spring temporal habitats differ more for juveniles than for adults of the same species. Seasonal differences in catch-weighted temperature are species-specific, but most of the species are distributed in cooler waters during spring and in warmer waters during autumn.

0305 Poster Session I, Friday July 25, 2008

Age Validation of Little Skate and Winter Skate Using Tetracycline Marking at both Egg and Adult Stages

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The northeastern American skate complex is a data poor fishery resource. For example, age data are not available for all skate species in all areas. As part of an age validation study on multiple skate species, individuals were treated with tetracycline at egg and adult life stages. The main focus of this study is to validate the periodicity of vertebral bands in adult specimens that were given an intraperitoneal injection of tetracycline. Adult little and winter skates are currently being maintained in a seawater laboratory facility for a minimum of one year. Subsamples were sacrificed early and mid-way through the experiment to confirm that incorporation of tetracycline into the vertebrae occurred in each treated species. As part of a preliminary study attempting to validate the formation of the birthmark, egg cases of little and winter skates were injected with tetracycline. The birthmark is often defined as the change in angle of the corpus calcareum, but is not consistently formed. Alternatively, defining the birthmark as the first visible band in the centrum may underestimate the true age. Two trials of injections were conducted: (a) tetracycline directly injected into the yolk-sac; and (b) tetracycline injected into the

cavity of the egg case. After each treatment, egg cases were maintained at ambient water temperatures in separate tanks. Newly hatched individuals will be immersed in an alizarin complexone waterbath, in an attempt to mark the hatch mark. Successfully hatched skates will be maintained for various time periods to determine if the tetracycline was incorporated in the notochord. If this treatment is successful, it may be applied to other skate species in the complex to validate age determination.

0475 Poster Session I, Friday July 25, 2008

NOAA Southeast Fisheries Science Center Elasmobranch Tagging Management System: One Database to Bind Them All

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The Panama City Laboratory and Mississippi Laboratories of the NOAA Southeast Fisheries Science Center (SEFSC) and our 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 program, offshore via fishery-independent surveys on NOAA research vessels, and commercial vessels carrying an observer. Elasmobranchs are also being tagged with satellite pop-off tags and acoustic tags. Recognizing the need to standardized data collection, we have been developing 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 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 January 2009 and online for public use January 2010.

0728 Poster Session III, Sunday July 27, 2008; STORER ICHTHYOLOGY

Predictive Modeling and Spatial Mapping of Rare Fish Species Using Boosted Regression Trees: A Step Toward High-Resolution Conservation Planning

Robert Hopkins, II

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Understanding species distributions is a central precept of conservation research. I analyzed the relationship between landscape attributes and the distributions of rare fishes in the upper Green River system (Ohio River drainage) at multiple spatial scales. Analyses were carried out using boosted regression trees (BRT) and occurrence records from museum collections. BRT are a form of logistic regression employing a boosting algorithm which greatly improves predictive accuracy over traditional classification trees. The resulting models indicate variable influences of natural and anthropogenic landscape attributes at each spatial scale and for each species. Specifically, the BRT models were able to capture complex interactions and instances where anthropogenic influences superseded the influence of natural environmental variables. The spatial distributions of each species were then predicted for each segment of the stream system using a Geographical Information System (GIS) and data quantified at multiple spatial scales. Validation of the modelling technique was completed using records for three proxy species with variable patterns of distribution and with similar numbers of occurrence records. In each case, the area under the Receiver Operating Characteristic curve (AUC) exceeded 0.75 – a useful amount of discrimination between sites of species presence and absence. The distributional maps from the analyses are now being used to visualize assemblages of rare fishes in the upper Green River. Furthermore, the modeled distributions and ancillary spatial data are being employed in the development of a spatial-selection algorithm to identify and prioritize freshwater biodiversity conservation areas in the aforementioned river system.

0624 Herp Stressors/Snake Conservation, Salons 6&7, Monday July28, 2008; STOYE CONSERVATION

Possible Effects of Endocrine Disrupting Chemicals on Diamondback Terrapins (*Malaclemys terrapin*) from Four Northeastern Sites

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Many chemicals are known to disrupt the endocrine systems of some animals, leading to developmental and reproductive disorders. The waters of Jamaica Bay, NY (JB) contain high concentrations of known endocrine disrupting chemicals (EDCs). Jamaica Bay is also home to New York State's largest population of diamondback terrapins (*Malaclemys terrapin*). The purpose of this study was to determine the possible effects of EDCs on the terrapins of JB. At least thirteen clutches from Jamaica Bay and each of three comparison sites (Cape May Peninsula,

NJ, Peconic Bay, NY, and Barrington River, RI) were collected from naturally laid nests. Eggs were randomly distributed among containers, incubated at a constant temperature, and weighed periodically. Hatchlings were reared and evaluated for six months. Body size (mass, carapace and plastron length) was measured routinely for each hatchling. Shell abnormalities were noted for each turtle. Righting response was tested on each turtle at various intervals to determine locomotor performance. Eggs and hatchlings from Jamaica Bay were larger than the other three sites. Cape May Peninsula turtles had the lowest percentage of shell abnormalities. Locomotor performance of turtles from all sites markedly increased with age. Although Jamaica Bay is probably the most heavily polluted of the four study sites, the results did not indicate that Jamaica Bay turtles were adversely affected. Major effects from EDCs on terrapins may occur over a more extended period of time in nature. The aromatase levels of hatchlings will be determined, as these may provide further insight to the effects of EDCs on diamondback terrapin hatchlings.

0350 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Genetic Structure of the Gray Reef Shark (*Carcharhinus amblyrhynchos*), Based on Microsatellite and Mitochondrial DNA Analyses With Implications For Management

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The gray reef shark (*Carcharhinus amblyrhynchos*) is an Indo-Pacific, coral reef associated species that presumably plays an important role as apex predator in maintaining the integrity of coral reef ecosystems. Populations of this shark have declined substantially in some regions due to over-fishing, with recent estimates suggesting a 17% decline per year on the Great Barrier Reef (GBR) and projections of only 0.1% of current populations remaining after 20 years at current exploitation rates. There is no information on population structure of gray reef sharks to aid in their management and conservation. We are assessing genetic structure in this species by using entire mitochondrial control region sequences and 15 nuclear microsatellite loci as markers. 275 gray reef shark samples were obtained from across the species' Indo-Pacific distribution: Western Indian Ocean (Madagascar/Seychelles), Eastern Indian Ocean (Cocos (Keeling) Islands, Western Australia), Central Pacific (Hawaii, Palmyra Atoll, Fanning Atoll), and Southwestern Pacific (Eastern Australia - GBR). Mitochondrial and microsatellite data concordantly identify Hawaii, the western Indian Ocean and Cocos (Keeling) Islands populations as genetically distinct relative to other sampling locations. Interestingly, the Palmyra and Fanning Atoll sharks, although showing significant genetic differentiation from the geographically closer Hawaii population, are not genetically differentiated from the geographically farther GBR population. Overall, at least four genetically identified management units appear to exist despite the modest geographic sampling depth: 1. Western Indian Ocean, 2. Cocos (Keeling) Islands, 3.

the Southwestern Pacific/Palmyra-Fanning Atolls, and 4. Hawaii. These results show strong genetic differentiation exists in gray reef shark populations separated by expanses of open ocean, and suggest proper management of this declining species will have to occur at the very least on a regional geographic scale.

0576 General Ichthyology I, Drummond, Saturday July 26, 2008

Temperature, a Sex-Linked Allele, and Autosomal Modifier(s) Control the Expression of Melanism in Male Mosquitofish (*Gambusia holbrooki*)

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The objective of this study was to determine the mechanisms responsible for control of the rare, melanic (black pigmented) phenotype in male mosquitofish (*Gambusia holbrooki*). Intrapopulation crosses of virgin female by melanic male mosquitofish were conducted for three populations of fish collected from nature. Between population crosses were also conducted for two of these three populations. Fish from all crosses were reared first in warm (31°C) then in cold (18°C) temperatures to evaluate the effect of genetics and environment on melanic (black) expression. Results demonstrate that melanic expression is best explained by a sex-linked allele, plus one (or more) autosomal modifier(s). In some populations melanic coloration is temperature-sensitive and requires cold temperature for expression, while in other populations it is not temperature-sensitive and melanic expression begins a few days after fry are born into a warm environment. In summary, melanism in mosquitofish is controlled by a few genes and by temperature. It is likely that more than one melanism 'allele' has arisen, since different populations express melanism during different gestational periods under different temperature regimes. Further, there is a positive association between the sex-ratio of the progeny produced by melanic males and the frequency of melanic male fish produced. The higher the frequency of melanism in offspring, by population, the greater the male bias in these offspring.

0073 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Toads Change Litter Chemistry but Not Litter Invertebrates and Litter Decay Rates in an Asian Subtropical Forest

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Amphibian populations have declined globally in the past 20 years and over one-third of amphibian species worldwide are threatened. However, the role of amphibians in ecosystem processes is just beginning to be explored. Litter decomposition is an important process for biogeochemical cycles and plant production in terrestrial ecosystems. We report a field experiment conducted in a lowland forest that used field enclosures to evaluate effects of the toad, *Bufo bankorensis*, on litter invertebrates and litter decomposition rates. We collected litterbags from toad and control (toad-excluded) enclosures to determine the invertebrate communities, decay loss, and nutrient contents of the litter. The presence of *B. bankorensis* significantly increased phosphorus concentrations in the litter, but did not alter the densities of litter invertebrates or rates of litter decomposition. These results were not consistent with the previous studies, which showed that *Plethodon cinereus* in a temperate forest of north-east USA and *Eleutherodactylus coqui* in a tropical rain forest of Puerto Rico significantly changed litter decomposition rates. We suggest that the functional roles of amphibians may be species-specific and vary with different terrestrial ecosystems.

0426 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Movement Patterns and Environmental Preferences of Blue Sharks (*Prionace glauca*) Determined by Satellite Archival Tagging

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Blue sharks (*Prionace glauca*) are common, highly migratory, pelagic sharks with hundreds of thousands captured annually in pelagic longline fisheries. They also form the largest component of the international fin trade. Despite their prevalence in global fisheries, management relevant information on their habitat utilization and movement patterns is fragmentary. During the summer of 2007, twenty-three blue sharks (male, n=21; female, n=2) were tagged with Microwave Telemetry Inc., satellite pop-up transmitters near Cape Cod, MA. Programmed pop-off dates ranged from 30 days to 12 months. To date, tags have collected information ranging between 4-186 days with seven tags still at liberty. Blue sharks preferred surface waters and spent 43% of their time at less than 2.4 m depth, 66% of their time at

depths less than 5 m (± 2.4 m) and 77% of their time at less than 11 m (± 2.4 m). Sharks spent 70% of their time in waters between 14-20°C. When sharks traveled off the continental shelf into deeper waters they dove more frequently. Geoposition was determined based on light level data and analyzed using the Kalman-SST filter. Sharks remained on the continental shelf during summer months, but moved to distant, off-shelf locations as the seasons progressed. One male shark moved at least 2,485 km over 6 months from its September tagging location to coastal Puerto Rican waters; another male shark moved at least 1,447 km from Cape Cod to the east of Bermuda between August and February. We will report a more detailed perspective on movement patterns from these and additional tags scheduled to release within the next few months.

0238 Poster Session I, Friday July 25, 2008

Age and Growth Estimates for the Smallnose Fanskate, *Sympterygia bonapartii* in the South-west Atlantic and Derived from Captive Born

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The smallnose fanskate, *Sympterygia bonapartii* is common endemic skate specie from south-west Atlantic. Although the relative abundant and broad geographical distribution few studies were conducted on biology of the smallnose fanskate. In order to provide insight into the life history of *S. bonapartii*, age and growth were estimated using vertebral centra from skates captured from research cruises conducted by Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP) in Uruguay and north Argentina coastal waters (34°-42°S). As well, the reproductive success of smallnose skate at Temaiken aquarium provided an opportunity to obtained data on growth between 0-2 years under constant temperature (16.4-18.2°C) and fed daily. Both captive and wild size at age data were fitted to Gompertz growth model. Vertebral age estimates ranged from 0- 12 years for females and 0- 8 years for males. Age at 50 % maturity estimated to be 7.03 years (63.5 cm TL) for females and 8.51 years (62.3 cm TL) for males. From the 25 born in captive skates measured monthly, the parameters estimated for females and males were $L_{\infty} = 83.90$ cm, $k = 1.00$ cm year⁻¹ and $L_{\infty} = 72.78$ cm, $k = 1.08$ cm year⁻¹, respectively. Female size at maturity was reached at 61 cm Lt (1.78 years), considered at the moment of oviposition. Captive females and males grew an average of 25.44 cm year⁻¹ 22.78 cm year⁻¹, respectively. Theoretical longevity was estimated between 14.12- 14.32 years for wild population and 3.28- 3.62 years for captive skates. This study is the first contribution to estimate age and growth for *S. bonapartii*. This information greatly improves the understanding of smallnose fanskate biology, and will be applicable to the stock assessment and management of this species in Uruguay and north Argentina coastal.

0412 Poster Session III, Sunday July 27, 2008

Population Genetics of Four Species of *Pteronotropis*

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Fishes within *Pteronotropis* are distributed across small clear or tannin-stained streams of the Gulf of Mexico and Atlantic coastal plain drainages in the southeastern United States. Due to the inherent patchiness of their small stream habitats and recent habitat loss, the distributions of *Pteronotropis* have become increasingly fragmented across their limited species ranges. In order to elucidate population genetic patterns in species with fragmented distributions microsatellite variation in four species of *Pteronotropis* from two Gulf of Mexico coastal plain drainages was examined. *P. euryzonus* and *P. grandipinnis* from the Apalachicola River drainage and *P. merlini* and *P. hypselopterus* from the Choctawhatchee/Pea River drainage were included in the study. Analysis of microsatellite variation sheds light on patterns of gene flow in species with fragmented ranges and may have important conservation implications.

0030 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Chondrichthyan Feeding Biomechanics: Intra- and Inter-specific Scaling Patterns

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The feeding performance of chondrichthyans is paramount in their ecological and evolutionary success. As performance is determined in part by morphology, it can be expected to change as an organism grows, thereby resulting in changes in resource acquisition. Changes in bite force were therefore investigated over ontogeny in the horn shark (n = 12, 19-59 cm SL), blacktip shark (n = 14, 48-121 cm SL), and spotted ratfish (n = 8, 21-44 cm SL) (intraspecific scaling) via biomechanical modeling. As aquatic poikilotherms, chondrichthyans can grow very large, making them ideal subjects with which to investigate the effects of body size on bite force among species as well. Therefore, an interspecific scaling analysis of bite force among ten species varying in size by nearly three orders of magnitude (16-300 cm SL) was used to determine if the high bite forces of large chondrichthyans are simply a consequence of their large body size, or rather the result of diet-related adaptation, and if changes in bite force are correlated with changes in head and tooth shape among species. Positive allometry of bite force over ontogeny was observed in all three species via positive allometry of jaw adductor muscle force (horn shark), jaw leverage (spotted ratfish), or both (blacktip shark). However, bite force scaled isometrically among chondrichthyan species, perhaps indicating that at large sizes, high absolute magnitudes of bite force overcome any mechanical constraints set by prey, precluding the need for relatively high feeding performance. Additionally, head

width was found to be the best predictor of bite force among these ten species. These contrasting scaling patterns are indicative of the unique selective pressures acting on chondrichthyans varying widely in size.

0525 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Deep Diving and Distant Travels: Vertical and Horizontal Movements of Whale Sharks (*Rhincodon typus*) Tagged off Quintana Roo, Mexico

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Satellite-linked pop-up archival transmitting (PSAT, Wildlife Computers) tags affixed to eleven whale sharks (six male, five female) ranging 5.5-8 m TL off Isla Holbox, Mexico have successfully transmitted data on depth, temperature and geolocation of animal movements. Once off the continental shelf, the sharks display dives to as much as 1,720 m (over one mile deep). Four of the 11 tags have been recovered and two provided significant minute-by-minute data. In some cases dives show a distinct crepuscular pattern of deepest diving at sunrise and sunset. Dive profiles are steep with descents of more than 30 m/min and even faster ascents, with no leveling off between surface and deepest point of the dive, indicating that feeding may not be the primary purpose of the diving behavior. Most geographic movements observed to date have been confined to the Gulf of Mexico basin, the northwest corner of the Caribbean Sea, or the Straits of Florida. However, one female shark demonstrated a migration of at least 7,213 km in 150 days, during which the shark moved from the southeastern Gulf of Mexico, through the northern Caribbean Sea, into the North Atlantic Ocean and across the equator to the South Atlantic Ocean, where the tag popped up near the Mid-Atlantic Ridge between Brazil and western Africa. This long-distance movement is consistent with genetic evidence that the Atlantic probably contains a single population of whale sharks.

0622 Herp Biogeography, Salons 4&5, Saturday July 26, 2008

Box Turtles in Arkansas

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The status of three-toed and ornate box turtles is relatively unknown in Arkansas. The ornate box turtle (*Terrapene ornate ornate*) distribution includes most of western Arkansas where it overlaps with the three-toed box turtle (*Terrapene carolina triunguis*) and in some locations they are sympatric. I surveyed 18 locations in Arkansas to examine for presence/absence of both species. Habitat loss has probably contributed to increased sympatry as I found new site records. Morphological examinations and preliminary genetic analysis suggests that hybridization between individuals of the two species is occurring. This has important conservation implications for the rarer (in Arkansas) ornate box turtle.

0688 Herp Systematics, Drummond, Friday July 25, 2008

Molecular Systematics of the Chamaeleonidae: A Balanced view from Africa and Madagascar

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While the true chameleons (Chamaeleonidae) are one of the most recognizable groups of lizards, due of their unique morphology, the generic relationships within the family are not well resolved. This is largely due to sampling bias, with previous molecular studies focusing primarily on taxa within a single geographic region: Africa or Madagascar. Here, we present the most complete taxonomic sampling to date for the family, with representatives from all currently recognized genera and species groups. This survey builds on previous molecular studies, combining mitochondrial (ND2, ND4, 16S) and nuclear loci (RAG1, Cmos, BDNF). Our novel phylogenetic results are discussed here within both a taxonomic and biogeographic context for the group and we present the first divergence time estimates for the entire family.

0462 Herp Systematics, Drummond, Friday July 25, 2008

Phylogenetic Affinities of the Namaqua Day Gecko, *Phelsuma ocellata*

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Phelsuma and *Lygodactylus* are two genera of diurnal geckos thought to be closely related to one another. *Lygodactylus* consists of 58 species and is distributed in Madagascar, Southern African and South America whereas *Phelsuma* is found primarily on Madagascar and surrounding islands. The only possible exception to the restricted distribution of *Phelsuma* is *Phelsuma ocellata*, endemic to western South Africa and Namibia. Although the placement of this species into the genus *Phelsuma* from a previously monotypic genus *Rhoptropella* is well supported by morphological and allozyme evidence, some recent work on visual systems and DNA sequence have suggested a lack of support for a close relationship of this species to *Phelsuma*. To examine the relationships of these three taxa, we sequences both mitochondrial (ND2) and nuclear (RAG1, phosphocin, and POMC) DNA for all major lineages of *Lygodactylus*, *Phelsuma*, and multiple samples of *Phelsuma ocellata*. Our resulting phylogenetic hypothesis supports the morphological and allozyme data in placing *Phelsuma ocellata* as the sister taxon to *Phelsuma*. The mitochondrial data supports a weak alternative arrangement and decreased taxon sampling improves this conflicting relationship, suggesting that the previous phylogenetic placement of *P. ocellata* as sister taxon of *Lygodactylus* was the result of incomplete taxon sampling coupled with a lack of resolution of mitochondrial markers.

0131 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Home Range Size of Male and Female Northern Pacific Rattlesnakes (*Crotalus o. oreganus*)

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Home range, behavior, and timing of movements vary in different populations of rattlesnakes. Through radiotelemetry work, home range size of male and female Northern Pacific Rattlesnakes (*Crotalus o. oreganus*) in the Carrizo Plain of Central California was compared. Global positioning systems (GPS) data and geographic information systems (GIS) were used to determine the home range size (minimum convex polygon) of each snake over a 1-2 year period. The home range analyses exhibited an effect of sex on home range size, with males having larger home ranges than females. There was also a strong correlation between the size of the snake and the size of the home range, as larger animals inhabited a much larger area than smaller ones. Because male *C. o. oreganus* are much larger in SVL and mass than females, the effects of sex and body size on home range are confounded. Further studies on snakes of a wide range of body sizes will help elucidate the relative contributions of sex and body size on home range size.

0032 Poster Session I, Friday July 25, 2008

Progress in Molecular Systematics and Inference of Reproductive Evolution of Characid Fishes (Teleostei: Ostariophysi)

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The ostariophysan family Characidae encompasses over 900 species, yet the monophyly of the family and the relationships among its genera are largely obscure. The large number of genera that are unassigned to a subfamily (i.e., *incertae sedis*) attests to this point. The characid subfamilies Cheirodontinae, Glandulocaudinae, and Stevardiinae, as well as some *incertae sedis* genera, contain all of the characiform fishes known to be inseminating. Molecular phylogenies that include multiple characid species are few, and even rarer are those molecular phylogenies that incorporate more than one inseminating characid species. We sought to infer the relationships among genera that contain inseminating species and deduce the number of times insemination evolved. Preliminary analyses included inseminating representatives of Xenobryconini, Corynopomini, the *incertae sedis* genus *Rachoviscus*, and certain externally fertilizing genera. DNA sequence data from multiple markers were analyzed using cladistic methods under the parsimony criterion. When insemination is optimized onto a cladogram, our results suggest that insemination has multiple origins within Characidae.

0228 Poster Session II, Saturday July 26, 2008

Female Behavior Facilitates Mate Detection in Northern Watersnakes (*Nerodia sipedon*)

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Female snakes have historically been regarded as playing little more than a passive role in mating systems, simply waiting to mate with the male who is victorious in pre-copulatory intrasexual competitions. Though the advent of radio telemetry has afforded new insights into reproductive ecology, the vast majority of our current understanding of mating dynamics still stems from factors influencing male mate acquisition (e.g., movement tactics, agonistic bouts). Here, we examine the association between female ecdysis, movement, and mate detection in Northern Watersnakes (*Nerodia sipedon*). We monitored eight radio-equipped adult female *N. sipedon* for ecdysis events, movement, attractiveness, number of mates, temporal mating pattern, and mating frequency four times daily throughout the 2007 mating period (April–June). Females were alone during the majority of the mating period indicating they were not attractive to males. However, immediately following an

ecdysis event, which occurred multiple times within the mating period, female movement (daily distance moved and frequency) peaked. The amount a female moved within a given mating period was a good predictor of the number of males she was located by and females were more likely to be located by a male immediately following an ecdysis event than during the remainder of the mating period.

**0109 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008;
GRUBER**

Influence of Temperature on the Habitat Use and Movement Patterns of Round Stingrays in a Southern California Estuary

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Sexual segregation among elasmobranchs often results in differential habitat use, with females of some species moving into shallow, inshore environments during summer. Although behavioral thermoregulation has been purported to explain this pattern, difficulties remain in linking a thermal preference to reproductive behavior or pregnancy. 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). This study 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 these areas during pregnancy. Rays were seasonally abundant with the highest densities occurring from May-August and few rays present from October-April (2006-07). Higher ray densities correlated with warmer seafloor water temperatures. Ray densities were also higher in the restored habitat than the natural habitat, except during September. Sex ratios were highly skewed toward female rays in restored habitats but only slightly skewed toward females in natural habitats. Ultrasonography, performed on a subset of female rays in restored areas, confirmed that 80% of rays were pregnant. In addition, passive acoustic telemetry revealed that rays showed site fidelity to restored areas during spring and summer, but moved into natural areas during early fall or emigrated from the estuary altogether by winter. This was supported on a shorter temporal scale by quantifying the daily activity spaces of rays during summer and fall. These results, combined, suggest that 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.

0430 Fish Systematics III, Drummond, Saturday July 26, 2008

Ontogeny and Homology of the Sucking Disc in Remoras (Teleostei: Perciformes: Echeneidae)

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Fishes of the carangoid family Echeneidae are characterized by a complex, adhesive, ovoid suction disc on top of the head with which they attach themselves to various marine hosts, including other fishes, sea turtles, and cetaceans. The moveable parts of the disc are serially arranged, bilaterally paired, rectangular, spinulose laminae that can be raised and lowered like the shutters of Venetian blinds; these laminae are collectively encircled by a thick, marginal "lip" of flexible connective tissue. Since its earliest descriptions, there has been general agreement that the bony components of the echeneid disc are those of a highly modified, spinous dorsal fin that has migrated from the usual postcranial location to a supracranial one and would thus comprise the proximal, middle and distal radials of spinous dorsal pterygiophores and dorsal spines. Most early authors (e.g., Gunther, 1860; Beck, 1869; Storms, 1888; Regan, 1912) who studied the anatomy of the disc proposed that the bilaterally paired laminae represent two halves of a transformed spinous ray, although there was considerable disagreement about exactly how this transformation occurred. Surprisingly, however, three recent papers (O'Toole, 2002; Fulcher and Motta, 2006; Richards, 2006) rejected the earlier hypotheses that the paired disc laminae are dorsal spines and proposed instead that they represent "a laterally expanded distal pterygiophore, while the medial spine is a reduced dorsal-fin spine." An ontogenetic perspective is clearly critical to ultimate resolution of this long-standing homology question, but echeneid larvae of sizes at which the bony components develop and transform are rare in larval fish collections. In 2005, I spent seven weeks exploring the extensive unsorted larval fish collections that emanated from over twenty years of plankton sampling by Japanese vessels surveying scombroid spawning grounds. The still unsorted non-scombroid specimens were made readily accessible in 2001, when they were transferred from the Far Seas Research Laboratory in Shimizu to the National Museum of Nature and Science in Tokyo. The developmental series I managed to acquire there provides unequivocal evidence that the paired disc laminae do indeed represent two halves of a transformed spinous ray, and, perhaps more importantly, elucidate the precise ontogenetic trajectory through which this extraordinary transformation occurs.

0668 Poster Session II, Saturday July 26, 2008

Form, Function & Fitness—Selection and Performance Gradients for Tadpoles Exposed to Predatory Naiads

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Natural selection acts on traits through the impact of those traits on organismal performance, which is the direct target of selection. To disentangle direct and indirect aspects of selection, we use the morphology, performance, and fitness path analysis of Arnold (*Am. Zool.* 23:347–361). In the classic predator-prey system of tadpoles v. predatory insects, there is conflicting evidence and intuition, which we address using the Arnold framework. Two hypotheses are generally advanced to explain how anuran morphology reduces predation risk: (1) by improving the tadpole's escape swimming performance, or (2) by using the tail to lure predator strikes away from the tadpole's body. We measured size, shape and burst swimming speed of 190 tadpoles and exposed them to predators to assess survivorship. Arnold's suggested path analysis, with additional direct paths from traits directly to fitness was used to understand patterns of selection and performance in the system. Tadpole morphology affected burst swimming speed, but swimming speed did not influence survival. Fast tadpoles were large, had long tails, deep tail muscles, and proportionally small bodies. However, tadpole body shape akin to published accounts of tail lure morphology had a direct relationship with survival. Thus, only the tail lure effect was supported. This study documents the utility of analyzing multiple trait effects. It also demonstrates that adding direct paths between traits and fitness to the classic Arnold path model can shed light on alternative functional hypotheses of selection. (published in *Evolution*, in press)

0582 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

Functional Consequences of Structural Differences in Stingray Sensory Systems (Elamobranchii: Batoidea)

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This comparative study of stingray species addresses the relationship of form and function in two sensory systems. Elasmobranchs demonstrate remarkable sensory capabilities. Particularly high interspecific diversity exists in batoid mechanosensory lateral line and electrosensory systems, which allow elasmobranchs to detect water movements and electrical fields respectively. This study compares sensory anatomy and detection capabilities of the lateral line and electrosensory systems in the benthic round stingray, *Urobatis halleri*, benthopelagic bat ray, *Myliobatis californica*, and the

pelagic stingray, *Pteroplatytrygon violacea*. Predictions based on detailed sensory system maps were tested in behavioural detection experiments. *U. halleri* feeds primarily on small epifaunal benthic invertebrate prey and the lateral line shows a high proportion of ventral non-pored canals while the electrosensory pores are highly concentrated around the mouth. *M. californica*, which feeds primarily on infaunal benthic invertebrates, has extensive and highly branched pored lateral line canals and a high electrosensory pore number and density concentrated anteriorly. Both systems in *M. californica* have dramatic lateral extension toward the wing tips on anterior edges of the ventral surface of the pectoral fins. *P. violacea* feeds primarily on squid and teleost fish, and has an intermediate proportion of pored and non-pored canals with little branching of pored canals and a significantly reduced electrosensory pore number and density. Responses of each species to weak water jets and electrodes are compared. *M. californica* responds to water jets at a higher rate over a significantly greater proportion of its disc width. Responses to weak electrical fields were comparable to those observed for sharks with minimum responses below 1 nanovolt per cm for benthic feeding species. Ecological and evolutionary implications of these results are discussed.

0530 Poster Session III, Sunday July 27, 2008

Temperature, Toads, and Trajectories: Morphological Ontogeny of Tadpoles in Different Thermal Regimes

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Recent progress has been made towards the explanation of how abiotic factors influence morphological phenotype in amphibians. Still, few studies have addressed the relationship between abiotic factors and morphological phenotype through ontogeny. Here, we examine development as a phenotypically plastic aspect of larval anurans and attempt to clarify the relationship between morphology, developmental temperature, and ontogeny in American Toad larvae. Fertilized eggs of the American Toad, *Anaxyrus* (= *Bufo*) *americanus* (Holbrook, 1836), were obtained from two pairs of adults, and larvae were reared in four temperature treatments (constant Mean, constant High, constant Low, and Fluctuating regime [Low night-High day]); developmental series were collected from each treatment (Gosner Stages 28–40). Distance measurements were recorded on various external features of tadpoles as well as on the internal skeleton. Linear morphometric data were used with geometric morphometric data taken from *A. americanus* chondrocrania in a previous study to make inferences about the effects of developmental temperature on morphology through premetamorphic ontogeny.

0684 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

White Shark (*Charcharodon charcharias*) Homing and Fidelity in the Eastern Pacific

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White sharks (*Charcharodon charcharias*) have been assessed as 'threatened' by the IUCN and are listed for protection under appendix II of CITIES yet basic aspects of their biology such as habitat preference, distribution and population structure are still poorly understood. Through collaborative efforts under the Tagging of Pacific Pelagics (TOPP) research program, we have deployed over 100 satellite and 50 acoustic telemetry tags on white sharks at seal rookeries off central California, and are revealing a predictable migratory pattern highly structured in space and time. The consistent use of discrete offshore habitats, followed by a return to the same coastal pinniped rookeries, was determined from long-term tagging and photo identification studies. During the coastal phase, the fine-scale movement of individuals was elucidated using passive acoustic telemetry. Individuals transited between Ano Nuevo, South East Farallon Island and other coastal white shark hotspots but resided at each site for periods of days to months. Satellite tracking revealed highly consistent use of two offshore habitats, one near Hawaiian waters, and another between Hawaii and Mexico known as the 'white shark café'. Despite a long migratory route and the potential for trans-oceanic passage, there was no evidence of straying from the eastern Pacific. Mitochondrial genetic data indicate that white shark females in the North eastern Pacific have maintained long term isolation from the other known white shark populations near South Africa and Australia. Despite a cosmopolitan distribution, site fidelity is a mechanism which may explain reproductively isolated populations.

0543 Poster Session II, Saturday July 26, 2008

Moisture Relations and Climbing Behavior in the Red-cheeked Salamander, *Plethodon jordani*

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Although I have observed many species of southern Appalachian plethodontid salamanders climbing above the ground surface on vegetation, the Red-cheeked Salamander, *Plethodon jordani*, is one of a group of related species that does so frequently. I have observed them feeding, being aggressive and courting, as well as just sitting, while up on vegetation. Since salamanders cannot control water loss

through their skin, and the above-ground environment is likely to be more prone to desiccation than the leaf litter-ground surface environment, questions are raised concerning their use of the elevated habitat. Are Red-cheeked Salamanders more active overall when vapor pressure deficit (VPD – a measure of water loss potential) is lower? Are they more likely to be climbing up on vegetation when VPD is lower? Is either behavior less likely as the number of days without rainfall increases? Salamanders were observed at night, by headlamp, with no other disturbance except for occasional photography, in Great Smoky Mountains National Park, TN, USA, between August 2006 and September 2007. There was no significant relationship between the number of dry days (0-3) and VPD, perhaps because temperature varies with the seasons and humidity tends to increase and temperature decrease as the evening progresses. The frequency of climbing behavior was correlated to VPD (lower VPD = more climbing); the activity level of the salamanders was not. The frequency of climbing behavior was only weakly correlated, and the number of active salamanders was not correlated, to the number of dry days (0-3). The activity level of the salamanders was not correlated to the amount of time since sunset; the frequency of climbing behavior was correlated with increasing time past sunset, although there may be a seasonal effect. This effect could be the result of a peak in the courtship season, as numerous courtships, attempted courtships, and other social interactions were observed during this period.

0487 Poster Session I, Friday July 25, 2008; CARRIER

Length Based Population Dynamics Analysis of Mako Sharks on the West Coast of North America

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Mako sharks, *Isurus oxyrinchus*, on the West coast of the United States and Baja California are impacted by commercial, recreational, and artisanal fishing pressures. Despite these pressures, little is known about the population sizes and dynamics of makos in this region. This study will endeavour to use genetic analysis to determine population structure of mako sharks in the region. This analysis will involve microsatellite genotyping of samples collected in conjunction with NMFS. We will then use length-based matrix models to determine population growth rates. The parameters for these models will be estimated based on both fisheries dependent and independent data as well as from available literature. We will then run elasticity analyses to determine which parameters have the greatest impacts on the population growth rate. Preliminary model runs suggest that the mako stocks are shrinking ($\lambda < 1$) and that the parameter to which model output is most sensitive is the survivability of large, reproductive sharks.

0570 Poster Session II, Saturday July 26, 2008

Brooding and Egg Feeding Behavior of a Rhacophorid Tree Frog (*Kurixalus eiffingeri*) From Taiwan

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We used an infrared digital camera to record the brooding and feeding behavior of *Kurixalus eiffingeri* (Rhacophoridae) in the field. Females of *K. eiffingeri* deposit fertilized eggs above the waterline on the inner walls of bamboo stumps. Male frogs exhibit paternal care during the embryonic period which ranges 9-14 days. Upon hatching, tadpoles drop into the pool of water where they grow and develop until metamorphosis. Female frogs visit and feed tadpoles at night at intervals of about 8 days. Tadpoles are obligatorily oophagous, and the length of larval period is 40~60 days. Results showed that during brooding, males lay on the clutches and often changed positions. Males frequently descended into the water, stayed for several minutes, and then climbed out of the water to lie on the clutch again. Egg feeding behavior was uniparental care in that male frogs did not involve during the whole behavioral sequences. As soon as the female entered the pool, tadpoles immediately became extremely excited and started to aggregate around her. Each tadpole stiffened its tail and began vibrating vigorously and nipping at the skin around her cloaca, thighs, and body. During the process, females stretched her body and allowed the tadpoles to touch her body. Tadpoles' movement became faster and more vigorous as the encounter progressed; this behavior was fastest and most vigorous moments before eggs were deposited in the pool. The "egg-begging" behavior lasted from few minutes to 15 min and females began to lay trophic eggs, a few at a time. As soon as the eggs are laid, the tadpoles swallowed the eggs immediately. A video on the brooding and egg feeding behavior will be showed during the presentation.

0316 Poster Session I, Friday July 25, 2008

Population Characteristics of *Manta birostris* Observed in Yaeyama, Okinawa, Japan, 1987-2006

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Encounter-history records and biological observations of manta rays at Yaeyama, Okinawa, Japan have been compiled for over 4500 dives conducted on over 2400 days in the period from 1987 to 2006. A photo-identification methodology based on the unique skin patterns of individual rays was used to identify 303 different manta rays. The disc widths of the smallest free swimming individuals was 0.9m. Maximum disc widths observed were 3.6 m for male and 4.3m for female. The age at first pregnancy appeared to be about ten-years of age, with mature females

appearing to give birth on a three or four year cycle. Newborn rays have been observed on many occasions, but preliminary analysis suggests that mortality or emigration from the study site is relatively high over the first three years of life. The longest period between the first and last sighting of a single individual was 27 years, for a female ray identified in 1980 that was still alive at the end of the study. Quantitative analyses indicate that this Japanese manta ray population is either stable or has increased over the study period.

0313 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

DNA evidence for cryptic species boundaries within *Manta birostris*?

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Molecular evidence to support/refute hypothesised cryptic species boundaries within *Manta birostris* were investigated. Genetic profiles of Indo-Pacific manta rays showed two distinctive clusters, with a pattern supporting speciation rather than geographic differentiation.

0276 Poster Session II, Saturday July 26, 2008

Habitat Use of Morphologically Poorly Diverged Geckos, *Gekko yakuensis* and *Gekko hokouensis* in Yakushima, Japan

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Gekko hokouensis is widely distributed in southern Japan, Taiwan and eastern continental China, whereas the distribution of *G. yakuensis*, its close relative, is confined to a narrow area in southern Japan; southern Kyushu, Yakushima, Tanegashima and Magejima. These two species hybridize and the offspring is viable. Furthermore, the hybrid swarms that consist of post F1 generations are reported from a few localities in southern Kyushu. In Yakushima, it is suggested that the putative hybrids exist in relatively high proportions in several localities where both *G. hokouensis* and *G. yakuensis* are found. In this study, distributions of the two species and their hybrids in Yakushima were surveyed in a finer geographical scale. *Gekko hokouensis*, *G. yakuensis* and their hybrids were determined on the basis of morphological characteristics. Furthermore, putative hybrids were confirmed by allozyme analysis. Then, the sampling site of each specimen was mapped and habitat analyses were conducted. Hybridization and introgression of the two species in Yakushima was confirmed. This study also revealed the two species' habitat utilization and their affinity to residential area. The results showed that habitat use of *G. yakuensis* is significantly different at the localities where *G. hokouensis* co-exist when it is compared to the localities where *G. yakuensis* solely exist. This suggests the

habitat use of *G. yakuensis* is affected by the presence of *G. hokouensis* through the ecological competition.

0735 Poster Session I, Friday July 25, 2008

Exploring Lightfish (Teleostei: Stomiiformes) Relationships: A Neuroanatomical Approach

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The lightfishes of the basal euteleost order Stomiiformes are comprised of four families and over 250 species of meso- and bathypelagic fishes. The hypothesized origins of the Stomiiformes and interrelationships of the four constituent families are based on phylogenetic inferences recovered from osteological data. Tests of phylogenetic hypotheses concerning basal euteleost clades have most recently focused on molecular evidence. Using a Sudan-black nerve-staining technique, we attempt to explore how neuroanatomical data may inform phylogenetic inference and corroborate or amend previous hypotheses. Our specific goal in the study was to explore how neuroanatomical characters associated with the stomiiform acoustical-lateral system may be used to infer interrelationships of taxa within the order. Our results show that characters associated with lateral-line neuroanatomy are, for the most part, phylogenetically informative and corroborate previous phylogenetic hypotheses for the group.

0652 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Cast in a Different Light: Comparative Innervation and Homology of Bioluminescent Organs in the Lightfishes (Teleostei: Stomiiformes)

Christopher Kenaley

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The lightfishes of the basal euteleost order Stomiiformes, comprised of four families and over 250 species, are characterized by a suite of luciferin-mediated photophores along the ventrolateral aspect of the body and on the head. The size and number of these photophores have served as important systematic characters within families and genera, however, their phylogenetic value in informing higher level relationships within the order have gone largely overlooked. To assess established phylogenetic hypotheses of major clades within the order Stomiiformes, characters associated with innervation of cephalic and ventrolateral photophores are brought to bear. Specifically, the most informative evidence is associated with differential patterns of spinal and lateral-line nerve input of ventrolateral photophores, and trigeminal (cranial nerve V) input of cephalic photophores.

0288 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Alberta Northern Leopard Frog Recovery Program

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¹Alberta Conservation Association, Sherwood Park, Alberta, Canada, ²Alberta Fish and Wildlife, Red Deer, Alberta, Canada

The northern leopard frog (NLF) (*Rana pipiens*) has suffered dramatic population declines in many parts of its range in Alberta, Canada. Although little studied, the decline in Alberta does not appear to be part of a natural cycle. The species' reduced area of occupancy and fragmented populations have led to its listing as Threatened under Alberta's *Wildlife Act* in 1996, and reaffirmation in 2003. A recovery plan was drafted and approved in 2005 and describes strategies and actions necessary for achieving the provincial goal of a "well-distributed, self-sustaining population of NLFs throughout their historical range in Alberta". The recovery plan focuses on the protection of existing populations from anthropogenic disturbances; population inventories and monitoring; habitat assessments; the reintroduction of frogs to some sites within their historical range; the implementation of stewardship projects with cooperative landowners; and the collection of additional data to aid in reintroduction efforts, including population genetics and disease surveillance work. Recently, recovery actions have included: a provincial inventory for the species (2005); the development of a reintroduction protocol, the reintroduction of frogs into several sites within their historical range; monitoring success at reintroduction sites; habitat protection activities, including stewardship projects; the production and distribution of outreach materials; and development of a GIS habitat model of potential NLF habitat.

0287 Poster Session III, Sunday July 27, 2008

Alberta Volunteer Amphibian Monitoring Program

Kris Kendell

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The Alberta Volunteer Amphibian Monitoring Program (AVAMP) is a long-term community survey of amphibians that was implemented in 1992 under the auspices of the Declining Amphibian Population Task Force established by the Species Survival Commission of the World Conservation Union (IUCN). The goal of the program is to increase awareness of the conservation issues facing amphibians as well as to provide a better understanding of the distribution and general status of amphibians in Alberta, Canada. The program is lead by the Alberta Conservation Association (ACA), and carried out in partnership with Alberta Sustainable Resource Development (ASRD), and other agencies. Through the program, volunteers are encouraged to submit location information on amphibian observations as well as incidental reptile observations. Volunteers are supplied a peer-reviewed monitoring manual and a CD featuring the calls of the anurans found in Alberta. These materials allow program participants to become familiar with the identification and

life history of Alberta's amphibian species. Included in the manual are detailed instructions on how to monitor amphibians, and record and submit observations. The time and energy volunteers put into the AVAMP is entirely up to them. To maintain communication with volunteers, they are sent a biannual program newsletter each spring and fall, called "Croaks and Trills". A dedicated toll-free phone number is also available to volunteers to contact the program coordinator if they have questions about the program, species identification, or conservation issues relating to amphibians (and reptiles) in Alberta. Hundreds of herptile observations are submitted annually to program coordinator, where they are verified for accuracy, entered into a spreadsheet and forwarded to ASRD for uploading into the Fisheries and Wildlife Management Information System.

0365 Poster Session I, Friday July 25, 2008; STORER ICHTHYOLOGY

Phylogeography of the Imperiled Redtail Splitfin (*Xenotoca eiseni*) in Mexico: Implications for Taxonomy and Conservation

Carys Kenway

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Xenotoca eiseni, the redbtail splitfin, a member of the livebearing subfamily Goodeinae (Teleostomi: Goodeidae), is endemic to the Mesa Central of Mexico. It has a restricted distribution in the Western basins of the Pacific coast including the Rio Grande de Santiago, Compostela, Ayuquila, Coahuayana, and the endorheic Lago de Magdalena. Previous studies have noted high levels of genetic differentiation between the endorheic Lago de Magdalena and surrounding basins, which may be indicative of more taxonomic diversity within *X. eiseni* than currently recognized. Therefore, the objectives of this study were to use mitochondrial DNA sequences (cytochrome b) to assess levels of genetic differentiation and phylogeographic structure among the geographically isolated populations in each of the basins in Central Mexico. Sequence data was gathered from 6 populations and multiple individuals within each population. Cytochrome b yielded approximately a 2.6% nucleotide difference between populations in the endorheic Magdalena basin and all other locations. When compared to other goodeid studies, this level of intraspecific genetic differentiation is more consistent with species level diversity for the Magdalena population. The taxonomic and conservation implications of this work will be discussed in light of these results.

Seasonal Residency And Migration Of Mature Lemon Sharks (*Negaprion brevirostris*) Off The Southeast Florida Coast

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In 2001 aggregations, of ~75, mature lemon sharks (*Negaprion brevirostris*) were discovered just off the Jupiter coast, FL, by a local SCUBA diver. The presence of concentrated groups presented us with the first opportunity to study wild lemon sharks of mature life stage. To assess the potential of utilising this aggregation for research, feasibility studies were conducted from 2003 - 2005 revealing that these sharks could be caught for further study. During the subsequent winter seasons of January to March 2006 - 2008, sharks were caught on hooks using rod and reel and polyball drop-lines. Captured individuals were secured to the boat measured, sampled for DNA and tagged (NOAA M-type dart tag and PIT tag). All mature lemon sharks received a Vemco V16H transmitter implanted in their coelom. These three-year transmitters in concert with an array of 18 VR2 monitors along the putative aggregation migration route were used to describe local movements. Our monitors form part of the Florida Atlantic Coast Telemetry (FACT) VR2 array consisting of approximately 123 monitoring stations, with 26 to date receiving hits from our study population (total of 31 mature lemon sharks, 11 females and 20 males). A male previously caught off Long Key, FL, and another previously caught in Winyah Bay, NC, were originally tagged under the NMFS co-operative shark tagging program. This demonstrated that mature lemons will undertake long migrations to join this aggregation. Results from the monitors showed that males left the array area around March/April 2007 then returned between December 2007 and January 2008. In contrast, the females produced hits on the array year round. Contact at the most commonly visited station predominately occurred during daylight hours. The further deployment of two wildlife computer MK10 PAT tags (three and six months release) should further reveal the longer-term movements of the mature males.

**0117 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR**

**Persistence and Prevalence of the Enzootic Amphibian Pathogen,
Batrachochytrium dendrobatidis, in Panama**

Vanessa Kilburn¹, David M. Green¹, Roberto Ibanez², Eldredge Bermingham²,
Oris Sanjur²

¹*McGill University, Montreal, Quebec, Canada*, ²*Smithsonian Tropical Research
Institute, Panama City, Panama*

The pathogenic chytrid fungus, *Batrachochytrium dendrobatidis*, is implicated in the population declines and extinctions of numerous species of tropical, principally montane, amphibians. If the fungus is enzootic, it may remain in the environment after an epidemic has passed and may infect both montane and lowland amphibians. Research sites at various elevations were established throughout Panama west of the Canal where abundances of amphibian populations at varying stages of epidemic infection could be examined. Chytrid prevalence and infection intensity were determined using sensitive DNA-based Real-Time Quantitative PCR amplification. Amphibian populations at all elevations were found to have at least some degree of chytrid infection, and the chytrid was found to persist on reptiles in addition to amphibians. Lowland amphibians appeared to be as susceptible to chytridiomycosis as their high elevation counterparts. These results suggest that the primary assumptions of chytrid ecology, which is that it causes fatal chytridiomycosis in the tropics only in areas of low temperatures and high moisture (i.e. highlands), should be reassessed. If the chytrid exists at all elevations, even if at low levels, then it is likely enzootic and perhaps only the current epidemic of chytridiomycosis disease is novel. Since the infection can remain in frog communities at any elevation, can persist for long periods of time (up to 11 years), and can survive on non-amphibian hosts, the eventual reintroduction of captive-bred amphibians as a plausible management plan for amphibian conservation should be carefully examined.

0185 Poster Session II, Saturday July 26, 2008

**Effects of a Long-term Elevation of Perceived Predation Risk on Territorial
Behaviour in Wild Juvenile Atlantic Salmon**

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Department of Biology, Concordia University, Montreal, Quebec, Canada

Local predation risk has striking effects on the short term behaviour of prey, including juvenile salmonids, in both laboratory and field conditions. However, the long term consequences of increased predation risk have rarely been examined. To examine the potential effects of prolonged exposure to an elevated perceived predation risk on the individual behaviour of juvenile Atlantic salmon, we established three contiguous sections differing in perceived predation risk in each of seven reaches of relatively uniform habitat in Catamaran Brook, New Brunswick, Canada. Each reach consisted of a low predation site (stream water control) and a

high predation site (conspecific alarm cue) separated by an undisturbed buffer zone. We manipulated the perceived predation risk over a four week period by releasing chemical alarm cue in the high predation site (skin extracts from juvenile Atlantic salmon) and stream water in the low predation site, when young salmon emerge from gravel nests and begin defending territories. As predicted, individuals in high predation risk sites had smaller territories compared to low predation risk sites. In contrast, individuals in risky sites had higher foraging rates than in control sites. However, fish did not differ in body size or condition between the treatments. Our study shows that juvenile salmon detect habitats with a high risk of predation and modify their behaviour when using such sites.

0422 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

The Effects of Mercury on the Behavior of *Agkistrodon piscivorus*

David Kimberly, Neil Ford

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Recent studies on a wide array of taxa have clearly demonstrated the adverse effects mercury can have on many life history traits. Symptoms such as ataxia, anorexia, and loss of locomotor and eye sight capabilities has been confirmed in birds, fish, and primates including humans. However, in spite of the wealth of data within this area, reptilian taxa are drastically understudied. The goal of this study is to compare cottonmouths from Caddo lake Wildlife Refuge, a historically contaminated site, with snakes from the Old Sabine Wildlife Management Area, an uncontaminated site, in order to reveal mercury's affect on the behavior of this top predator. Three series of tests, including predatory strike response, righting response, and sprint speed and endurance, were used in this study. Preliminary analysis shows a significant relationship with many components of the predatory strike response, including prey handling time. Additionally, righting response behaviors were significantly different between the Caddo lake population and the Old Sabine population. These results suggest that mercury contamination has subtle impacts on the behavior of snakes that likely would affect the long-term survival of the populations.

0691 Poster Session III, Sunday July 27, 2008

Diversification and Phylogeography of *Melanophryniscus rubriventris* (Anura: Bufonidae)

Laura King¹, Marcos Vaira², Daria Kosciński³, Maria Ines Bonansea², Stephen C. Loughheed¹

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Andean montane forests have proved especially diverse in their anuran faunas. Moreover, many traditionally regarded Neotropical species (based primarily on morphology) have been revealed to contain incredibly deep divisions. We investigated patterns of molecular divergence in *Melanophryniscus rubriventris* (Anura: Bufonidae), an aposematic toad from the Andes of northwestern Argentina and southern Bolivia. We sequenced both nuclear (rhodopsin exon 1) and mitochondrial (16S rRNA) genes to quantify diversity within and among five populations spanning the Argentine portion of the species' range. We found two distinct mitochondrial lineages, one of which was restricted to a single site near Baritú National Park in northern Argentina. We found three rhodopsin alleles, which appear to show clinal patterns along a north-south axis. This raises the possibility that there exist two species where previously only one was recognized. Coupled with other research from our lab, our results point to the importance of orogeny, climate change, and shifting vegetational patterns in shaping diversification of anuran lineages. Our findings also highlight the importance of detailed genetic studies in revealing cryptic phyletic diversity and in guiding conservation priorities. Studies such as ours are desperately needed in light of recent drastic amphibian declines, especially among tropical and montane taxa.

0563 Poster Session II, Saturday July 26, 2008

Body Temperatures of Hibernating Watersnakes

Richard King¹, Kristin Stanford¹, Doug Wynn², Kent Bekker³

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The use of temperature-sensitive radio transmitters has provided a wealth of information about reptilian thermal biology. However, much of this information pertains to the active season. Relatively few studies have used this technology to assess body temperatures during hibernation. We collected 351 body temperature readings from 44 hibernating adult Lake Erie watersnakes at irregular intervals during the winters of 2000-2001 and 2001-2002. In both years, entry into hibernation occurred in September and October and emergence occurred in April and May. Body temperatures were at their lowest and remained relatively stable between December and March. However, individual watersnakes exhibited different temperature profiles. For example, body temperature minima varied between 1 and 10 C among

individuals, a difference that may be bioenergetically important. Differences in minimum body temperatures between the sexes were small (1 C) and only approached significance ($P = 0.07$). Differences between years were larger (2 C, $P = 0.003$) but are likely due to differences in dates of data collection. Among nine watersnakes monitored in both years, there was no correlation in minimum body temperature between years. Warm spells during the spring of each year were associated with above-ground activity and high watersnake body temperatures. These were followed by re-entry into hibernation and lower body temperatures on subsequent cooler days. This observation suggests that emergence date is a phenotypically plastic trait that may respond to global climate change.

0262 Poster Session III, Sunday July 27, 2008

Effects of PCB Exposure on the Reproductive Potential of Artificially Matured Male American Eels

Jennifer Kinsey, Whitney Hable, Ken Oliveira

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The population of the American eel, *Anguilla rostrata*, has declined over the past two decades. The cause of the decline is unknown, but possibilities include anthropogenic activities such as over fishing and pollutants, parasites, and oceanic changes. Stress factors, such as contamination, can affect reproduction and could hinder recruitment for the species. These eels spend the majority of their life living in rivers along the east coast of North America, potentially exposed to a plethora of contaminants. Gametogenesis is initiated while the eels are still dwelling in rivers but are preparing for migration into the Atlantic Ocean. Little is known about reproduction in this species considering that during sexual maturation eels migrate to the Sargasso Sea, where spawning is presumed to occur, but has never been observed. This study aims to characterize artificial maturation of male eels and to test sublethal concentrations of a PCB mixture on spermatogenesis. Maturation was achieved by weekly injections of human chorionic gonadotropin (HCG). Sperm count, spermatocrit, and sperm motility were used to assess the quality of the sperm. A gonadal-stomatic index (GSI) was assessed for each eel and will be compared between treatments. Additional sampling and histological analysis are in progress.

0076 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Migration Behaviour of the Giant Manta (*Manta birostris*) in the Central Maldives Atolls

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Worldwide, populations of Giant mantas (*Manta birostris*) exhibit three types of migratory behaviour which can be categorised according individual home ranges. These are: 1) resident, inhabiting a specific home range at one location year round; 2)

migratory, moving from one location to another with changes in season; and 3) oceanic, travelling between different locations across open oceans. Although articles in SCUBA-diving related literature have suggested that mantas in the Maldives migrate between the western and eastern sides of atolls with the monsoons, perhaps in order to benefit from upwelling stimulated plankton growth occurring on the lee sides of the atolls, there has been no scientific research into this phenomenon prior to this study. Having developed a robust method for the visual identification of individual mantas, surveys were carried out throughout the central Maldives atolls recording manta visits to “cleaning stations” on reefs located along the peripheries of the atolls. Over 99% of 2680 manta encounters during the study occurred at leeward side cleaning stations. In North Male’ atoll where the data set included sightings for all months in the year, 48.3% of mantas (n=153) that were re-sighted, were sighted on both sides of the atoll during the relevant monsoon. All those re-sighted in both North-east and South-west monsoon seasons had migrated between the west and east sides, suggesting that a single population migrates between the cleaning stations on opposite sides of the atolls with the alternating seasons, rather than there being two distinct, east and west populations. Pursuit of food was not the only factor involved in migration with some animals making journeys between different atolls, or between different sites along the side of an atoll during a single season, having travelled a distance of 20-160km between survey sites. In summary the Maldives population would be considered migratory.

0653 General Ichthyology III, Drummond, Sunday July 27, 2008

Genetic Evaluation of Lake Sturgeon (*Acipenser fulvescens*) Designatable Units in Canada

Shawna Kjartanson, Nathan Lovejoy, Chris Wilson

University of Toronto, Toronto, Ontario, Canada

Canada’s largest landlocked fish, the lake sturgeon (*Acipenser fulvescens*), is a heritage species with considerable social, ecological and economic value. Over-exploitation and habitat alteration has led to severe reductions in population size and number across the species range. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified eight designatable units (DUs) in its most recent lake sturgeon status report. However, these population designations incorporated only extremely limited genetic data. In this study, eleven microsatellite loci are used to characterize 50 populations across the range of lake sturgeon in Canada. The robustness of the current designations are tested and discussed.

0220 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Jaw Closing Mechanics in Caecilians: Biting with Two Joints and a Hyobranchial Muscle

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The caecilian (Lissamphibia: Gymnophiona) skull is characterized by numerous specializations to the fossorial lifestyle of these animals. Bones are fused to compound elements to make the skull more solid and compact. The skull of caecilians was shown to be kinetic – the quadrate-squamosal complex can be moved with respect to the remainder cranium (streptostyly). The jaw closing system of caecilians is unique among vertebrates in that a hyobranchial muscle, the m. interhyoideus posterior, acts as accessory jaw adductor on the ventral side of the lower jaw, caudal to the jaw joint. Here we present a new modeling approach to describe the function of the caecilian jaw closing mechanism. Our model includes information on lever arms, muscle fiber orientations, and physiological cross sectional area of muscles to estimate caecilian bite forces. We show that every muscle in the caecilian jaw closing apparatus has a critical gape angle above that, the muscle will act opposite to the jaw closing movement, i.e. against bite force. The integration of the ancestral jaw closing musculature and the m. interhyoideus posterior, however, results in almost constantly high bite forces over a wide range of gape angles. Cranial morphology has a direct impact on jaw closing mechanics in caecilians. The m. interhyoideus posterior contributes less to total bite force in species with a fenestral temporal region (zygokrotapy), than in species with a closed skull roof (stegokrotapy). The unusual muscle configuration of the caecilian jaw is correlated with a mandibular joint in which the fossa is extensively flanking the condyle. Streptostyly mediates mediolateral movements between lower jaw and the remainder cranium and is suggested to amplify bite force.

0535 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

The Effects of Skull Morphology on Feeding Performance in Snakes: A Preliminary Study

Nathan Kley

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Uniquely among terrestrial vertebrates, snakes resemble fishes in relying largely on extensive and well-coordinated movements of complex skeletal linkage systems to feed. In recent years, ichthyological biomechanists have developed increasingly sophisticated and accurate models to predict feeding performance in fishes, and such models have even been used to predict feeding performance in fossil taxa. In contrast, no such predictive models have yet been developed for snakes. In fact, no

empirically derived data have ever been published that directly link any specific aspect of skull morphology with feeding performance in snakes. In this study, I quantified intraoral prey transport performance across a wide range of prey sizes for a phylogenetically and morphologically diverse sample of macrophagous alethinophidian snakes. I then quantified the cranial morphologies of all taxa included in these performance studies through detailed craniometric analyses, in which approximately 70 linear measurements were taken across all regions of the skull and jaw apparatus. Finally, regression analyses were conducted in order to develop a quantitative model predicting prey transport performance based on the relative proportions of individual bones and functional units within the head skeleton. Contrary to previous hypotheses, the relative lengths of neither the quadrate nor the supratemporal were found to be significant in determining feeding performance. Rather, these preliminary analyses suggest that the relative length the lower jaw is the single most important determinant of prey transport performance, explaining between 68 and 78 percent of the variance in the performance data, depending on which phylogenetic hypothesis is used for analysis.

0494 AES Age & Growth/Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Using Bomb Radiocarbon Analyses to Validate Age and Growth Estimates for the Tiger Shark, *Galeocerdo cuvier*, in the Western North Atlantic

Jeff Kneebone¹, Lisa Natanson², Allen Andrews³, Hunt Howell¹

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Refined and validated age and growth determinations are necessary for a proper understanding of tiger shark (*Galeocerdo cuvier*) life history characteristics in the western North Atlantic. Age and growth estimates were derived from band counts of 238 sectioned vertebral centra. Bomb radiocarbon analysis of ten band pairs extracted from four vertebral sections suggested band pairs are deposited annually up to age 20. Males and females were aged to 20 and 22 years, respectively, although longevity estimates predict maximum ages of 27 and 29 years, respectively. Two and three-parameter von Bertalanffy and Gompertz growth functions fit to length at age data demonstrated that growth rates were similar for males and females up to around 200 cm FL after which male growth slowed. Both sexes appear to reach maturity at age 10. The two-parameter von Bertalanffy growth function provided the best biological fit to length at age data generating parameter estimates of: $L_{\infty} = 330$ cm FL, $k = 0.131$ for males and $L_{\infty} = 347$ cm FL, $k = 0.124$ for females, with L_0 set at 62 cm FL. This study provides a rigorous description of tiger shark age and growth in the western North Atlantic and further demonstrates the utility of bomb radiocarbon as an age validation tool for elasmobranch fish.

0184 Fish Ecology I, Drummond, Thursday July 24, 2008

Using Fine Scale GIS Data To Quantify Microhabitat Use And Environmental Niche Characteristics Of Stream Fishes

Jason Knouft

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The application of geographic information systems (GIS) data to the study of abiotic factors regulating broad scale species distributions has recently received a large amount of attention. Although these applications have provided important insights into factors influencing species distributions, limited use of niche-based GIS techniques have been made in local habitats. Aquatic systems provide excellent opportunities for fine scale GIS applications because sites can be easily defined and the environmental factors regulating taxa in these systems are well understood. For this study, a 700 meter segment of Labarque Creek, a second order stream located on the property of the Washington University Tyson Research Center in eastern Missouri, was mapped using a high accuracy (<20 cm) Trimble GeoXH GPS unit. Georeferenced data for nine habitat variables characterizing depth, temperature, dissolved oxygen, sediment size, flow rate and riparian canopy cover were collected at over 200 points along the 700 meter stream segment. Continuous raster datasets were generated using an inverse distance weighting algorithm for each variable. Fishes were then collected at georeferenced localities along the stream reach. Fish occurrence localities were intersected with environmental datasets to characterize the habitat of each species along the stream reach. This method was able to discriminate habitat use among closely related species (e.g., within *Lepomis*) as well as differentiate between 'pool' and 'riffle' species. Niche breadth and niche marginality were also calculated for each species to characterize the habitat use for all taxa in relation to available habitat. Species' niche breadth and niche marginality were both correlated with number of individuals collected, indicating that species with narrow niche breadths and/or marginal niches tend to be less abundant. Results suggest that the application of broad scale GIS-based niche characterization techniques can be useful for understanding patterns and processes in local systems.

0522 Herp Stressors/Snake Conservation, Salons 6&7, Monday July 28, 2008

Amphibians of Brooktrout Lake: A "Recovering" Acidified Lake in the Adirondacks

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Brooktrout Lake is a high elevation lake located in the southwestern Adirondack mountains. During the latter half of the last century, pH of the lake measured <5, which was typical of acidified clear water lakes in the region during that time period. Over the last decade, long term monitoring of water chemistry indicated signs of recovery from acidified conditions. In 2005–2007, amphibian communities were

sampled using minnow traps, activity traps, and dip net sweeps to assess species composition, relative abundance, and reproductive success. Seven amphibian species were documented, with 6 of these species showing successful reproduction. The most abundant amphibians at the site were red-spotted newts (*Notophthalmus viridescens viridescens*) and green frogs (*Lithobates clamitans*). In November 2005, brook trout (*Salvelinus fontinalis*) were stocked into the fishless lake (which contained brook trout prior to acidification). Subsequent to the restocking, stomach contents of red-spotted newts and brook trout were sampled to determine degree of dietary overlap and to monitor changes in relation to fish introduction. Preliminary analysis indicates that newt diet varied throughout the year and was more diverse than trout diet. In October 2006 and May 2007, stomach samples from trout were dominated by *Chaoborus* (larvae and pupae). In October 2007 samples, *Chaoborus* were present, but not as abundant as in the previous year. Year class trout consumed corixids and zygopterans; fish of larger size classes consumed anisopterans as well. Activity traps are also being used to monitor invertebrate community changes over time, in response to changes in water chemistry and biological communities, including brook trout populations.

0070 Fish Systematics II, Salons A&B, Friday July 25, 2008

Review of *Melanochromis*, a Cichlid Genus of Lake Malawi, with the Description of Three New Species

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Trewavas (1935) originally distinguished the Lake Malawi cichlid genus *Melanochromis* from *Pseudotropheus* on the basis of morphology and arrangement of pharyngeal teeth and included five species in the genus. Later, Trewavas (1984) extended the diagnosis to include all elongate mbuna that possessed horizontal stripes and U-shaped tooth bands. We have examined the type specimens of *M. mellitus* (Johnson), *M. robustus* (Johnson), *M. loriae* (Johnson), and *M. chipokae* (Johnson) and discuss their taxonomy. We have extended the diagnosis of the genus, suggest reassigning seven species that do not show the characteristic melanin pattern and describe three new species from the eastern shore of the lake totalling the number of species of *Melanochromis* to 14.

0515 Fish Morphology & Histology II, Salons 6&7, Saturday July 26, 2008

The Evolution of Raking Prey-processing in Teleosts Fishes

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We investigated *raking*, a derived feeding behavior involving a novel tongue-bite apparatus (TBA), which occurs in two major teleost lineages, the osteoglossomorph (bony-tongues) and salmonid fishes. Clear differences were quantified at several organizational levels of form and function that may have caused the different evolutionary patterns observed within each lineage in the diversification of raking behaviors. All salmonids studied to date are characterized by a conservative TBA morphology and by having distinctly stereotypical rakes, both at the level of muscle activity and kinematics. In contrast, osteoglossomorphs are highly diverse at all levels and split into two distinct evolutionary lineages, each showing unique traits in their raking functional morphology. Osteoglossid arowanas employ a complex prey-compressing raking behavior, while notopterid knife fishes shred their prey using highly divergent kinematics, even among closely related taxa. At the level of muscle-activity, a pronounced variability in activity-patterns among osteoglossomorphs facilitate several pathways of modulation. In combination with divergent TBA morphology, modulation of raking muscle activity appears to have shaped the evolution of different raking behaviors both within this lineage and compared to salmonids. Using evidence from TBA osteology, myology and biomechanics, raking muscle activity and kinematics, and information on behavioral and neuro-motor control of prey processing, we illustrate how the interplay between form and function has shaped convergent as well as divergent raking behaviors among these basal bony fishes. Supported by NSF IOB 0444891, DBI 0420440.

**0090 General Ichthyology II, Salons 6&7, Saturday July 26, 2008; STOYE
GENERAL ICHTHYOLOGY**

**The Importance of Ontogeny: New Insights into the Caudal Fin Skeleton
of Tetraodontiformes (Teleostei)**

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Studying ontogeny enables us to reconstruct the development of a given structure from its first appearance to its full development. Ontogenetic fusions or reductions of elements cannot be detected if only the adult morphology is studied, and the omission of early developmental stages may lead to misinterpretations of characters and therefore to erroneous phylogenetic assumptions. For the first time we describe the ontogeny of the caudal fin skeleton of representatives of all families of the Tetraodontiformes, with the exception of the Molidae, which lack the caudal fin entirely. The order Tetraodontiformes has been characterized as a monophyletic unit in the latest morphology-based phylogenetic study (Santini & Tyler 2003), by, among other characters, the reduction of the number of epurals to one. We found that larval

triacanthodids have either two or three epural cartilages, of which two later ossify. The posterior one remains very small even in the adult and has thus been overlooked previously. Larval triacanthids have two epural cartilages, of which the posterior one is resorbed during further development so that only the anterior one ossifies. As the most basal family of the derived subclade Gymnodontes, the Triodontidae are of special interest. The smallest specimen of a *Triodon* collected so far has two epurals and the element previously identified as the uroneural two is actually the fifth hypural. The caudal fin structure of *Triodon* is therefore much more plesiomorphic than assumed previously and may point to a more basal position of this taxon in the phylogenetic tree of tetraodontiforms. We also comment on other unusual caudal fin characters we encountered during our study.

0547 Poster Session III, Sunday July 27, 2008

The Dorsal- and Anal-fin Skeleton of the Mediterranean Clingfish *Gouania wildenowi* (Teleostei: Gobiesociformes)

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Gouania wildenowi is an elongate species of gobiesocid endemic to the Mediterranean region that inhabits the narrow interstices between coarse gravel along sheltered and exposed shorelines. Previous researchers investigating the osteology of *Gouania* (and other gobiesocid fishes in general) have focused mostly on the neurocranium and paired-fin girdles, and have paid little attention to the skeleton of the dorsal- and anal-fins. The dorsal- and anal-fin skeleton of gobiesocids exhibit several reductions, including the loss of spines and distal radials, but at the same time exhibit a novel ligament connecting adjacent proximal-middle radials. In addition to these aforementioned features, *Gouania* exhibits further reduction of the dorsal- and anal-fin skeleton, including a notable decrease in the size of the proximal-middle radials in an anterior-posterior direction. The dorsal- and anal-fin rays of *Gouania* are also unbranched and unsegmented. Unlike other gobiesocids (excluding *Alabes*), which exhibit a one-to-one relationship between the dorsal- and anal-fin rays and proximal-middle radials, in *Gouania* there are a higher number of proximal-middle radials than fin rays in each fin. Interestingly, the dorsal- and anal-fin rays do not articulate with the distal tip of the proximal-middle radials but are instead positioned between proximal-middle radials. These observations, based on examination of cleared and double stained specimens as well as histological sections, will be illustrated for *Gouania* and a number of other gobiesocid taxa.

0546 Fish Conservation, Drummond, Sunday July 27, 2008

Conservation and Taxonomic Status of the Spotted Form of the Margined Madtom *Noturus insignis* in the Dan River: A Genetic, Morphological and Distributional Investigation

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Comparative morphological and genetic data were used to determine the taxonomic and conservation status of a spotted variant of the Margined Madtom (*Noturus insignis*) that occurs in the upper Dan River system in the Roanoke River Drainage. Sequences for 401 bp of the mitochondrial ND2 gene and allelic distributions for 11 variable allozyme loci were examined across the geographic range of *N. insignis* and between spotted and unspotted individuals. Maximum likelihood reconstructions of haplotype diversification did not support of monophyly of the spotted form. ND2 nucleotide diversity was slightly lower in the spotted form, but within one standard deviation of diversity among unspotted individuals. Both mtDNA and allozyme variation was significantly structured geographically, but after controlling for geography, neither marker supported the hypothesis of genetic isolation between spotted and non-spotted forms. Significant morphological differentiation was detected between spotted and non-spotted individuals for one of 16 morphological characters, but multivariate analysis did not indicate significant differentiation. Unpublished distribution records indicate that spotted individuals have been taken in multiple drainages, beyond the upper Dan River system. This distribution and placement of spotted individuals throughout the mtDNA tree suggests multiple independent origins of the spotted form. Sampling in the upper Dan River system indicated that: 1) spotted and wildtype individuals are sympatric, 2) the spottedness is a continuously distributed trait, and 3) the spotted variant is more widely distributed than previously known. The genetic data and the preponderance of morphological data suggest appreciable gene flow between spotted and non-spotted individuals in the upper Dan River system. Neither data set supports special conservation status or taxonomic recognition of the spotted form in the upper Dan River system.

0188 Poster Session II, Saturday July 26, 2008

Genetic Analysis of Amphibian Dispersal in a Forested Landscape

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Knowledge of how amphibians use the upland forest habitat is critical for predicting the impacts of forestry practices on amphibian population persistence and for the

development of sound wetland management policies. Yet, amphibian terrestrial habitat use and dispersal rates are poorly understood, and currently available data are insufficient to determine the amount of upland habitat that should be protected surrounding wetlands. We address this issue, through a genetic study of dispersal and population structure for two species of vernal pool-breeding amphibians, the wood frog (*Lithobates sylvaticus*) and the spotted salamander (*Ambystoma maculatum*), in a forested landscape. Using microsatellite markers, we genotyped 461 spotted salamanders and 307 wood frogs collected (as embryos) from 25 vernal pools located in a hemlock-northern hardwood forest in eastern Maine. Study ponds were initially chosen as pairs that were separated by distances in the following categories: 0-250m, 250-500m, 500-1000m and 1k-5k, with no stepping stone ponds in between. In addition, genetic differentiation was investigated among all ponds and groups of ponds in the study area, spanning a maximum inter-pond distance of 55k. Results of population-based analyses (F_{ST} and allelic differentiation tests) indicated that ponds were significantly differentiated overall, with F_{ST} s of 0.022 and 0.017 for wood frogs and spotted salamanders, respectively. Genetic differentiation among ponds, however, was extremely variable and did not follow a strict isolation by distance pattern. These preliminary findings suggest that the population genetic structure we observed cannot be attributed to geographic distance alone, but rather inter-pond connectivity may be influenced by landscape features such as roads or habitat fragmentation. The latter is discussed in light of additional results using individual-based analyses, which demonstrate the presence of spatial genetic structure on a fine scale.

0035 General Ichthyology I, Drummond, Saturday July 26, 2008

Cross-species Microarray Hybridizations in Cyprinids: Extending Genomic Resources to Non-model Organisms

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Efforts toward advancing our understanding of the biology of fishes at the genomic level are hampered by lack of genomic resources for non-model species. Development of technology and protocols is costly and so most genomic resources (e.g., microarray chips) are available only for model organisms. Consequently, an important challenge in genomics is determining the extent to which we can co-opt these genomic resources for use in non-model systems. We investigated the efficacy of using commercially available fathead minnow (*Pimephales promelas*) oligonucleotide microarrays to quantify genome-wide gene expression patterns in the Rio Grande silvery minnow (*Hybognathus amarus*). The latter species was chosen because it co-occurs with fathead minnow in the wild and is of considerable interest to natural resource managers because it is a federally endangered species. Specifically, we assessed whether sufficient sequence homology existed across the genomes of these species to permit adequate hybridization of *H. amarus* mRNA to *Pimephales* microarrays, and whether results from hybridization assays were consistent and reproducible. Development of microarray protocols for closely-

related species will permit profound insight into the molecular underpinnings of organism-environment interactions and offers the exciting prospect of comparative studies at the whole-genome scale.

0435 Poster Session II, Saturday July 26, 2008

Differential Expression of Peroxiredoxins in an Anoxia-Tolerant Turtle

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Peroxiredoxins (Prx) are a family of multifunctional thioredoxin-dependent peroxidases that have been identified in a wide variety of organisms. A key function of peroxiredoxins is to protect cells against damage caused by reactive oxygen species (ROS). ROS damage in mammals is often observed in organisms transitioning from hypoxic/ischemic states back to oxygenated states. However, many organisms, including the freshwater turtle, *Trachemys scripta elegans*, have well-developed natural anoxia tolerance that allows them to survive repeated cycles of anoxia and reoxygenation without apparent damage. We hypothesized that peroxiredoxins are involved in the anoxia tolerance of turtles. Western immunoblotting was used to quantify the amounts of different peroxiredoxin isozymes (Prx1, Prx2, Prx3, Prx4, Prx5, and Prx6) in multiple organs (heart, kidney, liver and muscle) of turtles comparing three states: aerobic control, 20 h anoxic submergence in nitrogen-bubbled water and 5 h aerobic recovery after anoxia. Increased levels of selected peroxiredoxins were observed in an organ-specific manner under anoxia and/or recovery. Prx1 was elevated in muscle during both anoxia (by 2.2-fold) and recovery (by 1.5-fold). Prx2 was elevated in heart and muscle during anoxia (by 2.2- and 2.9-fold, respectively). Prx3 increased in liver during both anoxia and recovery (by 2.8- and 1.6-fold) and in muscle during anoxia (by 1.6-fold). Prx5 was elevated in heart and kidney during anoxia (by 2.7- and 1.8-fold, respectively). Finally, Prx6 was elevated in muscle during anoxia (by 1.8-fold). These results suggest a key role for these enzymes in antioxidant defense in anoxia-tolerant animals.

0432 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Tales from the Turtle Pond: Molecular Mechanisms of Anoxia Tolerance in Overwintering Turtles

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Winter survival for many turtle species is ensured by underwater hibernation that provides an escape from freezing temperatures. While short breath-hold dives can be supported by aerobic metabolism, long-term underwater hibernation requires different strategies to allow survival. Turtles belonging to the *Trachemys* genus, such as the red-eared slider (*T. scripta elegans*), can survive submerged in cold water for many weeks. Reserves of body oxygen are quickly used up and so anaerobic metabolism, strong metabolic rate depression and a capacity to buffer huge amounts of lactate are important to survival. While these and various physiological responses to anoxia have been studied in detail in turtles, the gene transcriptional regulatory processes that underlie these responses are only now being identified. The transcription factor NF- κ B has recently emerged as a central regulator of the vertebrate stress response, controlling hundreds of different effector genes. I hypothesized that this transcription factor would be activated under anoxia in *T. s. elegans*. Western blotting with antibodies recognizing NF- κ B was used to compare levels of NF- κ B under three states: normoxia, 5 and 20 hours of anoxic submergence. Both total NF- κ B in liver and the relative amount of NF- κ B in the nucleus increased during both anoxic conditions. An enzyme-linked immunosorbent assay was also used to assess the DNA-binding activity of NF- κ B in liver during normoxia and 1, 5 or 20 hours of anoxia. Results confirmed increased DNA binding activity by nuclear NF- κ B after 5 and 20 hours of anoxia, strongly suggesting that genes under NF- κ B control would be up-regulated under anoxia. Finally, to confirm up-regulation of target genes, reverse-transcriptase PCR was used to measure mRNA transcript levels of selected downstream genes under NF- κ B control and found that transcript levels increased under anoxia. These findings show that the NF- κ B pathway is activated in turtle liver during anoxia and support a role for this transcription factor in anoxia survival by *T. s. elegans*.

0283 Poster Session III, Sunday July 27, 2008

Role of Sex Steroid Hormones and Environmental Factors on the Initiation of Courtship Behavior and Mating in Male Red-Sided Garter Snakes, a Species Exhibiting a Dissociated Reproductive Pattern

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The red-sided garter snake (*Thamnophis sirtalis parietalis*) initiates courtship behavior and mating at a time when the gonads are completely regressed. Initial studies reported that the level of circulating sex steroid hormones were basal. These data suggested that initiation of reproductive behavior is independent of sex steroid hormones. In fact, the only cue(s) identified to date that have been found to initiate courtship behavior and mating is a period of low temperature dormancy followed by exposure to warm temperatures. Several studies have now found circulating androgen levels to be elevated upon emergence. In addition, sex-steroid concentrating regions, located within the neural pathways critical for the expression of reproductive behaviors, have been found to be hypertrophied at the beginning of the breeding season. Therefore, while the importance of low temperature dormancy cannot be discounted, the occurrence of elevated circulating androgens, in association with hypertrophy of sex-steroid concentrating regions, suggest a more significant role of sex steroid hormones in the initiation of reproductive behavior than previously considered. This poster reviews the studies conducted by my lab during the past 10-15 years. Here we offer an alternative to the long-held assumption that sex-steroid hormones play no role in the initiation of courtship behavior and mating in the red-sided garter snake, a species exhibiting the dissociated reproductive pattern. Our data demonstrates a relatively significant yet indirect role for sex-steroid hormones in the initiation of reproductive behaviors in the red-sided garter snake.

0249 Poster Session I, Friday July 25, 2008

***Mobula japonica* (Müller & Henle, 1841) in Australian Waters**

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The Japanese devil ray *Mobula japonica* (Müller & Henle, 1841) has a circumtropical distribution in warm temperate and tropical waters of the Atlantic, Pacific and Indian Oceans. It has been documented in Australian waters from only four specimens and two live sightings, all from the east coast (between approx. 15°S and 33°S), in the Southwest and Western Central Pacific zones. The first record is from a specimen collected inshore from the estuarine waters of Lake Macquarie in New South Wales (32°59'S, 151°35'E) in April 1968. The head of this specimen is lodged in the Australian Museum, Sydney. Accompanying photographs show distinguishing characteristics of the species and original collection notes indicate a size of 1880mm

disc width (DW). More recent records come from beach-washed specimens in southern Queensland. A 1088mm DW immature male was beach-washed on Eurong Beach, Fraser Island in August 2000; a 2224mm DW mature male was beach-washed on Flinders Beach, North Stradbroke Island in September 2007; and, a ~3100mm DW unsexed individual was beach-washed north of McLaughlan Rocks, Fraser Island in October 2007. Additional live sightings (verified from photographs) have been reported off Southport, southern Queensland and from the northern Great Barrier Reef. Mobulids are not well represented in museum collections due to their large size and irregular capture by most fishing and sampling techniques. The number of recent beach-washed records of *M. japanica*, together with live sightings, indicates that the species is likely more common than previously documented in the waters of eastern Australia. The family Mobulidae is represented in Australian waters by four species (*Manta birostris*, *Mobula eregoodootenkee*, *M. japanica* and *M. thurstoni*).

0250 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

The Conservation Status of South American Marine Chondrichthyans: Assessing Species for the IUCN Red List of Threatened Species™

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The IUCN-World Conservation Union's Shark Specialist Group has a global programme underway to assess the conservation status of the world's chondrichthyans for the IUCN Red List of Threatened Species™. Assessments of South America's chondrichthyan fauna (~270 species) have been drawn together into the report *The Conservation Status of South American Marine Chondrichthyans*. Species were evaluated against the IUCN Red List Categories and Criteria to assess their global conservation status, and assigned to one of the following categories: Critically Endangered (CR; extremely high risk of extinction), Endangered (EN; very high risk of extinction), Vulnerable (VU; high risk of extinction), Near Threatened (NT; close to qualifying for, or is likely to qualify for a threatened category in the future), Least Concern (LC; does not qualify for a threatened category or Near Threatened) or Data Deficient (DD; presently inadequate information for an assessment of threatened status). At the global level, 25.1% of species occurring in South American marine waters are considered threatened (3.1% CR, 5.3% EN, 16.7% VU), 15.9% NT, 14.5% LC and 44.5% DD. Of the South American endemics, nearly one third (30.1%) are listed as threatened (2.8% CR, 7.5% EN, 19.8% VU) while 6.6% are NT, 9.4% LC and over half (53.8%) are considered DD. The vast majority of those species assessed as CR are coastal species that face strong fishing pressure as a result of being targeted or incidentally captured in often unregulated artisanal and/or industrial fisheries. While those species considered to be threatened require urgent actions to arrest population declines and ensure their long-term viability, the large proportion of DD

species highlights the overall lack of knowledge of many species in the region. This is of concern, as some of these species are currently fished directly or taken as bycatch while little information is available on their population status.

0585 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Demographics of an Urban Water Snake Population: Mark-recapture of *Nerodia erythrogaster* on The University of Texas at Austin Campus

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Numerous species are faced with increasing urbanization of habitat. We examine habitat use and population structure of blotched water snakes, *Nerodia erythrogaster*, in an extremely urbanized setting—a small, perennial creek that flows through the University of Texas at Austin campus. This population of *N. erythrogaster* is particularly interesting because it occupies a heavily urbanized environment with available habitat often <10 m wide. Not only is this snake population located on a large university campus (~50,000 students), but these snakes live in a watershed that drains a large portion of north Austin, potentially making these snakes more vulnerable to local stochastic changes (e.g., floods). To study the population structure of *Nerodia erythrogaster*, we have used a mark-recapture survey protocol with PIT tags to mark every snake found along an 800 m length of creek as it runs through campus. Since we began our project in July 2006, we made nine survey trips, marking a total of 44 individuals. We recaptured ten of these marked snakes a total of 17 times, providing some remarkable data on growth as well as movement, and we conservatively estimate there may be another 20 sub-adult or adult snakes yet unmarked in this stretch of the creek. Prospects for long-term continuation of this study are excellent and will focus on detailing growth patterns and population dynamics, as well as gathering detailed data on habitat use and home range. We recently initiated a radio-telemetry component of this project, thus further providing unique educational opportunities for our diverse undergraduate student body.

0524 Poster Session II, Saturday July 26, 2008

The Effect Of Predation Risk On The Morphology, Behavior, And Life History Of The Mole Salamander, *Ambystoma talpoideum*.

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Phenotypic plasticity allows one genotype to exploit and adapt to a greater range of environments by expressing varying phenotypes. Previous studies have shown that 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 "larval-type" 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 morphological and behavioral responses of larval mole salamanders (*Ambystoma talpoideum*), a facultatively paedomorphic salamander, to three predators (bluegill, *Lepomis macrochirus*; dragonfly naiad, *Anax junius*; and paedomorphic *A.talpoideum*) and examined the effects on growth rates and the expression of paedomorphosis. Larvae in the bluegill treatment responded by decreasing activity levels while larvae in the conspecific treatment increased activity. Larvae in the bluegill and odonate treatments were significantly larger than larvae in the conspecific treatments. Odonates also induced significantly larger larvae than controls. Bluegill and odonates induced longer and higher tails than conspecifics. Growth rates were higher in the bluegill and odonate treatments than the control and conspecifics. There were no differences in the proportion of paedomorphs across treatments. Results suggest that *A. talpoideum* has evolved behavioral and morphological plasticity in response to predators. The predation risks in this study, however, were not great enough to affect the expression of paedomorphosis.

0676 Fish Systematics II, Salons A&B, Friday July 25, 2008

Molecular Systematics of the Agonostomatine Mulletts (Teleostei: Mugilidae).

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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, we will, using a variety of methods, test the monophyly of the subfamilies of mullets, focusing on relationships within the Agonostominae, in order to more fully understand this unique distributional pattern.

0687 Poster Session III, Sunday July 27, 2008

Disentangling Complex Phenotype-environment Relationships: Diversification of the African Cyprinid *Barbus neumayeri* across Water Flow and Oxygen Gradients

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Environmental factors influence phenotypes directly through selection for canalized genotypic differentiation and/or through phenotypic plasticity. The environment also influences phenotypes indirectly through trait correlations and correlations with other environmental variables. These indirect relationships make it difficult to determine cause and effect when examining phenotype-environment relationships. One approach to dissect complex relationships is the use of path models to partition direct and indirect effects. Using nine populations of the African cyprinid *Barbus neumayeri*, we employed path analysis to examine direct, indirect, and total effects of two environmental variables, water flow and dissolved oxygen, on morphology. Water flow and dissolved oxygen directly influenced relative gill size, body shape, and tail fin shape in manners consistent with classic ecomorphological predictions. But indirect effects also played an important role in the system. We found that: (1) oppositely signed direct and indirect effects of water flow on body shape resulted in a nonsignificant total effect; (2) Dissolved oxygen had no direct effect on body shape, but a strong total effect via indirect effects on gill size; (3) Water flow indirectly influenced gill size via effects on dissolved oxygen. Examining multiple environmental parameters and multiple traits enables understanding of complex relationships between environment and phenotype. (published in J. Evol. Biol. 20:1171-81)

0130 Poster Session II, Saturday July 26, 2008

Salinity Tolerance of the African Jewelfish *Hemichromis letourneuxi*, a Non-Native Fish in South Florida

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The African jewelfish (Cichlidae: *Hemichromis letourneuxi*) is a predatory, non-native fish that has been established in urban Miami canals since the early 1960s. Recently, this species has spread across southern Florida including Everglades National Park and Big Cypress National Preserve. Little is known about the salinity tolerance of *H. letourneuxi* and such data would be useful to predict its further expansion into coastal environments in southern Florida. The response of this species to salinity was evaluated by exposing fish to progressively increasing salinities until each treatment (0, 5, 10, 15, 20, 30, 40, 50, 60, 70 and 80 ppt) had reached its target salinity. Fish were held at target salinities for a minimum of 30 days. *Hemichromis letourneuxi* showed excellent survival from 0 to 50 ppt. At 60 ppt, only 25% of the fish survived and mean estimated survival time was 12 days (95% Confidence Interval = 4-20 days). Fish in the 70 and 80 ppt treatments experienced 100% mortality after only one day. Surviving fish grew equally well across the range of salinities tested. Experimental results indicate the African jewelfish can persist in salinities prevalent in coastal environments, even during periods of hypersalinity; such as those found in northeastern Florida Bay during times of drought.

0507 Poster Session II, Saturday July 26, 2008

Life History of Manini, *Acanthurus triostegus sandvicensis*

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We describe the life history of manini, a Hawaiian subspecies of an Indo-Pacific surgeonfish, a target of recreational and commercial fishing. Histological examination of gonads provides sex-specific size-at-maturity, and ovaries of mature females are examined to describe size versus fecundity relationships. Otolith microstructure analysis is used to produce a growth curve. Morphometric relationships are provided. Laser videogrammetry is used to describe size structure, which is converted to age structure. The latter is used to estimate mortality in exploited and unexploited areas. The above parameters necessary for life-history-based management techniques.

0136 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Use of Passive Integrated Transponders in Subterranean Monitoring of Temporal and Spatial Habitat Use by Ambystomatid Salamanders

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Previous studies have made use of a number of different marking and tracking methodologies such as radiotelemetry, radioisotopes, toe clips, photographs of spot patterns, and concentric drift fences in the analysis of habitat use and migration patterns of Ambystomatid salamanders. These methods allow for the determination of terrestrial "life zones" for these animals. We are investigating the utility of Passive Integrated Transponder (PIT) tags as a means of identifying and tracking specific individual salamanders over extended periods of time in subterranean non-breeding habitat. Recent improvements in Radio Frequency Identification (RFID) antenna technology allow the detection of PIT tagged fossorial animals at depths of up to 30 cm. Our results thus far indicate that individual salamanders marked up to 2 years previously can be detected and identified subterraneously in non-breeding habitat and that estimates of migration distances and daily movements are obtainable in Spotted Salamanders (*Ambystoma maculatum*) with this technology. PIT tagged Spotted Salamanders had a mean migration distance from vernal pool breeding habitat of 58.7 m and were found at a mean depth of 6.03 cm. Mean non-breeding home range size during an extreme drought period was 0.5m². Unearthed individuals had a mean dispersal of 8.4 m after being returned to their burrows. Based on tag and antenna longevity, lower cost, and the capability of individual identification, PIT tags may prove very useful for monitoring Ambystomatid salamanders in their non-breeding habitat.

0324 AES Systematics & Biogeography I, Jarry/Joyce, Saturday July 26, 2008

Population Genetics of the Short-tailed Stingray, *Dasyatis brevicaudata*

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Many stingray species have very broad distributions, but there have been few phylogeographic investigations into the genetic relatedness of stingray populations. The short-tailed stingray (*Dasyatis brevicaudata*) is a large temperate stingray solely distributed in the southern hemisphere and has been recorded in New Zealand, southern Australia and South Africa. We examined the genetic relationships of short-tailed stingrays (n = 156) throughout this species' known range using the entire mitochondrial DNA control region (1934 nucleotides). Of 18 haplotypes found, 4 were shared by Australia and New Zealand, whereas Australia/New Zealand and South Africa shared none. New Zealand and Australia had 4 and 7 unique haplotypes respectively. The degree of differentiation and genetic isolation between populations assessed with AMOVA revealed significant levels of population structure at both large and small scales. Gene flow between Australia/New Zealand and South Africa separated by ca. 11,000km was highly restricted. However, restricted gene flow was also apparent between Australian and New Zealand populations separated by shorter geographic distances (ca. 2,500km, $F_{ST} = 0.084$). These results give an insight into the evolutionary history of short-tailed stingrays in the southern hemisphere.

0008 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Taxonomic Review of Symphurine Tonguefishes (*Symphurus*: Cynoglossidae) from Taiwanese Waters

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Symphurine tonguefishes belong to one genus (*Symphurus*) of approximately 80 species of small-sized, left-sided flatfishes. This genus is the most speciose and widely distributed of the Cynoglossidae, which comprises three genera and about 130 species. Although this genus has such great diversity, only three species of *Symphurus* were recognized previously from Taiwanese waters. However an investigation of the deep waters around Taiwan has provided many different deep-sea *Symphurus* specimens in recent years. Our study, utilizing a number of internal and external features, provides some new diagnostic counts and morphometric characters to assist in the identification of these species. Photographs of fresh specimens have proven especially useful in assisting the identification of species with overlapping meristic characters. Our results indicate that at least seven species

of *Symphurus* including three possible undescribed species occur in waters around Taiwan. This assemblage comprises two species with 12 caudal-fin rays (*S. orientalis* and *Symphurus* sp.3), and five species that possess 14 caudal-fin rays (*S. bathyspilus*, *S. hondoensis*, *S. strictus*, *Symphurus* sp.1 and *Symphurus* sp.2). Here we present diagnostic information for each nominal species, a fundamental key for Taiwanese *Symphurus* and photos of fresh caught specimens of each species.

0256 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Linking Landscape Processes to Phylogeographic Patterns in the Wood Frog

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The effects of environmental change on amphibian population persistence highlight a need to study the factors influencing population connectivity. Improvements in the availability of high-resolution geographic data have made it increasingly possible to quantify the effect of landscape features on dispersal and genetic structure. However, the extent to which processes operating at fine spatial scales can be extrapolated to explain patterns at larger spatial scales remains unclear. In the present study, we test whether factors impacting wood frog dispersal at fine spatial scales are correlated with genetic structure at regional scales. Using recently developed methods based on circuit theory, we generated landscape resistance matrices between wood frog populations in eastern North America based on continent shape, land cover, wetness and slope. We then determined whether these matrices are correlated with genetic structure based on microsatellite and mitochondrial DNA markers and whether such correlations outperform a null model of isolation by (linear) distance. In general, the results suggest that the landscape has very little impact on genetic structure at regional spatial scales in the wood frog. Only the landscape resistance model incorporating continent shape consistently outperformed the isolation by distance model. The results demonstrate high levels of population connectivity and are consistent with the high dispersal capabilities of the wood frog observed at fine spatial scales, as well as low levels of phylogeographic structure across the species' range. However, that landscape features that influence wood frog dispersal at fine spatial scales do not appear to influence genetic structure at broader scales suggests that our ability to extrapolate results across spatial scales may be limited. This result highlights a need to evaluate landscape effects on population structure across multiple spatial scales to better understand the degree to which fine-scale landscape processes are linked to broader phylogeographic patterns.

0077 Herp Behavior, Salons A&B, Thursday July 24, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

A Seven Year Study of Natal Beach Contributions to a Loggerhead Sea Turtle (*Caretta caretta*) Feeding Assemblage

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The loggerhead sea turtle (*Caretta caretta*) possesses a unique life history that includes complicated subadult and adult migratory patterns. For example, subadult individuals are known to congregate annually in large coastal feeding assemblages, but the contribution to these assemblages from proximal nesting beaches remains obscure. To better understand the contribution of discrete nesting beaches to feeding assemblages off the southeastern US coast, an in-water survey was conducted from Wilmington, North Carolina to St. Augustine Florida, targeting subadult loggerhead sea turtles with both fisheries-dependent and fisheries-independent trawling over a seven-year period. In recent years, however, the focus of the survey has been more focused, e.g., the effort has concentrated in those feeding areas in and around Charleston, South Carolina. In this study, genetic data (mtDNA control region sequences) were used to validate the Charleston feeding assemblage as an adequate proxy for the entire South Carolina coast; subsequently these data were used to assess temporal variation in nesting beach contribution to the coastal subadult feeding aggregation. We compare this temporal component of genetic variation to that component among nesting beaches, and discuss the use of these data in conservation efforts aimed at this threatened species.

0272 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Phylogenetic Systematics of Flyingfishes (Exocoetidae)

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Flyingfishes (family Exocoetidae) are aptly named for their ability to glide long distances over the surface of the ocean. Flyingfishes are abundant, diverse and important to tropical pelagic marine ecosystems and commercial fisheries. Morphological similarity between species often make their identification and phylogenetic reconstruction difficult; however, morphology-based phylogenies have been generated for some taxa within this group. Here, we present a phylogenetic analysis for exocoetids, based on molecular genetic information. Our dataset consists of Cytochrome *b* and Recombination Activating Gene 2 (RAG2) sequences for multiple representatives within each accepted genus. We compare our topology to previous hypotheses of evolutionary relationships, and comment on the monophyly of species-rich genera such as *Cheilopogon*, *Cypselurus*, and *Hirundichthys*.

0337 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008

Like Father, Like Son? Feeding Apparatus in Adult And Larval *Hippocampus reidi*

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The family of Syngnathidae (Gasterosteiformes) encompasses the pipefishes and seahorses. Apart from the prehensile seahorse tail and the elongated pipefish body, syngnathids are characterised by a remarkable cranial morphology with an elongated snout. Unlike other longsnouted suction feeders, the snout of syngnathids is not formed by the extension of the jaws, but of an extended ethmoid region. The upper and lower jaws closing the mouth aperture are minute, thus putting constraints on prey size, limiting their diet to tiny invertebrates. The small diameter of the snout, however, enables them to perform very fast and powerful suction feeding. Moreover, pipefishes and seahorses achieve prey capture times of even less than 6 ms, being among the fastest teleost feeding intake ever recorded. Of course the hydrodynamic implications involved in suction feeding through a long, narrow tube requires special adaptations in the feeding apparatus, particularly of musculoskeletal components forming and supporting the jaws and ethmoid region. A thorough osteological and myological description of the adult cranium of *Hippocampus reidi*, based on *in toto* cleared and stained specimens, serial histological sectioning and graphical 3D-reconstructions, will be given in order to reveal morphological specialisation in the feeding apparatus that could be considered adaptive. Usually, the cranial morphology of fish larvae is a primordial configuration, however, kinematical data on larval *H. reidi* have shown that larval suction feeding is extremely fast and occurs according to a similar kinematic pattern to that of adult feeding. This implies that already in an early stage, large forces will be exerted onto the cranial skeleton, where it is expected that little rigid skeleton elements are present. So the second aim of this study is to investigate whether the feeding apparatus is in fact similar in *H. reidi* larva that had just left the brood pouch compared to the adult condition.

0408 Poster Session III, Sunday July 27, 2008; STORER HERPETOLOGY

Egress and Reproduction in Northern Pacific Rattlesnakes (*Crotalus o. oreganus*) in Central California

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The timing of reproduction and overwintering in the rattlesnake species *C. o. oreganus* has not been extensively studied in populations living in California, and some confusion remains about the exact timing of reproductive events such as copulation and vitellogenesis. There have been studies on the timing of reproductive events in Idaho and British Columbia. However, due to the drastically different climate in these regions and California, these studies say little about the timing of such events in central California (the southernmost part of the range of *C. o. oreganus*). To investigate this, 10 male and 10 female *C. o. oreganus* were implanted with radiotransmitters in the fall of 2006, and were radiotracked about once a week throughout their active season, and about once a month during winter. The results gathered so far indicate that snakes in this population typically emerge from refugia in early March, and spring breeding peaks in April. There appears to be a moderate amount of breeding activity in late summer and early fall; however, the majority of breeding activity was observed in the spring. The time at which snakes enter hibernacula for the winter appears to depend on environmental conditions, but has been observed to be around the beginning of November. In conjunction with my field work, I have examined preserved female snakes to measure follicle size at different times of the year. Females collected in the spring displayed the largest follicle size, and most of the snakes collected in the summer and fall were either observed to be pregnant or non-reproductive. These results are preliminary and a larger sample size is needed in order to make assertions about the timing of vitellogenesis.

0565 Poster Session I, Friday July 25, 2008

The Visual Biology of Holocephalans: A Review

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The holocephalans (commonly referred to as chimaeroid fishes or ratfish) are an ancient group of fishes commonly found in temperate deepwater habitats of the continental shelves and slopes. In contrast to their close relatives, the elasmobranchs, many aspects of their biology are poorly understood. Holocephalans are generally described as having large eyes and are assumed to rely heavily on vision. However, the visual biology of these animals has received little attention. This study aims to present a review of the available literature alongside new data on relative eye size. The relative size of the eyes and the optic tectum (the part of the brain that receives the majority of sensory input from the eyes) is large, suggesting that holocephalans rely heavily on vision. Holocephalan retinas have been reported to contain rod

photoreceptors and a reflective tapetum lucidum, both adaptations for increasing visual sensitivity in low-light levels. The topographic organization of the retinal ganglion cell layer in two species of *Hydrolagus* has revealed a dorsal horizontal streak of increased cell density, which indicates that viewing the substrate-water interface is important in these fishes. The peak absorbance (λ max) of rod visual pigments correlates with the photic environment. Species found in deepwater (*Chimaera*, *Hydrolagus*) have rod visual pigments with λ max values around 480nm, whereas the more shallow-dwelling *Callorhynchus callorhynchus* has a rod visual pigment with a λ max of 499nm. Similar differences are also seen in relative eye size, with deepwater species having relatively larger eyes than species found in shallower habitats.

0231 Fish Systematics I, Salons A&B, Friday July 25, 2008

Systematic Review of the Neotropical Catfish Genus *Hypophthalmus* Cuvier (Siluriformes: Pimelodidae)

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The genus *Hypophthalmus* Cuvier, 1829 consists of three generally recognized species, *H. marginatus* and *H. edentatus* both from the Amazon, Orinoco and Guianas, and *H. fimbriatus* from the Amazon only. The status of *H. oremaculatus* (Paraná), *H. perperosus* (Amazon), and *H. longifilis* (Suriname) are in question due to uncertainties about distinguishing characters and missing type material. Our recent discovery of taxonomic variation in vertebral numbers suggested unrecognized species of *Hypophthalmus*. We have now examined type material and over 1,000 non-type specimens in ichthyological collections in Europe and North and South America and representing populations from all drainage basins where *Hypophthalmus* occur. Meristic characters plus features of fin placement and shape, head and nape lengths, barbels, and lateral line branching patterns indicate five species in the Amazon basin, two in the Orinoco, one in the Paraná, and one or two in the Guianas.

0370 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

To Breathe or Not to Breathe: Turtle Survival Strategies Under Ice

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Freshwater turtles at northern latitudes may spend over half their lives in hibernation. Turtles can employ two strategies to tolerate the prolonged winter season without access to aerial oxygen: anoxia tolerance or anoxia intolerance. Although lab studies have provided information on survival by turtles when submerged at cold temperatures, only recently have field studies started to examine this aspect of the annual cycle of turtles. The purpose of this study was to compare the overwintering ecology and site selection among 3 turtle species near the northern limits of their ranges, to allow inference about physiological adaptations. We synthesized data from three radiotelemetry studies in Ontario to look for species-specific characters and general patterns. Spotted Turtles (*Clemmys guttata*) in eastern Georgian Bay used defined structures in sphagnum swamps with little dissolved oxygen, showed fidelity to sites, and hibernated communally. Similarly, Blanding's Turtles (*Emydoidea blandingii*) in Algonquin Park used eutrophic wetlands with low dissolved oxygen, chose sites that were colder than random sites, and showed fidelity to overwintering sites. By selecting sites with low temperatures, individuals can minimize metabolic stress caused by low oxygen levels. In contrast, Wood Turtles (*Glyptemys insculpta*) in Sudbury overwintered in a flowing river that provided high dissolved oxygen, and they did not show site fidelity. Winter movements made by Wood Turtles were not related to temperature or oxygen levels, but may be related to maintaining a certain distance from shore and water depth to protect against accidental relocations during winter. No winter mortality was observed, and all 3 species used overwintering sites that were ice and snow-covered for extended periods and that maintained stable body temperature just above freezing. Given that the majority of turtles in Ontario are considered to be at risk, these hibernation ecology data are important for defining critical habitat and thus species recovery.

0009 AES Management, Jarry/Joyce, Sunday July 27, 2008

Shark Management Based on Vital Parameters Analysis

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As sharks own various life history characteristics shark management based on vital parameters is more reasonable and realistic. In this study, the vital parameters of 63 populations from 39 species were collected from literatures. The vital parameters including the ratio between size at birth and asymptotic length (L_b/L_∞), the ratio between size at maturity and asymptotic length (L_m/L_∞), maximum age (T_{max}), age at maturity (T_m), growth rate (k), and annual fecundity (f/R_c) were analyzed with principal components analysis (PCA) and cluster analysis. Four groups were categorized and the empirical equations describing the relationships between finite population increase rates (λ') and vital parameters were developed as followings: (1) for species with slow growth rate ($0.034 \text{ yr}^{-1} < k < 0.103 \text{ yr}^{-1}$) and high longevity ($26 \text{ yr} < T_{max} < 81 \text{ yr}$), e.g. *Isurus oxyrinchus*, *Carcharhinus obscurus* etc.; (2) for species with fast growth rate ($0.103 \text{ yr}^{-1} < k < 0.358 \text{ yr}^{-1}$) and low longevity ($9 \text{ yr} < T_{max} < 26 \text{ yr}$), e.g. *Mustelus manazo*, *M. californicus* etc.; (3) for late mature ($L_m/L_\infty \geq 0.75$) and low longevity ($T_{max} < 29 \text{ yr}$) species, e.g. *Alopias pelagicus*, *Notorynchus cepedianus*, (4) whale shark, *Rhincodon typus*, with the most fecundity, highest longevity and slowest growth rates than other species. The finite population increase rates predicted by empirical equations developed in this study have good agreement with those calculated from conventional demographic analysis. Our empirical equations which need fewer parameters not only can reduce the uncertainties from vital parameter estimations to increase the accuracy of estimation but also account for the difference in life history among groups. This approach provides an economic and effective way for shark management.

0704 Poster Session II, Saturday July 26, 2008

Lizard Tail Length and Break Frequency Vary Ontogenetically and Ecologically

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Caudal autotomy is a widely recognized and successful escape tactic employed by many lizard taxa. Behavioral and morphological aspects of the tail facilitate its loss, such as conspicuous coloration, movement before and after autotomy to distract a predator's attention, long size (to increase the chance that the tail is seized and not the lizard itself) and weak fracture planes within caudal vertebrae. Lizard tails also serve a variety of functions beyond predator distraction, such as energy storage, counterbalance and social status, and tail loss and length must be viewed within the context of tail use to be fully appreciated. We should expect differences in tail length and autotomy frequency between ecologically different species. Previous studies

have determined that autotomy does not incur a substantial energetic cost in juveniles in at least one species and that, among adults, autotomy can either have no effect or a detrimental one. Consequently, I examined juvenile and adult fluid-preserved specimens of ecologically different lizard species to quantify variation tail loss frequency and in relative tail length (to body size). I expected frequencies of tail breakage to be higher in juveniles because their smaller body size. I also expected juveniles (and adults of small bodied species) to have higher relative tail lengths. I also expected primarily arboreal taxa to have longer relative tail lengths and lower rates of tail loss than more terrestrial ones. There was little variation intraspecifically, with no differences in autotomy frequency and only one instance where juvenile relative tail length was significantly greater than that of adults. There was substantial variation interspecifically, with smaller bodied species and more arboreal taxa having longer relative tail lengths and more arboreal species having lower rates of tail loss. Clearly, there is a complex interplay between age class, ecology and tail loss in lizards.

0423 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Associations between the Reproductive Success of Amphibians and Water Quality, Aquatic Predators and Landscape Context of Wetlands in an Agricultural Region of Iowa, U.S.A.

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Contaminants and habitat degradation are among the suspected causes for worldwide amphibian declines. Although these factors may be relevant in the Midwestern US, little field research has been done to rigorously examine the potential relationships between contaminants, land use context, and amphibian communities. From April to July 2006 we conducted amphibian surveys at 29 wetlands in north-central Iowa, a region dominated by intensive row crop agriculture. The Iowa Department of Natural Resources collected water quality data from these same wetlands. We utilized visual encounter surveys and funnel trapping surveys to document reproductive success of multiple species at each wetland. We used the information-theoretic approach to develop and choose models that best estimated relationships between successful reproduction and the covariates: pesticides, nutrients, wetland density, distance to nearest neighboring wetland, proportion cropland in the landscape, and fish presence. Alachlor, phosphate, and fish were negatively associated with successful reproduction of *Rana pipiens* and alachlor was negatively associated with the reproductive success of *Pseudacris triseriata*. We could not detect significant effects of covariates on *Hyla versicolor/chrysoscelis* or *Ambystoma tigrinum*; however, we only detected reproductive success for these species in fishless wetlands. These results suggest priorities for continued assessment of effects of agricultural practices and habitat management on amphibians.

0456 Fish Ecology I, Drummond, Thursday July 24, 2008

Reproductive Parameters of California Sheephead Across the Channels Islands

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California sheephead (*Semicossyphus pulcher*) are a protogynous, sequential hermaphrodite that ranges from Monterey, California to southern Baja, Mexico including the Channel Islands of California. For the last 30 years, sheephead landings in California have increased considerably. Although protogyny is not unique among teleosts, it is not common in commercially valuable species and there is recent concern for the sustainability of the sheephead stock. Sheephead were arbitrarily collected from seven of the Channel Islands (Santa Catalina, San Clemente, Santa Barbara, San Nicolas, Anacapa, Santa Cruz and Santa Rosa) during the breeding season from mid-June through mid-September, 2007. Most fish were taken from unrestricted fishing areas; however, a small sub-sample of fish was collected from no-take marine reserves at three of the islands (Santa Cruz, Santa Barbara and Anacapa Islands). To account for differences in length-frequency, size-frequency and sex ratio at the population level and to develop a metric that could be used to assess the reproductive potential of populations relative to each other, fecundity per total biomass was determined for each island. Fecundity per biomass values ranged from 36 eggs/g to 299 eggs/g, and averaged 305 eggs/g in the reserves. Santa Catalina, San Clemente and San Nicolas Islands had the lowest reproductive capacity with 36, 45 and 107 eggs/g, respectively. Sex ratios were also compared across populations, with Santa Catalina, San Clemente and San Nicolas Islands having the lowest (F:M; 0.61, 0.92, and 1.21, respectively) and Santa Cruz Island with the highest (16). The pooled sex ratio in the reserves was 6.25. These findings indicate that parameters of sheephead reproductive biology vary across the Channel Islands. The extremely low fecundity per biomass values observed in some populations and the skewed sex ratios across populations indicate that some islands have lowered reproductive capacity that may be attributed to fishing related impacts.

0759 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Exploring the Distribution of Genetic Variability among Populations and Subspecies of *Aphredoderus sayanus*

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We examined the geographic and taxonomic correlates of genetic variation in *Aphredoderus sayanus* to determine the degree of correspondence between previously described intra-specific morphological variation across the range of this taxon and the underlying genealogical relationships among its populations. We test the hypotheses that a) the two putative subspecies of Pirate Perch (*A. sayanus sayanus* and *A. sayanus gibbosus*) represent distinct genetic assemblages and b) Florida populations form a porous boundary between the two incipient taxa. We relate our findings to the phylogeography of the similarly distributed subspecies of *Esox americanus*, which have been shown to display more complexly structured genetic variability than is predicted by proposed models of subspecies formation. We also discuss other factors that may be important in shaping this common biogeographical pattern among freshwater fishes of North America.

0280 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Origins and Early Diversification of Neotropical Freshwater Fishes

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Neotropical freshwater fishes constitute the most species-rich aquatic fauna on Earth, including approximately 6,000 species, or perhaps 10% of all known vertebrate species. The evolutionary origins of this immense fauna may be traced to the Cretaceous and Paleogene, an interval of more than 120 million years. Combined paleontological and phylogenetic evidence indicate that certain teleost clades, especially among the characiforms, siluriforms, and cichlids, came to dominate Neotropical freshwaters during the Paleocene (65 - 62 Ma). Diversification of Neotropical fishes took place within the context of two mega-events, each extending over tens of millions of years; 1) the break-up of Gondwana, and 2) Late Cenozoic global cooling. The geological separation of South America from Africa and Antarctica involved the rise of the Andes in three distinct phases (the Peruvian (125 - 71 Ma), Incaic (55 - 34 Ma), and Quechua (23 - 0 Ma) orogenies), and an overall compression and rotation of the Continental Platform. Late Cenozoic global cooling resulted in a contraction of tropical climates to lower latitudes, the spread of tropical savannahs, and a fall in eustatic (global) sea levels. A combination of tectonically induced crustal deformations and eustatic sea level changes resulted in at least two major Paleogene (Paleocene 61 - 60 Ma, Oligocene 30 - 27 Ma), and one major

Neogene (Miocene 20 - 10 Ma) marine incursions into the continental interior. Marine transgressions reduce and fragment areas of freshwater habitat, reducing and isolating populations of freshwater fishes, and increasing rates of extinction and speciation; *i.e.*, the overall rate of net diversification. Marine regressions expose new areas of lowland freshwater habitat into which surviving lineages can expand and diversify. Combined information from geology, palaeontology, phylogenetics and biogeography are starting to provide a general picture of the circumstances which gave rise to the richest freshwater fish fauna on Earth.

0618 Poster Session II, Saturday July 26, 2008; CARCNET/RÉCCAR

The Relation between Variation in Phenotypic Fitness Proxies and DNA Microsatellite Heterozygosity in Eastern Foxsnakes (*Elaphe gloydi*)

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Many species face extinction in Canada and globally, a phenomenon that is mostly attributable to large-scale anthropogenic changes to habitat. Molecular markers, like nuclear DNA microsatellites, are increasingly used to provide inputs into endangered species conservation. It is generally assumed that DNA microsatellites, and other such PCR-based markers, are selectively neutral. However, it is also broadly assumed that variation in such molecular markers mirrors variation at other loci that underlie quantitative attributes important in fitness, from individual levels to comparisons across populations. Such assertions are especially important in those instances where sampling of fitness-related traits (e.g. growth rates, survivorship, fecundity) is not logistically feasible, and where scarce conservation resources must be apportioned among competing species/initiatives. We conduct the first systematic investigation of the relationship between individual-level variation in DNA microsatellites and quantitative correlates of fitness in two regional populations of the eastern foxsnake (*Elaphe gloydi*) in Ontario. Our results indicate that individual microsatellite heterozygosity does not predict variation in three metrics of fitness (body condition, growth rate, total number of ventral scales). Blood smears have been collected from individuals in both populations and over the summer we intend to extend our analysis to include levels of parasitaemia and other hematological measures. Our study contributes to a growing body of literature that questions the use of putatively neutral molecular markers to make inferences about adaptive diversity important to survival and reproduction, and thus to management of species of conservation concern.

0079 General Ichthyology I, Drummond, Saturday July 26, 2008

Geometric Morphological Differences Distinguish Populations of Scup, *Stenotomus chrysops* Linnaeus in the Northwestern Atlantic Ocean

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Scup (*Stenotomus chrysops* Linnaeus), a commercially significant marine species, may constitute a species complex, which is distributed from Nova Scotia to south Florida. We investigated morphological differences in *S. chrysops* collected from northern and southern extents of its range from April - July 2005, when populations had formed spawning aggregates. We compared morphology among populations using geometric, landmark-based analysis, and morphological and meristic traits for 184 individuals that were sexed and staged to maturity. A discriminant functions model significantly separated populations among latitudes, but not between sexes, using 20 of 33 characters (> 92% accuracy of prediction). Multiple analysis of variance revealed that 8 of the 20 characters significantly differed among populations. Forehead and body depth dimensions importantly distinguished among populations. Morphological differences among populations may be attributed to larval development, ecological divergence, and/or genetic isolation.

0654 AES Food & Feeding, Kafka/Lamartine, Saturday July 26, 2008

Occurrence of Cookie Cutter Shark Bites on Pelagic Fishes Landed in the Hawaii Long-line Fishery

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Based on its unique dentition and bite mark, the cookie cutter shark (*Isistius brasiliensis*) is known to prey on a wide variety of pelagic organisms. Its bite mark is characterized as a slightly oval semi-circular gouge ranging in diameter from 3-8 cm. To examine feeding and distribution of cookie cutter sharks around the Hawaiian Islands, long-line, hand-line, and troll caught pelagic fish landed at the Honolulu Fish Auction were sampled every week for 1-year. Ten pelagic fish species comprising a total of 15,107 fish were sampled for cookie cutter shark bites over the year. Seventy three percent (± 23.6 %) of the swordfish (*Xiphias gladius*) surveyed each week had cookie cutter shark bites and 43 ± 16.7 % of the opah (*Lampris regius*) surveyed had bite marks. None of the 430 blue marlin (*Makaira nigricans*) sampled were found to have bite marks. The percentage of all fish with bites was consistent from Feb - Dec (~15.3 %), but was the lowest during the month of Jan (6.7 %), even though this was when the second highest number of fish were sampled (n = 1029).

Swordfish (range: 1-8) and opah (range: 1-7) had the greatest numbers of bites per fish; however, swordfish, yellowfin (*Thunnus albacares*), bigeye tuna, and opah had a higher occurrence of healed bites to fresh bites. Skipjack tuna (*Katsuwonus pelamis*) and sickle pomfret (*Taratichthys steinachneri*) had a higher occurrence of fresh bites than healed bites. This suggests that cookie cutter sharks take advantage of pelagic fish caught via hook & line, but may more regularly prey on swordfish and opah than blue marlin, skipjack, or sickle pomfret. Because cookie cutter sharks are rarely observed, the high percentage of fish landed with bites throughout the year may indicate that they are more common around the Hawaiian Islands than previously expected.

0457 Fish Systematics I, Salons A&B, Friday July 25, 2008

Mining Phylogenetic Markers from Sequence Databases for Assembling the Euteleost Tree of Life (EToL)

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With the advance of novel sequencing technologies, more and more sequences will be submitted and stored in public repositories. Such enormous data sets have not, however, been explored in a way that maximizes their scientific merit. As a case study, we have been applying an integrated bioinformatics approach to mining phylogenetic markers from various sequence databases (e.g., GenBank and Hovergen) in order to assemble a complete tree of euteleost fish. We will present preliminary results of bioinformatics development and analyses, which include 1) a pipeline that can map genetic sequences of all euteleost species available in NCBI onto a 2D space (species versus genes), 2) the euteleost supermatrix and supertree created using a variety of computational algorithms, and 3) candidate markers suitable for the inference of large phylogeny. We will discuss those challenging issues pertaining to the development and application of phylogenetic markers.

0235 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

How Can the Feeding Habits of Sand Tiger Sharks, *Carcharias taurus*, Affect the Success of Conservation Programs?

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The sand tiger shark, *Carcharias taurus*, is one of the most threatened species of shark worldwide. Recovery programs are now in effect, but it is unknown how they can be furthered or hampered by the ecology of sand tigers. Using data collected from a north Patagonian recreational fishery (n = 164), we analyze the relationships between prey consumption and life history traits (size, sex, maturity stage) and season; assess how prey capture behaviour may affect the success of mandatory catch-and-release measures to alleviate fishing mortality; and measure prey selection and overlap with fisheries to evaluate how they affect sand tiger populations. Body size was the main determinant of benthic elasmobranch consumption, indicating that the largest individuals - the target of fisheries - have the greatest effects on keystone mesoconsumers and hence on the community as a whole. Sand tigers did little prey handling, resulting in rapid hook swallowing and consequently severe damage to the internal organs from the hook in most individuals (87.4%), indicating that the release of hooked individuals would not minimize fishing mortality substantially. Sand tigers fed selectively on skates (Rajidae), Sciaenid fishes, smooth-hound (*Mustelus schmitti*) and angel (*Squatina guggenheim*) sharks, and flatfishes (Paralichthyidae), all of which are preponderant in fishery landings. This results in an almost complete (>90%) overlap with fisheries. We conclude that ignoring the feeding habits of sand tigers - characterized by low plasticity, high selectivity, high overlap with fisheries, and little prey handling - could substantially affect the success of recovery programs.

0222 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Developmental Anomalies in Batoid Fishes

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Developmental anomalies in skates and rays have been documented since the 16th century, although not accurately recognized as such until the 1830's by Müller and Henle. For several centuries, deformed specimens were given new genus and species names, with drawings often grotesque or depicting the creatures as monsters. The most commonly documented anomaly is the incomplete fusion of the pectoral fin with the head, resulting in large gaps or clefts between the pectoral fins and rostrum. Since the batoid "disc" is formed during embryogenesis by the rostral migration of the anterior margins of the pectoral fins, it is logical that this process might occasionally terminate prematurely before the fusion is complete. In fact, a

permanent condition of incomplete closure between head and pectoral fins has evolved in the angel sharks, Squatinidae. In skates and rays, if the incomplete closure does not impair locomotion or sensory function, the anomaly is not usually fatal. If the deformity is so severe that structures such as mouth or nares do not fully develop, mortality is generally assured. Radiography and/or clearing and staining of specimens help to visualize skeletal deformities resulting from incomplete pectoral closure. One skeletal defect common to several specimens examined appears to be the abnormal formation or disarticulation of the antorbital cartilage, although the functional significance of this structural deformity is not clear. Other developmental anomalies that occur very rarely in batoids are hermaphroditism, dicephalus and multiply fertilized ova.

0420 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Field Testing Cohort and Capture Marks With Passive Integrated Transponder (PIT) Tags, a Case Study with Greater Siren, *Siren lacertina*

Thomas Luhring

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Marking techniques for greater siren (*Siren lacertina*) are limited in applicability because of various morphological constraints and only one technique, passive integrated transponder (PIT) tags, has been tested in the field. I tested a cohort mark (toe clip) and a capture mark (tailfin scoop) for duration and readability in the field. Trapping occurred from September 2006 through September 2007 at an isolated wetland on the Savannah River Site in Aiken, South Carolina. All animals were given a PIT tag which permitted the tracking of individual healing rates for toe clips and tail scoops. Each captured siren was returned to the laboratory and photographed to follow mark regeneration rates. Toe clips were discernable longer than tail scoops. Although most marks showed signs of regeneration after more than 30 days, most toe clips and tail scoops were discernable up to 180 days after the mark was administered. Most tail scoops did not persist longer than 180 days, however, the majority of toe clips were discernable through the end of the study (up to 332 days). The readability of both marks was correlated with mark age and with the amount of growth (mass and length) since the application of the mark.

0415 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Population Ecology Of The Greater Siren, *Siren lacertina*: The Enigmatic Giant Salamander Of North America.

Thomas Luhring, Brian Todd

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Greater siren, *Siren lacertina*, population ecology is poorly known despite their relatively high abundance and large size. We used passive integrated transponder (PIT) tags to conduct a 13 month mark-recapture study at Dry Bay, a 5-ha isolated wetland located on the Savannah River Site in Aiken, South Carolina. Trapping at Dry Bay resulted in 470 *S. lacertina* captures. Of 271 animals marked over the course of the study, 83 (30.6%) were recaptured 174 times. We used program MARK to analyze robust design mark-recapture models and estimated the population of *S. lacertina* at the study site in any given month to be 248.4 individuals (202.2 - 318.5, 95% CI). Monthly survival rates were estimated to be 0.88 (0.77-0.94, 95% CI) and 0.80 (0.74-0.85, 95% CI) using robust design or Cormack-Jolly Seber models, respectively. Density was estimated to be 0.005 sirens/m² and biomass was 1.5 g/m² (average mass of all animals equal to 297.8g). Greater sirens demonstrated a switching point when they reached 350-400mm snout-vent length (SVL), whereupon growth rate in mm/day (for SVL) decreased and the variability in mass gained or lost per day increased. Growth in mm/day was negatively correlated with SVL whereas growth in g/day was positively correlated with SVL. We found peaks of activity in January and May/June that may correspond with breeding and foraging activity, respectively. Body-condition varied by month and peaked in June and July.

0264 General Ichthyology I, Drummond, Saturday July 26, 2008

Wood-eaters, Algivores, and Insect Tweezers: Variation in Jaw Mechanics within Assemblages of Neotropical Surface-scraping Catfish

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The family Loricariidae contains over 700 valid species native to tropical Central and South America. All loricariids feed via a highly derived, biomechanically decoupled oral jaw system with three independently operable rami: A single upper jaw is composed of fused premaxillae whose rotation around a mesethmoid condyle is actuated by a novel division of the retractor palatini. Independent left and right lower jaw rami have been rotated ventrally and deflected medially so that their long axis is perpendicular to the longitudinal body axis, with teeth facing down and a coronoid arch directed up, allowing the scraping or scooping of substrates via jaw adduction. Furthermore, the loricariid jaw functions within a ventral oral disk that permits concurrent respiration, surface attachment, and feeding. Complexity of the loricariid jaw, along with its radical departure from traditional teleostean four-bar linkage models, make investigation of its form and function challenging. Initial results of a research project attempting to quantify mechanical and ecomorphological

variation within sympatric assemblages of loricariids are presented. Because upper and lower jaw elements are highly three-dimensional and have few homologous landmarks that might permit interspecific comparison of shape, and because it is not possible to identify a fulcrum for the upper jaw that is homologous across all taxa, one-dimensional data comprising putative lever arms was gathered from the right lower jaw of 25 loricariid species collected from the Marañon River of northern Peru. Loricariid jaw rami bear single rows of teeth that can be synchronously applied to substrates, so output lever arms were measured from the anguloarticular condyle to both the proximalmost and distalmost tooth. The input lever arm was treated as the distance from the center of combined adductor mandibulae insertion to the anguloarticular condyle, and a mechanical advantage was predicted from ratios of input to output lever arms. Tooth row length is the distance across which force is distributed, and area of insertion of the combined adductor mandibulae muscle was used as a proxy for force into the system. Resulting patterns may circumscribe the spectrum of potential mechanical avenues for force optimization in the lower jaw of this highly complex and three-dimensional system.

**0591 General Ichthyology II, Salons 6&7, Saturday July 26, 2008; STOYE
GENERAL ICHTHYOLOGY**

**Secondary Sex Characters Reveal Cryptic Species in the Genus *Rasbora*
(Teleostei; Cyprinidae) in Northwestern Sumatra**

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Three species of the *Rasbora trifasciata* complex *sensu* Brittan (1954) were collected during an ichthyofaunal inventory in Northwestern Sumatra in 2006: *Rasbora meinkeni*, *R. tobana*, and one undescribed *Rasbora*. Three morphs of *R. meinkeni* distributed in three geographically isolated river drainages are distinguished based on color patterns and the distribution of male nuptial tubercles. The structure of the nuptial tubercles in the three morphs of *R. meinkeni* and the other two species were compared with scanning electron microscopy (SEM) to assess the taxonomic status of those taxa. To confirm that reproductive maturity had been achieved, the testes of each individual being examined was analyzed histologically. The SEM study revealed four tubercle morphotypes of which two are unique to two morphs of *R. meinkeni*. In addition, each morph of *R. meinkeni* also displays a distinct morphotype of superficial neuromasts on the cephalic region. These different morphotypes of nuptial tubercle and superficial neuromast are diagnostic characters by which each morph can be recognized as a separate species. The distribution of these diagnostic morphological characters is in accord with a preliminary molecular phylogeny based on the 16S region of mtDNA sequences of the species, excluding *R. tobana*. The molecular phylogeny comprises two clades, each of which represents several individuals of *R. meinkeni* and the undescribed *Rasbora*. This study also revealed the presence of an aspermatogenic part of the posterior portion of the testes of adult male *Rasbora* which contains mature sperm cells which indicates the reproductively active stage of the testes.

Pelvic Fin Locomotion In Benthic Batoids

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Studies of locomotion in batoids have largely focused on pectoral fin movements. However, pelvic fin 'punting,' has been described as an important locomotive mechanism in skates. Other benthic batoids have been observed performing similar punting movements despite lacking the skate's specialized pelvic fin structure. In this study, we compared the use of pelvic fins in locomotion among four benthic batoid species: the lesser electric ray, *Narcine brasiliensis*, the yellow stingray, *Urobatis jamaicensis*, and the Atlantic stingray, *Dasyatis sabina*, and the little skate, *Raja erinacea*. These species allow for comparative analyses across the three benthic batoid swimming styles: axial undulation, pectoral undulation and an intermediate between pectoral undulation and oscillation. To determine structural and locomotory differences between the pelvic fins of these species, we compared the pelvic fin to pectoral fin surface area ratios, pelvic fin skeletal elements and musculature, and swimming kinematics, including punting distance (body length (BL)), speed (BLsec⁻¹), glide duration (sec), and thrust duration (sec). The relative size of the pelvic fins may indicate their importance in locomotion, as the fins of *N. brasiliensis* (n=10) were significantly larger than those of *U. jamaicensis* (n=6) and *D. sabina* (n=10). In fact, whereas speed is highly variable, *N. brasiliensis* punted a significantly greater distance (0.80±0.26 BL; n=4) than *U. jamaicensis* (0.69±0.39 BL; n=4) and *D. sabina* (0.32±0.17 BL; n=4), without any difference in effort. Moreover, punts by *U. jamaicensis* and *D. sabina* were always accompanied with pectoral fin movement. By coupling the kinematic and morphological results of this research with those from past studies on batoid pectoral locomotion and feeding, we can begin to construct a comprehensive view of batoid ecomorphology.

0527 Poster Session II, Saturday July 26, 2008

Three-finger Toxins in Viperid Venoms: A Comparison of the Proteome and Transcriptome of the Desert Massasauga (*Sistrurus catenatus edwardsii*)

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Snake venoms are complex mixtures consisting primarily of proteins, and they may vary significantly in composition between species. For many years, α -neurotoxins, the dominant lethal toxins of many venoms, were thought to be limited to only elapid snake venoms. However, we have recently demonstrated that three-finger toxins (3FTx) are present in both colubrid venoms and in the venom gland transcriptome of the Desert Massasauga. We constructed a cDNA library of the venom gland and sequenced 576 ESTs, demonstrating that mRNAs of 5 isoforms of the well-known three-finger toxins are also present in this viperid species. However, a proteomic analysis of the expressed venom showed that proteins of the expected size class were not present in detectable amounts, demonstrating that the proteome (as used by the snake) and the transcriptome (genetic potential for protein expression) are not identical. Neither major neurotoxin protein family (PLA₂-based presynaptic or 3FTx postsynaptic toxins) was present in the venom proteome, consistent with the observation that Desert Massasauga venom is moderately toxic to mice (LD₅₀ = 1.35 μ g/g) but is nearly an order of magnitude less toxic than the most potent rattlesnake venoms, which do contain presynaptic neurotoxins. Several important conclusions follow: 1) there is greater similarity in the venom gland genomes of advanced snakes than has been previously recognized; 2) post-synaptic neurotoxins appear to be broadly distributed among many (all?) venomous snakes; and 3) pretranslational mechanisms must exist which can greatly affect composition, and therefore effects, of venom which is expressed in and stored within the gland. These results suggest that the composition of expressed venom may be capable of responding relatively rapidly to local selective pressures, and differential pretranslational processing of transcribed mRNA, by an as yet unknown mechanism, represents another factor affecting venom composition among advanced snakes.

0529 General Herpetology I, Salons 4&5, Sunday July 27, 2008

A 12 Year Synopsis of Habitat Use and Movement Patterns of the Desert Massasauga (*Sistrurus catenatus edwardsii*) in Colorado

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Since 1995, we have been monitoring and PIT-tagging Desert Massasauga Rattlesnakes (*Sistrurus catenatus edwardsii*) in a large population in SE Colorado. Movement behavior, home range and core activity centers, habitat use, and prey base were studied by radiotracking 36 snakes over three active seasons (May-October). Male home ranges and core activity centers were significantly larger than female

home ranges and core activity centers. Mark and recapture data for 770 snakes over three seasons indicated a population size of >3000 snakes in an area of approximately 4800 hectares. In the spring, snakes make long distance directed movements (mean = 1.89 km) from the hibernaculum (shortgrass, compacted clay soils) to summer foraging areas (mixed-grass/sand sagebrush, sand hills). Summer activity was characterized by short distance movements, and snakes were most often observed at the base of sand sagebrush in ambush or resting coils. Prey base surveys indicated a significantly higher abundance of both rodents and lizards in summer foraging habitat. Observations on six radioed gravid females indicated that Desert Massasaugas show maternal attendance for at least five days post-parturition. The average snake encountered was approximately 3 years old; 4 year old snakes were less frequently encountered, but fewer than 4% were considered to be 5 years or older. The lack of snakes greater than the fourth year size class, coupled with a maximum recapture interval of 2 years, confirmed that adult survivorship is low for Desert Massasaugas in southeastern Colorado. Conversely, initial growth was quite rapid; snakes grew an average of 0.57 mm/day in their first full year. Snakes returned to the hibernaculum area in October and appeared to hibernate individually in rodent burrows. However, within 50 meters of individual Massasauga hibernacula, eight species of snakes, five species of anurans and two species of turtles were observed using the same area for hibernation. Prey resource density was very low relative to habitat utilized by Desert Massasaugas during the summer. Migration patterns exhibited by Desert Massasaugas appear to be resource driven, and stable hibernation conditions therefore were the primary resource attracting a diverse assemblage of species to this area.

0064 AES Management, Jarry/Joyce, Sunday July 27, 2008

Nibbles from the Sea: Sourcing Shark Damage on Pelagic Longlines

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Considerable ecological and economic problems can occur from shark interactions in pelagic longline fisheries. Depending on where fisheries are located, shark catches can be good or bad, but when sharks damage (depredate) catches the economic results are certainly negative. Incentive for fishermen to avoid depredation events is high, motivating this study into the factors contributing to depredation events in the US Atlantic pelagic longline fishery. Many factors can contribute to depredation rates including effort, gear type, target species, catch location, time, and the diversity of the catch. But because depredation events are relatively rare, a large number of zeros appear in the data, and conventional modelling approaches become ineffective means for understanding these processes. To accommodate this issue, this study utilizes zero-inflated Poisson and negative binomial models (mixture models) to understand how depredation events occurred in a large scale fishery and what factors contribute most to their occurrence.

0274 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

The Importance of Plethodontid Salamanders to Forest and Stream Ecosystem Processes

John Maerz, Joseph Milanovich

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We have known that plethodontid salamanders are the most abundant vertebrates in the forests and primary streams of the eastern United States for more than 30 years, and yet the importance of these organisms to ecosystem processes remains a relatively neglected area of research. Hypothesized roles of plethodontids include nutrient sinks, energy conduits, and top predators in detrital food webs. In this talk, we revisit this depauperate literature and present the results of some recent preliminary studies examining the effects of plethodontids on tree regeneration in forests and on nutrient capture and export in primary Appalachian streams. Early estimates of plethodontid importance to terrestrial energy flow and nutrient dynamics suggested these organisms were insignificant in nutrient turnover or as nutrient sinks; however, recent advances in estimating plethodontid abundance suggest those estimates were probably low by at least a factor of 4 (likely a factor of 6-8). Adjusted estimates suggest that ~0.15% of NPP passes through plethodontid populations, which is comparable to bird and small mammals, and standing crops of key nutrients may be 4-8 times greater in salamanders than small mammals. Beyond nutrient cycling, experimental evidence suggests abundant plethodontid populations can reduce litter invertebrate abundance, affecting decomposition rates and increasing survival of germinating oak seedlings. Finally, recent research in southern Appalachian and piedmont streams indicate that streams support an average of 64 larvae and produce 40 metamorphic plethodontid salamanders per m. Stable isotope data indicate that these larvae are effective at capturing and ultimately exporting stream nutrients. An improved awareness of the potential importance of plethodontids to ecosystems processes will hopefully stimulate more empirical research on this topic. Ultimately, our understanding of the importance of plethodontids will affect efforts to conserve these animals and inform our predictions of ecosystem responses to environmental change.

0715 Fish Ecology I, Drummond, Thursday July 24, 2008

Diatom Preference of the Rio Grande Silvery Minnow (*Hybognathus amarus*)

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The federally endangered Rio Grande silvery minnow (*Hybognathus amarus*) was historically the most abundant fish in the Rio Grande basin, but currently occupies no more than 5% of its historic range. *Hybognathus amarus* populations have been declining over 100 years and the exact cause has not been identified. Many hypotheses exist for the decline but have been largely untested. Very little attention has been paid to food resources. In an investigation of feeding preferences, we were guided with three objectives; first, time to first feeding response to a diatom food resource by examining the relationship between time to first feeding and utilization. Second, substrate preference was determined (fine silt/clay or coarse sand). Third, feeding preference was determined by presenting a combination of 16 diatom species over the course of six feeding trials with six replicates each. Results for objective one revealed a significant difference ($p < 0.001$) between location and time with utilization peaking at 10-15 minutes and appearing to decline thereafter. For objective two there was no significant difference between substrates ($p = 0.21$). For objective three, multiple comparisons revealed significant difference between *Nitzschia palea* and *N. linearis* ($p = 0.013$) and *N. palea* and *N. paleaformis* ($p < 0.001$). There was no difference in utilization between *N. linearis* and *N. paleaformis* ($p = 0.48$). Results from feeding preference trial three demonstrate a significant difference between *N. palea* and *Cyclotella meneghiniana* ($0.01 < p < 0.025$). Results for feeding trial four revealed a significant difference between *N. palea* and *N. paleaformis* ($0.01 < p < 0.025$). Results for feeding trial six showed significant differences between *N. paleaformis* and *N. molestiformis* ($0.005 < p < 0.01$), *N. paleaformis* and *Navicula venta* ($0.01 < p < 0.025$), and *N. paleaformis* and *N. cf. palea* ($0.025 < p < 0.05$). While no diatom species was clearly preferred in trial six, *Nitzschia paleaformis* and *Nitzschia palea* were more preferred than *Nitzschia cf. spp* or *Navicula spp*. There were no significant differences between the other diatom species. *Nitzschia palea* was the preferred diatom in 50% of the feeding trials.

0253 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

3D Dorsal Fin Function in Spiny Dogfish during Steady Swimming

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Sharks exhibit a great diversity of locomotor modes with different body shapes across phylogeny and habitat. Dorsal fin size and anteroposterior placement also vary considerably across shark taxa. This diversity could be related to both evolutionary history and habitat requirements. Little is known about the function of dorsal fins in sharks, although in teleosts the dorsal fins function as stabilizers and thrust enhancers. In order to investigate the function of the dorsal fins in sharks, high speed video was used to record movements of the dorsal and caudal fins of four spiny dogfish, *Squalus acanthias*, swimming at 0.5 BL s^{-1} and 0.75 BL s^{-1} in a flow tank. Two cameras, capturing dorsal and lateral views, recorded images at 125 f s^{-1} , enabling 3D visualization. Points on the dorsal and caudal fins were tracked during five tail beats for each individual. The data was plotted and analyzed for 3D displacement and temporal variables. Average tail beat frequency increased from 0.88 s^{-1} at 0.5 BL s^{-1} to 1.20 s^{-1} at 0.75 BL s^{-1} , although amplitude remained constant. The first dorsal fin moves independently of the body with a higher amplitude at lower speeds, indicating a stabilizing function to counter increased instability at lower speeds. The first dorsal fin has a three dimensional conformation at maximum displacement. The second dorsal fin appears to be moving passively with the caudal portion of the shark, although the dorsal fin could be augmenting thrust by increasing total area of the caudal region. Further investigation using electromyography and fluid dynamics will reveal whether sharks are actively controlling dorsal fin movements. The function of the first dorsal fin as a stabilizer may partially explain differences in size and placement of this structure in relation to habitat and locomotor mode.

0561 Poster Session II, Saturday July 26, 2008

Altitudinal Variation of a Freshwater Fish Assemblage in Mountain Streams of the North Flank of the Andes in Colombia

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Altitude is a variable frequently related with the changes in species richness and community composition. Various hypotheses have been proposed to explain the patterns of species richness as it varies with altitude, some of these are: 1) reduction

of available area and environmental complexity, 2) more severe climatic conditions 3) reduction of the diversity of resources and competition and 4) reduction of primary productivity. This study describes changes in the fish assemblage along an altitudinal gradient between < 500 and > 2000 m on the eastern versant of the Colombian Andes. We used a simple linear regression analysis to determine the rate of loss (reduction) or of gain (accumulation) of species with an increase in elevation. We applied a scaled multidimensional analysis (NMDS) to define sets of sites with similar species compositions. We evaluated the changes in structure of the fish assemblage using K - dominance curves. Also, for each altitudinal level we calculated Shannon, Simpson and evenness indexes. In all, we captured 2049 individuals pertaining to 51 species (35 génera, 15 families). Species richness decreased with an increase in elevation, with the model explaining 56% of the variation; this was only marginally significant ($p = 0.057$). We found that all the physico-chemical variables were negatively correlated with elevation, but temperature was the only one that showed significant correlations ($r = -0.73$; $p < 0.0002$). The multidimensional scaling (stress = 0.11) revealed that species composition was relatively distinct at lower elevations (sites < 500 m) from the high sites, with a marked transition zone at intermediate elevations between 1000 and 1500 m. Visual inspection of the K dominance curves indicate that the structure of the fish assemblage changes with increased elevation, with the overall pattern being significant reduction of diversity with increased altitude, an increase in dominance and a decrease in equitability.

0195 Poster Session II, Saturday July 26, 2008

Expression of Heat Shock Proteins and Heat Shock Factor-1 in Response to Dehydration in *Xenopus laevis*

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The highly permeable skin of amphibians typically forces them to live in wet habitats. However, some species experience seasonally dry environments and need strategies to survive when water is scarce. The African clawed frog, *Xenopus laevis*, is native to South Africa and lives in ponds that can dry out during the dry season. When this occurs, frogs can dig underground and may enter a resting state called estivation. We hypothesized that under desiccating conditions, *X. laevis* cells respond by increasing the production of molecular chaperones that protect and stabilize other macromolecules throughout the stress. Western blotting was used to quantify the protein levels of a specific class of chaperones, heat shock proteins (HSPs), in six organs of control versus dehydrated *X. laevis*. Experimentally dehydrated animals lost 28.0 ± 1.6 % of total body water during aerial exposure over 6 days. Levels of HSP60, HSP40, HSP10, inducible HSP73 and constitutive HSC70 were assessed. HSC70 increased significantly only in heart (by 3.5-fold) of dehydrated frogs but HSP73 levels increased by 1.5-2 fold in skeletal muscle, lung and skin. Levels of other HSPs rose in organ-specific patterns; e.g. HSP60, HSP40 and HSP10 all increased in kidney of dehydrated frogs. Analysis of changes in the expression of the heat shock transcription factor 1 (HSF-1) that regulates HSP gene expression, found significant

increases in four organs of dehydrated *X. laevis*. We conclude that low water stress triggers the HSF-1 mediated up-regulation of HSP genes to enhance chaperone proteins levels in organ-specific patterns and contribute to the stabilization of cellular proteins under stress. For more information visit www.carleton.ca/~kbstorey. (Funded by NSERC Canada)

0472 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

The Shifting Baseline of Threshold Feeding Responses to Electropositive Metal Deterrents in Two Species of Dogfish

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Due to the potential repercussions for fisheries, the use of electropositive rare earth metals to deter sharks from interacting with baited fishing gears is undergoing extensive investigation across multiple species. This lab-based study aimed to assess the behavioural responses to rare-earth metal variants in a squaloid, the spiny dogfish (*Squalus acanthias*), and a triakid, the smooth dogfish (*Mustelus canis*), two species commonly captured as bycatch in western North Atlantic commercial and recreational fishing operations. In species-specific trials, tank-acclimated animals were exposed to squid-baited hook-gear setups. Either a lanthanide/cerium alloy ("mischmetal") or rare-earth magnet (neodymium-iron-boride), and corresponding chemically inert stainless steel decoys were deployed just above (mock) hooks to "protect" associated baits. In total, 89 videotaped trials were conducted, in which the response behaviour (e.g. approaches, flinches, general avoidances, complete disregard, bites) of dogfish around the baits/metals was carefully monitored. A nested repeated measures design was utilized where animals were changed out weekly to reduce the potential for learned behaviour, and to enhance the overall sample of experimental animals. Relative to decoys, spiny dogfish were significantly more averse (e.g. > rate of avoidances and flinches; lower bite rate) to alloys, and smooth dogfish to magnets, when trials followed same-day routine feedings. However, bait selectivity in both species progressively declined in trials following 2- and 4-day periods of food deprivation, whereby the repellents no longer had any effect. Animal density (either three or 15 animals per tank trial) had no effect on selectivity regardless of hunger level. Results suggest that once a threshold hunger level is surpassed, neither metal variant appears to effectively repel these two dogfish species. The significant interspecific variation in response to the two metals when satiated indicates possible divergences in sensory processing of the metallic repellents and associated behaviours between the two species.

0327 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Protecting Fishes and Fish Habitat in Agricultural Drains in Canada

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In Canada, there has been longstanding tension between those who manage drains to maximize agricultural benefit and those who manage the aquatic resources in drains. This has led to a debate as to whether or not drains constitute fish habitat. The federal Department of Fisheries and Oceans contends that drains contain aquatic resources protected by the federal Fisheries Act, and have developed a drain classification to assist in the permitting of drain maintenance. The agricultural community contends that drains are artificial and, as a result, contain a low richness and abundance of fish species. To determine if drains contain fish abundance, richness and habitat similar to natural watercourses, a study of 24 paired drain and reference watercourses was conducted in southwestern Ontario. It concluded that there were no significant differences between watercourses for all six biological parameters and nine of 13 physical habitat parameters measured. Drain maintenance is another source of tension and constitutes the removal of in-stream and riparian structure to enhance the rate of water flow. To determine the impact of drain maintenance on aquatic resources, a BACI study is currently underway to examine effects of maintenance on fish and macroinvertebrate communities and habitat. Preliminary results indicate that fish communities start recovering relatively soon after maintenance. The results of these studies highlight the importance of undertaking scientifically sound studies to support difficult management decisions.

0635 Poster Session III, Sunday July 27, 2008

Morphological Analysis of North American Cave and Swamp Fish (Amblyopsidae)

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Amblyopsidae is a family of North American fishes that is endemic to the United States. The family is comprised of five genera that include a total of six described species. They are found in swamps springs and subterranean waters that occur in limestone rock on both sides of the Mississippi River with a range that encompasses central and southeastern Missouri, northwest Alabama, northwest Georgia, central Tennessee, Kentucky, southern Indiana and northern Arkansas. We conducted a morphometric shape analysis of all species to see if external morphology could be correlated to isolation and other ecological factors. We established twelve landmarks on the full lateral region of the body, seven on the dorsal region of the head, and eight on the ventral and lateral region of the head using a TpsDig version 2.10.

Using Goodall's statistical test to analyze morphometric data we concluded that each species of Amblyopsidae is morphologically distinct from one another. However, they show a great deal of intraspecific variation consistent with the idea that isolation of populations generates detectable differences that are correlated to geographic distribution.

0428 Fish Ecology II, Salons A&B, Monday July 28, 2008

Young - of - the - Year Winter Flounder Distribution Among Coastal and Estuarine Habitats

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Spatially and temporally synoptic fish surveys may yield biased data when used for the determination of habitat preference. Here, a study of post-metamorphic winter flounder, *Pseudopleuronectes americanus* (Walbaum 1792), was conducted to address this concern. Sites were selected to determine if densities of juvenile flounder differ between eelgrass bed edge (*Zostera marina*) and dynamic, sandy substrate both inside and outside a Massachusetts, USA, estuary. Sites were sampled monthly to characterize settlement, migrations and possible shifts in habitat use over the first year. Representative sites were chosen within the Plymouth Harbor / Kingston Bay / Duxbury Bay (PKD) estuary and outside the PKD inlet in Cape Cod Bay (CCB). Habitat was classified on SCUBA transects, collecting sediment cores and digital quadrat photographs at each site. Fish collections were accomplished using a 1 meter beam trawl towed on three fixed transects at each site (June 2006 - May 2008). Temperature data revealed temperature differences between PKD and CCB, particularly during the growth season. Two-Way ANOVA was used to test for differences in flounder catch between habitats (eelgrass edge vs. sand) and locations (CCB vs. PKD). A significant interaction between location and habitat was identified. The pattern of dependence between location and habitat effects is synergistic. The effects of habitat and location act together to promote a positive deviation in mean catch. Winter flounder density was greatest at eelgrass edge and sandy habitats within the PKD estuary and lower among comparable habitats in CCB.

0389 Fish Morphology & Histology II, Salons 6&7, Saturday July 26, 2008

Constructional Constraints In Hammerhead Sharks: Shape Change And Space Utilization Within The Cephalofoil

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Constructional constraints are particularly important within spatially limited structures such as the head. The head must contain all structures associated with feeding, respiration, neural integration, sensory reception, and musculoskeletal support. Sphyrnid sharks present an excellent study system for investigating the potential functional trade-offs within the head. *Eusphyrna blochii*, *Sphyrna lewini*, 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 the implications of changes in head form. Preliminary data indicate that the more basal, *E. blochii*, has relatively small anteriorly positioned eyes. Through phylogeny the relative size and position of the eyes changes, such that the most derived *S. tiburo* has larger more medially positioned eyes. Mouth size and position remain unchanged, however *S. lewini* has relatively smaller jaws. The position of the external nares, as well as the volume occupied by the nasal capsule is highly variable, but shows no phylogenetic trend. Interestingly, the volume of the brain remains unchanged through phylogeny. These preliminary data indicate that the neurocranium and jaws are morphologically conserved whereas the laterally expanded cephalofoil and its constituent sensory components account for the morphological diversity within the clade.

0567 Poster Session II, Saturday July 26, 2008

Muscle Activity Patterns and Feeding Kinematics in Atlantic Hagfish (*Myxine glutinosa*)

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We investigated motor patterns of the three largest muscles in the hagfish feeding apparatus: the deep protractor muscle (DPM), clavatus muscle (CM), and tubulatus muscle (TM). The anatomy of the DPM and CM suggests they respectively protract and retract the dental plate. Hooked bipolar electrodes were implanted from the ventral surface of anesthetized *Myxine glutinosa*. After recovery, we simultaneously videotaped behaviors and muscle activity patterns from specimens feeding on uniform portions of squid. Ingestion usually required three gape cycles (dental plate protraction-retraction events) and intraoral transport required four gape cycles. Percutaneous implantation of electrodes did not inhibit normal feeding behaviors, as time and angular kinematic variables in these specimens were similar to those from a previous noninvasive study. Time to maximum gape was significantly longer during transport events than capture events. Gape cycle time and dental plate retraction time were similar in both capture and transport. The DPM was active

during protraction, while the CM and TM were active during retraction. In both capture and transport phases, the DPM had longer bursts (414 ms) than the CM (308 ms) and TM (255 ms). For each muscle, burst duration was similar in both capture and transport phases. All muscles were active during every gape cycle in the capture phase. In the transport phase, the DPM was active in all gape cycles while the CM and TM were active during the first two gape cycles. Our study corroborates anatomical predictions about DPM and CM function in hagfish feeding behaviors. We propose TM activity during retraction provides a fixed point for the CM to retract the dental plate. Decreased TM and CM burst frequencies during transport phases raise the possibility that elastic recoil of the CM tendon is sufficient to passively retract maximally protracted dental plates.

0044 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Redescription of Two Species of Manta Rays with Resurrection of *Manta hamiltoni* to species level

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The taxonomic status of the genus *manta* has historically been questionable and convoluted. Currently it stands as a monospecific genus, with a single recognized species, *Manta birostris*. This species has been documented to occur as far north as southern California and Rhode Island on the United States east and west coasts, Japan, and the Azores Islands in the northern hemisphere and as far south as Uruguay, South Africa and New Zealand in the southern hemisphere. A worldwide survey and a five-year study in Mozambique has unveiled enough empirical evidence to suggest that there are at least two extant species of the genus *Manta*. The two species are often separated geographically, but 'sympatric' populations do occur, although interaction between the species appears to be uncommon. The two species have fundamentally different distributions throughout the world's oceans, appearing to prefer different conditions. Based on morphometrics and several different external characteristics, the genus *Manta* should consist of at least two species, both of which are comprehensively described and contrasted for the first time. *Manta birostris* maintains its authenticity, with a second species, *Manta hamiltoni*, resurrected from a previous description by Newman in 1849. Distinct differences in the biology and behaviour of the two species are also noted. The inherent differences of these two species have significant implications for conservation and management strategies throughout their various distributions.

0045 Poster Session I, Friday July 25, 2008

Cleaning Behaviour of a Photographically Identified Population of Manta Rays in Southern Mozambique

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Cleaning behaviour in reef fishes has been studied in detail both in the field and experimentally. Manta rays, *Manta birostris*, are widely known by SCUBA divers to visit inshore reefs to be cleaned by small host cleaner fish. The areas that they frequent are often referred to as 'hot spots' or 'aggregation sites'. In some locations, these cleaning stations are active year-round, while in other locations the presence of manta rays at inshore reefs is seasonal or erratic. Details of the cleaning behaviour between cleaner hosts and manta ray clients have yet to be reported in the literature in detail. The frequency with which manta rays visit these designated cleaning stations has also not yet been explored. Such valuable information could heavily influence local eco-tourism industries, highlight the need to protect potentially critical habitats, and have implications on the management of manta rays populations worldwide. Our study aimed to gain a preliminary understanding of the habitat usage, in respect to cleaning, of a semi-resident population of manta rays in southern Mozambique. Through the examination of frequently used cleaning stations on inshore reefs we provide rough estimates of both the frequency with which they visit these stations and the total time individuals spend cleaning per day. These estimates offer new insights into how important these sites are to the daily and seasonal activity of these rays. Additionally, having used minimally intrusive photographic and observational techniques over a four-year period, we report on the diversity and behaviour of cleaner fish species specifically associating with manta rays in this region.

0150 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008;
GRUBER

Comparative Metabolic Biochemistry Of Shark Myocardial Tissue

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Recent work on lamnid sharks (Family Lamnidae) has revealed their ability to undergo broad high-latitude migrations and rapid sojourns into depths repeatedly well below the thermocline. Both scenarios significantly expose these fishes to cold temperatures. Lamnids also have the ability to maintain their swimming muscles at temperature levels above ambient (regional endothermy), and this unusual quality may allow these sharks to sustain muscle metabolic biochemical capacities when exposed to colder water temperatures. However, the lamnid heart does not benefit from regional endothermy, and the pericardial cavity and all myocardial tissues are at thermal equilibrium with ambient temperatures. Because proper cardiac function is essential for providing lamnids with adequate supplies of oxygenated blood that

are suitable for preserving swimming muscle function, a heart that is exposed to either prolonged cold or to rapidly fluctuating ambient temperatures should be capable of maintaining elevated metabolic biochemical capabilities. Therefore, the objective of this study was to compare the activities of citrate synthase (CS), lactate dehydrogenase (LDH), and myofibrillar ATPase (ATPase) in the myocardial tissue of lamnids and non-lamnids at various temperatures in order to determine how activities are affected by temperature. Initial analysis shows that the CS activity for lamnid sharks relative to non-lamnids is ~2.35x higher at 10°C, ~2.08x at 20°C, and ~1.89x at 30°C. LDH activities were also higher in lamnids relative to non-lamnids (~1.37 at 20°C). The thermal rate coefficients (Q_{10}) were lower in lamnids relative to non-lamnids for CS (1.39 ± 0.15 for lamnids at 10-30°C, 1.55 ± 0.19 for non-lamnids at 10-30°C). The Q_{10} value for LDH is $\sim 1.03 \pm 0.01$ for lamnids at 10-30°C. Overall, it appears that lamnids have higher cardiac enzyme activities than non-lamnids, but respond to temperature changes in a similar manner.

0245 Fish Conservation, Drummond, Sunday July 27, 2008

Range-wide Population Assessment of California Grunion, *Leuresthes tenuis*

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The California Grunion *Leuresthes tenuis* is an indigenous silverside found only along the coast of Baja and Alta California, that provides a unique recreational fishery. During spectacular midnight spawning runs, adults emerge from ocean waves onto sandy beaches to fertilize eggs in the sand. Embryos incubate on shore until washed into the sea when tides rise again at the next full or new moon. Some of the most urban beaches in California are Essential Fish Habitat for this species. Although protected since 1927 by a closed season and gear restrictions, the California Grunion is extremely vulnerable during spawning to animal predation and human poaching, and incubating eggs are exposed to a variety of human impacts. Little is known historically about the population status of this species because it is not easily monitored by traditional fisheries methods. Recently we began training and working with volunteers from local communities to assess grunion populations. These volunteer "Grunion Greeters" monitor beaches during the times of predicted spawning runs and report their data via an interactive web page. Since 2002, observers from as far south as Imperial Beach to as far north as Tomales Bay have confirmed the presence of this charismatic fish on many sandy beaches, identified previously unknown spawning beaches, and confirmed a northward range extension. Large runs may occur on public and private beaches, mostly during the closed season. The median run is just a few hundred fish, and the majority of all reported runs are at or below this size. Runs in the northern part of the range generally are far smaller than runs in southern California. Additional protections are recommended for this unique natural resource. Funded by California Sea Grant

0656 Herp Reproduction, Salons 4&5, Sunday July 27, 2008

A Novel Sex Chromosome System in the Australian Chelid Turtle *Emydura macquarii* Provides New Insights in the Ever Increasing Complexity of Sex Chromosome Evolution

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Heteromorphic sex chromosomes are known in only seven turtles possessing genotypic sex determination (GSD), two of which correspond to cryptic sex microchromosomes detectable only with high-resolution cytogenetic techniques. Using comparative genomic hybridization (CGH) and GTG-banding, a heteromorphic sex chromosome system was detected in *Emydura macquarii*, an Australian side-necked turtle. Several of our findings are unique in turtles. First, the heterogametic chromosome is larger than its homologue. Second, CGH revealed a chromosomal region specific to the heterogametic-sex, which appeared heteromorphic using GTG-banding, and was restricted to the telomeric region of the p arm. Based on our observations and the current phylogeny of chelid turtles, we hypothesize that the sex chromosomes of *E. macquarii* might be the result of a translocation of an ancestral sex microchromosome system onto the tip of an autosome. We discuss the potential causes and consequences of such a translocation event in the evolution of sex chromosomes and sex determining systems of turtles in general.

0174 Poster Session III, Sunday July 27, 2008

Evaluation Genotoxic and Mutagenic Potential of Waters of Preto River through Micronucleus Test using Erythrocytes of *Oreochromis niloticus* (Teleostei, Cichlidae)

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Pollution of water resources is a serious and growing problem. Despite the existence of relevant legislation the pollution of the aquatic environment by toxic chemical pollutants continues to occur, with domestic and industrial effluents being the main sources responsible for the contamination of aquatic environments. In the present study, micronucleus test in erythrocytes of *Oreochromis niloticus* was performed to diagnose the water quality of Preto river, in the city of São José do Rio Preto-SP, Brazil. The water samples collected in summer and winter (2007) from the six sites river were placed in individual aquaria and diluted 1:1 with well-water, and then aerated continuously for three days, after which five specimens of *O. niloticus* were added and left for 72 h. Control fish were placed in aquarium containing the same volume of well-water. After this exposition time, blood samples were obtained by means of cardiac puncture using heparinised syringes. Smears slides were then prepared (blood extensions). The material was fixed in absolute ethanol for 10 min and, after 24 h, the slides were hydrolyzed in HCl 1N for 11 min in moist chambers at 60 °C. Subsequently, the slides were washed in destiled water and placed in Schiff's Reactive for 2 h. Three thousand erythrocytes were analyzed per fish, under immersion objective (100x). A higher induction of micronuclei and nuclear alterations (notched nuclei, lobed nuclei, blebbed nuclei, broken-eggs, carolysis, vacuolated cytoplasm) were found during winter (dry season), whereas lower incidences were observed in summer (raining season). The water level decreases during the dry season might favor to a higher concentration of pollutants in the Preto river, while during raining season, they might be diluted. The results suggest that the concentration of pollutants is directly dependent on rainfall indexes and hydrologic balance of Preto river.

0067 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Dynamics of the Coqui Frog Invasion of Hawaii

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Coqui frogs (*Eleutherodactylus coqui*), introduced to Hawaii around 1988, have been aggressively spreading through wet forests of Hawaii Island and have achieved population densities up to 3 times those in native Puerto Rico. Coqui frog populations in Hawaii are largely unrestrained by predators or competitors. A hypothesis that high-density Hawaii frog populations are additionally fostered by food webs of forests dominated by an invasive nitrogen-fixing tree (albizia, *Falcataria molluccana*) and associated invasive shrubs, was not supported. Dense populations of frogs were found in forests dominated by the Hawaiian native Ohia (*Metrosideros polymorpha*) tree as well. Frog population density was significantly related to forb and shrub understory foliage density in both forest types but not to density of individual taller trees. Frogs chose nighttime perch heights independent of the variation in vertical density of understory foliage density over 0-3m. Sound pressure levels (SPL) of the male frog chorus ranged up to 73 dB and are considered nuisance noise in Hawaii by people favoring formerly quiet nights. Campaigns to control Hawaii frog populations by spraying citric acid or hydrated lime over discrete areas of a given frog population have only temporary success in the face of the re-invasion potential of the more widespread frog population. In areas of human habitation or areas undergoing vegetation restoration, removal of dense exotic understory shrubs may effectively reduce coqui frog population density. Supported by NSF DEB-0445267 and grants from Hawaii State Department of Agriculture and Hawaii County.

0440 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008

Distribution and Movements of Neonate Atlantic Sharpnose Sharks, *Rhizoprionodon terraenovae*, in a South Carolina Estuary and Nearby Coastal Ocean Waters

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Distribution and movements of neonate Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) were investigated using tag-recapture methods in North Inlet, SC. One hundred fifty four sharks were captured on standardized hook-and-line gear from May to September 2007. Atlantic sharpnose sharks were measured, tagged, sexed, and released. Hierarchical loglinear analysis showed no dependence of neonate shark abundance on creek size and tide. A Kruskal-Wallis test showed no significant differences between CPUE for any of the creeks sampled ($\chi^2 = 8.176$, $df = 5$, $p = 0.147$). A t-test showed no significant difference in CPUE for small or large creeks ($p = 0.89$). Concurrently, the average pre-caudal length (PCL) of these estuarine sharks

was compared to that of sharks caught at a nearshore ocean location (Springmaid Pier in Myrtle Beach, SC, n = 214) to investigate the importance of the estuary habitat as a nursery area for this species. An ANCOVA showed that location (estuary or nearshore) was not a predictor of average PCL ($p = 0.30$), indicating that neonates were about the same size at the two locations throughout the period. However, regression analyses showed a significant increase in neonate length in the estuary but not at the nearshore site over about a 30 day period. Ten of the 410 *R. terraenovae* tagged during this study were recaptured over the summer (2.4% recapture rate). Five of the 154 sharks tagged in the estuary were recovered there while one was recaptured about 20 miles north. Four of the 214 sharks tagged at Springmaid Pier were recaptured at that location or at other nearshore locations further north. Mixed results regarding site fidelity and growth of neonates at the estuarine and nearshore ocean indicates that both areas are extensively used by young Atlantic sharpnose sharks. Additional mark-recapture studies and estimates of mortality will be necessary to determine whether either or both habitats serve as nurseries for the species in South Carolina.

0661 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

DNA Barcoding and North American Freshwater Fishes

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Until recent years, morphology has almost entirely served as the criterion and operational tool for identifying species diversity in vertebrates. While neither a requirement in the Code of Zoological Nomenclature nor of most species concepts, diagnoses and descriptions of species have almost universally been based on morphological data. In recent years an international initiative has coalesced around DNA barcoding, promoting the use of a standard molecular marker for species identification and discovery, with an early emphasis on fishes (FISH-BOL). The mitochondrial 5' cytochrome *c* oxidase subunit I (COI) fragment is a short segment of 650 bp that serves as a conservative protein-coding gene and its diagnostic utility ranges from being usable in degraded samples to situations where unique sequence arrays differentiate otherwise morphologically cryptic species. The gene has also been identified as possessing a greater range of phylogenetic signal than others of the mitochondrial genome at the species level, making it also useful tool for phylogeny reconstruction. Previous studies support the use of the locus on numerous phyla ranging from fruit flies to primates, with a success rate in species identification exceeding 95% of the taxa examined. To explore the usefulness of COI as a tool for species identification in fishes, we have partnered with the Canadian Barcode of Life Network to generate sequence data for several thousand specimens representing most of the diversity of North American freshwater fishes. We present our general findings as to both the usefulness of the gene for accurate species identification and for phylogeny reconstruction.

0214 Poster Session II, Saturday July 26, 2008

Trophic Structure of Midwater Fishes Near Cold Seep Areas in the Gulf of Mexico Based on Stable Isotopic Analyses

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Chemosynthetic energy produced at hydrocarbon cold seep sites provides a nutritional basis to support benthic communities. The same nutrient basis from cold seep sites may be transported through the water column and incorporated by midwater fishes. This energy could be transported to midwater and surface communities via vertical migration of midwater fauna. This study focused on potential pathways for chemosynthetic energy to influence areas outside the benthic communities. During August 2007, midwater fauna were collected in the water column (surface to 1000 m) over three hydrocarbon seep sites in the central to western Gulf of Mexico using Tucker trawls, equipped with internal plankton nets for simultaneous sampling of smaller fauna. Zooplankton samples were collected using plankton nets, and phytoplankton were collected by filtering seawater through glass filters. Stable isotope analyses ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) were used to determine trophic position and the potential contribution of chemosynthetic energy in the midwater fish community. A total of 258 fish species from 67 families were collected. The dominant families were Gonostomatidae and Myctophidae, with *Cyclothone* spp. (Gonostomatidae) being the most abundant taxa captured. A total of 226 isotope samples were analyzed, from 5 fish families, 9 invertebrate families, phytoplankton, *Sargassum* and detritus. Based on preliminary results, midwater fishes primarily fed on zooplankton, with the exception of one myctophid species. *Myctophum affine* (Myctophidae) occupied a lower trophic level with a diet apparently comprised of phytoplankton. No chemosynthetic signature was detected thus far from isotopic analyses of midwater fishes. Despite the lack of evidence to support chemosynthetic influences within the water column, midwater fishes are important components of the midwater community, providing a link between the surface and lower depths.

0308 Herp Genetics, Salons A&B, Sunday July 27, 2008 - STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Genetic Population Comparisons of Insular and Mainland Florida Cottonmouths (*Agkistrodon piscivorus conanti*)

Ryan McCleary

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Analysis of genetic structure and diversity in populations can be useful for examining modes of evolution and, in common species, for determining baselines for future genetic comparisons. I hypothesized that an insular population of the cottonmouth, *Agkistrodon piscivorus conanti*, would be genetically distinct from two mainland populations due to a natural barrier causing separation and the insular population's unique feeding ecology. By adapting 10 microsatellite markers

originally developed in related snake species for use in cottonmouths, I analyzed genetic relationships between three geographically-distinct populations: Seahorse Key (SHK; N = 26), an island in the Gulf of Mexico; Lower Suwannee (LS; N = 9), a mainland area adjacent to SHK; and Paynes Prairie (PP; N = 46), a mainland site located ~100 km away from LS. These three populations are separated either by distance (LS and PP), by a salt water corridor (SHK and LS) or by both (SHK and PP). Further, SHK snakes have a unique feeding ecology, in that they subsist mainly on marine fish dropped or regurgitated by colonially-nesting seabirds. Blood samples from live snakes were collected via the caudal tail vein or by cardiocentesis, and tissue samples from dead-on-road specimens were collected from the body wall. DNA was extracted from these samples via DNEasy tissue kit and genotyped with a MegaBACE 1000. Preliminary microsatellite analysis using STRUCTURE 2.2 determined a greater genetic distance between SHK and either mainland site than between the more geographically separated mainland sites. These data indicate that salt water may be an effective barrier to dispersal in the cottonmouth, and that SHK snakes may be more inbred than mainland populations. These results also demonstrate the utility of molecular markers from closely-related species, and give a baseline of genetic structure in an organism that may be affected by increasing habitat destruction.

0151 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Visual Fields in Carcharhinid and Sphyrnid Sharks

Michelle McComb, Stephen Kajiura

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The bizarre “T” shaped head morphology of hammerhead sharks (Carcharhiniformes, Sphyrnidae) has captivated biologists for centuries and the selective forces behind its evolution remain the source of many untested hypotheses. The lateral expansion of the head shifted the spatial location of various sensory structures with the eyes being displaced to the distal tips of the cephalofoil. It has been suggested that the widely separated eyes confer upon hammerheads a broader visual field compared to their carcharhinid relatives. This concept pervades the popular media, despite the lack of supporting evidence. We tested the “expanded visual field” hypothesis by measuring the horizontal and vertical visual fields, convergence distance, and blind area for the scalloped hammerhead, *Sphyrna lewini*, the bonnethead, *Sphyrna tiburo*, and a representative carcharhinid, the blacknose shark, *Carcharhinus acronotus*. All three species shared similar monocular visual fields (171° - 181°) but *S. lewini* had a significantly greater horizontal binocular overlap (31.0°) than both *S. tiburo* (13.4°) and *C. acronotus* (10.6°). In addition, *S. lewini* achieved anterior binocular convergence at a closer distance (38 cm) than either *S. tiburo* (51 cm) or *C. acronotus* (47 cm). However, despite possessing the closest convergence distance, *S. lewini* demonstrated the largest anterior blind area (384 cm²) which is principally a result of head width. To determine if the hammerheads behaviorally compensate for this enlarged anterior blind area, we also analyzed the swimming kinematics of all species to measure the maximum head yaw angle. In addition to the horizontal visual fields, we also assessed the vertical visual fields for

all three species. All three species demonstrated a full 360° visual field in the vertical plane. The comparable visual field dimensions, close binocular convergence distance and large binocular overlap demonstrated by *S. lewini* lend support to the expanded visual field hypothesis.

0158 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

Biodiversity and Agricultural Sustainability in North America

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Aquatic and riparian ecosystems are fragile environments rich in biodiversity. They are threatened by impacts related to a variety of land-water interactions. Degradation of terrestrial environments adjacent to freshwater ecosystems can adversely impact aquatic habitats and associated biological communities through many mechanisms. Understanding the mechanisms driving losses in aquatic and riparian biodiversity is important to the conservation and restoration of these environments worldwide. This symposium will address the effects of agricultural production on aquatic and terrestrial ecosystems and their resident biodiversity, and management practices and alternatives that preserve it.

0096 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Adding Insult to Injury: Can the Gopher Tortoise Survive in Florida?

Earl D. McCoy, Henry R. Mushinsky

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The human population of Florida has increased dramatically over the past 50 years. The demand for housing, as well as associated roads, utility corridors, and service areas, has confined the once-thriving gopher tortoise population of the State largely to small habitat islands. These habitat islands inevitably become degraded by a variety of insults, such as pollution from nearby homes and lawns, predation by feral pets, and canopy closure resulting from lack of burning. As a result of the loss, isolation, and degradation of its preferred habitats, the gopher tortoise now inhabits many areas that would have been considered marginal, at best, at one time. During most of the past century, the gopher tortoise was exploited widely for food in Florida, and this form of harvesting appears to have had consequences that still can be seen today. The harvesting of gopher tortoises for food has dramatically abated recently, but, in the highly-urbanized setting of modern Florida, it has been replaced by harvesting for other purposes. We illustrate three of these kinds of harvesting, one to cull out "sick" individuals, a second to mitigate the effects of development, and a third to relocate individuals out of harm's way. These recent forms of harvesting probably are more serious threats to the continued existence of the gopher tortoise in Florida than harvesting for food ever was.

0448 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Agriculture Alters Gonadal Form and Function in *Bufo marinus*

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Many agricultural contaminants are known to disrupt endocrine systems of wildlife. However, evidence of endocrine disruption in wild amphibians living in agricultural areas has been mixed and controversial. Typically studies designed to test for effects of pollutants on wildlife attempt to compare polluted versus unpolluted sites. We take a novel approach to address this question by explicitly quantifying the relationship (dose response) between gonadal abnormalities and habitats characterized by differing degrees of agricultural activity. We quantify the occurrence of gonadal abnormalities and measures of gonadal function in 20 or more giant toads (*Bufo marinus*) from each of 5 habitats that occur along a gradient of increasing agricultural land use from 0-97%. We find that the number of abnormalities per individual as well as the frequency of intersex gonads increases with agriculture in a dose-dependent fashion. We also show that these gonadal abnormalities are associated with altered gonadal function—sex hormone synthesis and the maintenance of sexual dimorphism. Testosterone, but not 17β estradiol, concentrations were altered and secondary sexual traits were either feminized (increased skin mottling) or demasculinized (reduced forearm width and nuptial pad number) in intersex toads. Females did not differ across sites; however, males from agricultural areas had hormone concentrations and secondary sexual traits that were intermediate between intersex toads and non-agricultural male toads. Importantly, skin coloration at the most agricultural site was not sexually dimorphic; males had female coloration. Steroid hormone concentrations and secondary sexual traits are known to correlate with reproductive activity and success, thus affected toads likely have reduced reproductive success. Indeed, recent studies have explicitly linked pesticide exposure to local extinctions and declines. We have identified one likely mechanism for these declines.

0433 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008

Comparison of the Elasmobranch Fauna in Two South Carolina Estuaries, Differing in the Degree of Human Impact

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A pilot study of urbanized Murrells Inlet and relatively pristine North Inlet, similar-sized northeastern South Carolina estuaries suggested decreased abundance and diversity of elasmobranchs in the former. We set 58 longlines from May-November, 2007 in each estuary and also conducted a hook-and-line survey. Forty-five elasmobranchs (36 sharks, 9 skates and rays) were captured in North Inlet, including 19 adult and neonate Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*), 8 female blacktip (*Carcharhinus limbatus*), 5 adult bonnetheads (*Sphyrna tiburo*), 4 juvenile blacknose (*C. acronotus*), 4 southern stingrays (*Dasyatis americana*), 3 bluntnose stingrays (*D. say*), 1 Atlantic stingrays (*D. Sabina*) and 1 clearnose skate (*Raja eglanteria*). In Murrells Inlet, we caught one shark (young-of-year bonnethead) and 5 female southern stingrays. Elasmobranchs and sharks, but not ray abundance differed significantly (Wilcoxon rank sum test, $p < 0.05$) between the systems. Environmental factors were similar between the two inlets throughout the sampling season. Boat traffic was higher in Murrells Inlet than North Inlet over the sampling period (257 observations vs. 30). Shark diversity and abundance in Murrells Inlet is reduced compared to North Inlet, suggesting that some aspect of the system, human or otherwise, is causative.

0279 AES Food & Feeding, Kafka/Lamartine, Saturday July 26, 2008

Monthly Changes in Diet and Foraging Patterns for Two Shark Species in a Temperate Estuary: Evidence for Improved Hunting Capacity?

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¹*University of Rhode Island, Kingston, RI, United States*, ²*NOAA Fisheries, Narragansett, RI, United States*

Short term changes in feeding are difficult to study in large highly mobile predators that typically occur at low densities. The Delaware Bay estuary supports substantial populations of several shark species including *Carcharhinus plumbeus* and *Mustelus canis*. Non-lethal diet sampling of both these species was conducted during the middle week of June, July, and August for three years. *M. canis* adult females and young of the year (YOY) exhibited no significant monthly changes in mass of stomach contents, diet diversity, or meal size. Some prey changed in importance for both sizes during the summer, particularly in August. Several prey exhibited concurrent shifts for both *M. canis* size classes and coincided with published information on their seasonal movements. Some changes in YOY diet may have been related to ontogeny, but the continuous feeding pattern of *M. canis* and small

size of YOY limited elucidating these relationships. *C. plumbeus* exhibited some changes in feeding during the summer. YOY had significant shifts in feeding pattern and diet composition by August. Early in the summer YOY had less stomach contents, smaller meal sizes, and consumed predominately less mobile prey types. Both juvenile size classes had limited changes in feeding patterns and diet composition between months. *C. plumbeus* YOY in August were similar in diet to small juveniles in June and July, and small juveniles by August had a diet more consistent with large juveniles. Dramatic changes in feeding by YOY *C. plumbeus* suggested improvement in hunting capability by late summer, and some shifts to larger or more mobile prey continued for juveniles. Shifts in consumption of some prey were consistent with reported times of peak abundance for those species, and suggest a generally opportunistic feeding strategy on abundant fish species.

0338 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Foraging Ecology and Population Dynamics of the Manta Ray, *Manta birostris* in Lagoonal Waters of Ningaloo Reef, Western Australia

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¹Murdoch University, Perth, Western Australia, Australia, ²University of WA, Perth, Western Australia, Australia, ³Australian Institute of Marine Science, Darwin, Northern Territory, Australia

In response to increasing tourism pressure on Manta Rays (*Manta birostris*) within Bateman Bay, Ningaloo Reef, Western Australia, a number of baseline studies are being undertaken. Included in these are a) photographic identification to determine population demographics including residence, b) an investigation of prey availability and foraging behaviours, and c) acoustic tagging to determine habitat use. So far using photographic records over 300 individuals have been identified engaged in a number of behaviours. Of over 700 photographic observations the dominant behaviours within Bateman Bay were foraging (44%), presence at 'cleaning stations' (25%), and simply traversing the area (23%). Mature females, some of which have been recorded on over 25 occasions in 2 years make up the bulk of the population year round, whilst mature males and juveniles of both sexes appear to be highly seasonal. Results of plankton net tows adjacent to both foraging and non-foraging manta rays have shown that they utilise different foraging strategies depending on season, prey type and prey density. Swarming prey, predominantly small (<500um) calanoid copepod species are targeted within Bateman Bay throughout the year and appear to be the main prey type for 'resident' manta rays, whilst no active feeding was observed on mixed assemblages, the majority of gelatinous planktonic species, organic debris or phytoplankton blooms. This tendency to prey specificity may add to the difficulties of obtaining sufficient nutrient intake and place additional importance on lagoonal areas known to be rich in targeted species abundance. Use of an extensive acoustic array is hoped to further elucidate movements of both resident and transient individuals and confirm Bateman Bay as critical habitat for Manta Rays along Ningaloo Reef.

0421 Poster Session II, Saturday July 26, 2008

Changes in Metabolism and Swim Bladder Characteristics of American Eels in Response to Infection with *Anguillicola crassus*

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The nematode *Anguillicola crassus* is a parasite of European and Asian anguillid eels that has recently been introduced into North America. Upon the ingestion of an intermediate or paratenic host the parasite burrows into the wall of the swimbladder and eventually the lumen. The damage caused by the parasite can be dramatic ranging from scarring to complete loss of swimbladder function. American eels spend several years feeding and growing (yellow phase) as a primarily benthic fish where swimbladder function is not critical. The feeding of the parasite will deplete energy reserves but this can be mitigated by increases in feeding. Upon reaching the silver phase maturing eels cease feeding and begin a several thousand kilometer migration to the Sargasso Sea spawning area. The purpose of this study was to examine the anatomical and physiological effects of the parasite on the silver eel phase. Silver eels were collected while migrating from the Paskamansett River Dartmouth MA, USA. in the Fall of 2007. Oxygen consumption is being measured by a static respirometer and a recirculating flume respirometer (Model 90; Loligo Systems) that will allow us to determine metabolic rate and cost of transport for the eel. Upon completion of the swim trial the eels will be sacrificed and eel body parameters (total length, weight, and volume) and swimbladder characteristics (volume and retia length) will be measured. Comparisons of these parameters between parasitized and unparasitized eels will be made to explore the effects of the parasite on this presumably sensitive and important life history stage of the eel.

0169 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

The Evolutionary Development of Limb Length in the Australian Agamids: The Role of Structural Versus Regulatory Change

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¹*University of Melbourne, Victoria, Australia,* ²*Museum Victoria, Victoria, Australia*

The relative contribution of structural versus regulatory mutations in morphological evolution has caused much debate. My study examined whether structural changes to genes, rather than regulatory mutations, may have played a role in evolution of hindlimb length in Australian agamid lizards. The Australian agamids form a monophyletic evolutionary lineage, they are speciose (approximately 73 species) and they show significant variation both in body size and limb length. Limb length has evolutionarily functional significance with regards to affecting locomotion and physical performance abilities, influencing an animal's ability to escape predators, forage and survive in certain microhabitats. Consequently, evolutionary changes in

the limb length of a species will have direct effects on numerous important life history traits. Thus, the changes in developmental genes or regulatory changes in the genes that lead to variation in limb length have important evolutionary consequences. The potential role of structural gene changes was examined in three developmental limb genes: *Pitx1*, *Shh* and *Sox9*. The expression of these genes during limb development was confirmed using reverse-transcriptase PCR and quantitative real-time PCR in the agamid *Ctenophorus pictus*. Subsequently, comparative methods were used to analyse the evolutionary correlation between hindlimb morphology and amino acid sequence in 24 Australian agamids. Genetic results indicate that *Shh* and *Sox9* vary little in amino acid sequence, while *Pitx1* showed considerable variation. Thus, only *Pitx1* was analysed using comparative methods, with results showing no evolutionary correlation between hindlimb length and amino acid sequence in Australian agamids. These results imply that if these genes are involved in limb-length evolution, then it is more likely due to regulatory changes than structural changes. This study presents the first gene-expression and evolutionary analyses of limb genes in agamids and one of the first in reptiles, providing an important foundation for future studies in the evolutionary development of reptilian limbs.

**0368 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY**

**Phylogeography of the Mountain Mullet (*Agonostomus monticola*:
Mugilidae) in Mexico**

Caleb McMahan

Southeastern Louisiana University, Hammond, Louisiana, United States

The mountain mullet represents an understudied taxon that is allopatrically distributed along the Pacific and Atlantic Coasts of North, Central, and northern South America. 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. 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 preliminary study was to conduct a phylogeographic study of *Agonostomus monticola* in Mexico (Atlantic and Pacific basins) using cytochrome b sequences. To date, sequence data has been gathered from 11 populations and nearly 30 individuals. Phylogeographic relationships (Bayesian and Maximum Parsimony) strongly support the monophyly of populations within each of the basins. Genetic distances between Atlantic and Pacific basin populations are high ($\geq 8.5\%$) which is indicative of a long period of isolation. Future work will focus on increasing population sampling throughout the range of *Agonostomus monticola*, and assessing morphological variation within this taxon.

0366 Poster Session I, Friday July 25, 2008

Systematics of the Enigmatic Middle American Genus *Vieja* (Teleostomi: Cichlidae)

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Vieja (Teleostomi: Cichlidae) has long been taxonomically troublesome, as multiple taxonomic hypotheses have been proposed for the group. Several researchers have recognized *Vieja* as a monophyletic group comprised of a single genus, whereas others have suggested that the genus is only weakly defined and instead consists of multiple genera including *Chuco*, *Paratheraps*, and *Vieja*. As many as 16 species have been recognized in "*Vieja*." Previous studies of "*Vieja*" have either focused on biogeographic questions or only included a subset of the taxa in this group. No molecular study has focused on the systematics of "*Vieja*." Therefore, the objective of this study was to conduct a comprehensive study to assess the systematic relationships among the species traditionally assigned to *Vieja* (*sensu stricto*) using cytochrome b sequences from Genbank and sequences generated by our lab. We included additional species and populations of *Vieja*, including *V. zonata* (Atlantic and Pacific Basins) that have not been previously included in any cichlid systematic studies. Phylogenetic relationships indicated that "*Vieja*," excluding *V. tuyrensis*, is a strongly supported monophyletic group. There is support for some of the previously proposed generic re-assignments (i.e. *Chuco* and the *V. heterospila* group), and no support for the monophyly of others (i.e. *Vieja* and *Paratheraps*).

0541 Poster Session II, Saturday July 26, 2008

The Impact of Agriculture and Sedimentation on Fish Community Structure

Trevor Meckley, Scott Starr, Dominique Dagit, John Wallace, Sean Miller

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Lancaster County has historically been an agricultural center because of its rich soils. Agricultural processes have resulted in the addition of fertilizers, chemicals and sediment into streams and rivers. One of the most problematic is sediment, which has profound effects on the physiological and the physical make up of a stream. Sedimentation is a combined result of current land use practices throughout a watershed coupled with the historic land uses of the region. We examined the potential impact of sediment on six headwater streams of second and third orders in southern Lancaster County, Pennsylvania (n = 3 agricultural streams, n = 3 forested streams). We collected physical and chemical data to assess the water quality and rate of erosion among these streams. In addition, Geographical Information Systems (GIS) data based on recent Lancaster County maps was used to examine land use patterns and soil type in each watershed. Fish were collected in a 100 meter stretch from each stream using a fish electroshocker in October 2007 and February to March 2008. An Index of Biotic Integrity (IBI) was determined for each stream and used to

evaluate fish community structure and function. The agricultural impacted streams tended to have higher levels of phosphate, total suspended solids, turbidity levels, and erosion rates. Fish IBI scores for the sediment impacted sites decreased with increasing sedimentation. Also, Fish IBI scores were directly affected by average stream depth. This becomes important because average stream depth correlated with percent agriculture because the removal of forest resulted in a narrower and deeper channel. Therefore, it would appear that in 2nd and 3rd order streams the Fish IBI may not be an accurate indicator of stream health because of the influence of stream depth. However, when comparing streams with similar link magnitude the fish IBI may prove extremely useful in assessing long term watershed health.

0702 Poster Session I, Friday July 25, 2008

Reproductive Biology of the Pacific Sharpnose Shark, *Rhizoprionodon longurio* (Jordan & Gilbert, 1882), in the Mexican Pacific Ocean

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Centro Interdisciplinario de Ciencias Marinas, La Paz, B.C.S, Mexico

The Pacific sharpnose shark, *Rhizoprionodon longurio*, is a specie of commercial importance in some places of the Mexican Pacific coast with reproductive migrations through this coast. Its distribution goes from Southern California to Perú. Samples were obtained from the fishing camps of Bahía de La Paz, B.C.S., Punta Arenas, B.C.S., Mazatlán, Sin., in the Gulf of California; and Ensenada Chipehua, Salina Cruz, Oax., in the Gulf of Tehuantepec, from March 2004 to September 2006. The reproductive biology of 387 Pacific sharpnose shark was examined. Their total length (TL) ranged from 46 cm to 123 cm. Five new-born of sizes between 36 and 46.5 cm TL were captured incidentally in Bahía de La Paz. The overall sex ratio was 1.18:1 males per female. Ovarian egg diameters and the presence of uterine eggs or developing embryos show that female maturation occurs at about 80 cm TL, while clasper development suggests that males mature at about 82 cm TL. Forty four pregnant females and 24 with uterine eggs were captured, with fecundity between 2 to 10 embryos. The smallest embryos were found during August and new-born during May and September. The gestation period was estimated in 11-12 months. The mating time in Bahía de La Paz apparently occurs from May to August.

0557 Poster Session I, Friday July 25, 2008

***Paratrygon aiereba* (Chondrichthyes: Potamotrygonidae) Fisheries at Purus River, Brazil**

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Purus River is an important fishery area in Amazon basin. This river system is responsible for almost 30 % of the fishing production landed in Manaus market. In the last decade the stocks of commercially important teleost fish such as *Colossoma macropomum* is decreasing and freshwater stingrays species can be observed in the captures. The propose of this work is describe the freshwater stingray fishery at Purus River system, Information was collected from catch landed at local markets from 2006 through 2007. At least three species of potamotrygonid were observed at market: *Potamotrygon motoro*, *P. scobina* and *Paratrygon aiereba*. The latter species is the main target species due to its greater biomass, despite its low abundance. The fishing effort is concentrated on main channels of Purus river, on the preferential habitat of *Paratrygon aiereba* adult specimens. The fishing activities occur during the reproduction season. The highest captures were obtained at lower Purus because following factors: (i) the proximity of the capture locations to consumer markets; (ii) larger autonomy and load capacity of fishing boats at lower Purus River; (iii) the higher abundance of this species in places around confluence areas among main rivers system in the Amazonian basin. A management plan for *Paratrygon aiereba* in this area should be considered urgently by regional and national regulatory environmental agency.

0088 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008; GRUBER

Olfactory Morphology and Physiology of Batoids

Tricia Meredith, Stephen Kajiura

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The olfactory capabilities of elasmobranchs are legendary, but their reputation is based on surprisingly little empirical evidence. Olfaction plays an important role in the localization of prey, with amino acids acting as particularly effective odorants for elasmobranchs. Despite the importance of this sensory modality, olfactory thresholds have been assessed for only four elasmobranch species using a handful of amino acids. Literature values for these species indicate sensitivities at approximately 10^{-7} to 10^{-8} M. This study integrates the comparative olfactory morphology and physiology for batoid species from three families in two orders: the Atlantic stingray, *Dasyatis sabina*; the yellow stingray, *Urobatis jamaicensis*; and the clearnose skate, *Raja eglanteria*. The olfactory organs (rosettes) were dissected from representatives of each species ($n \geq 6$) and the total surface area of the olfactory

lamellae was quantified. The surface areas were compared using an ANCOVA with disc width as a covariate. To supplement the morphological data, an electro-olfactogram (EOG) technique was employed to assay the sensitivities of these species ($n \geq 6$) to a suite of twenty proteinogenic amino acids. The results indicate that the olfactory rosettes of the skate *R. eglanteria* are significantly smaller than those of the stingrays *D. sabina* and *U. jamaicensis*. Despite the morphological differences, the olfactory thresholds were similar for all three species, with each detecting amino acids down to a concentration of approximately 10^{-8} to 10^{-9} M. The most stimulatory amino acids differed somewhat for each species; which may reflect prey preferences. The results obtained corroborate the sensitivities reported in the literature, and illustrate that physiological sensitivities can converge independent of morphology. This study provides the first comparative analysis of the olfactory morphology and physiology of elasmobranchs.

0482 Poster Session I, Friday July 25, 2008

Measuring the Size Distribution of Mantas Rays Seen Along the Kona Coast of Hawaii

Eli Michael, Tim Clark, Victoria Newman

Manta Pacific Research Foundation, Kailua-Kona, HI, United States

Knowledge of the growth rate of a species is critical for its proper management. We use a system of parallel lasers mounted to an underwater camera to measure the size of manta rays present along the Kona coast of Hawaii. We discuss our measuring techniques and their limitations. Some of the older female rays have disk widths as large as 4.2 meters, while the younger males can be half that size. Knowing approximate birth dates for many of these rays (first sightings of new born pups), the Von Bertalanffy growth function was used to estimate the growth of the population over time. With a high resight rate for these mantas, continued long term observations will allow us to measure explicit growth rates.

0236 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Home Range Size and Refuge Use of Florida Pine Snakes, *Pituophis melanoleucus mugitus*, in a Southwest Georgia Pine Forest

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Florida pine snakes (*Pituophis melanoleucus mugitus*) are associated with upland pine forests in the southeastern coastal plain. Along with native pine forests, Florida pine snake populations are believed to be declining. Few data are available on the habitat requirements of this largely fossorial snake. Therefore, the purpose of this study was to describe aspects of the spatial ecology of the species, and in particular, to

determine which features within the landscape [i.e., stump holes, pocket gopher (*Geomys pinetus*) burrows and gopher tortoise burrows (*Gopherus polyphemus*)] were used as below ground refuge sites. The study took place on a 12,000 ha longleaf pine (*Pinus palustris*) forest in southwest Georgia. We used radio-telemetry to track 12 snakes (8 males, 4 females) twice a week for a minimum of one year. Mean home range size (minimum convex polygon) of males was 51 ha (range= 18-130) as compared to 34 ha in females (range= 18-76). Snakes were most frequently observed using pocket gopher burrows (57% of below ground observations). However, they also used burrows of small mammals (8%), stump holes (6%), nine-banded armadillo (*Dasypus novemcinctus*) burrows (3%), and tortoise burrows (2%). In 24% of observations we were unable to determine the refuge type. Data indicate the importance of underground refuges, particularly pocket gopher burrows, to Florida pine snakes. Currently, southeastern pocket gopher populations are declining, which may have important conservation implications for pine snakes.

0410 General Ichthyology I, Drummond, Saturday July 26, 2008

Shape Variation between Contemporary and Archived Cichlids from Lake Nabugabo, Uganda: Evidence for Rapid Morphological Change

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The explosive speciation of haplochromine cichlid fishes in Lake Victoria is unrivaled among vertebrates; however, $\approx 40\%$ of its endemic fishes disappeared between 1980 and 1986 associated with various anthropogenic perturbations, including introduction of the predatory Nile perch. Similar faunal collapse occurred in other nearby lakes that experienced Nile perch introduction, including Lake Nabugabo, a historic backwater of Lake Victoria. However, some native species persisted in the face of Nile perch predation by exploiting habitat refugia and/or via behavioural mechanisms; and, over the past decade, resurgence of some species has been reported. Resurging species may differ in phenotype from their pre-Nile perch conspecifics due to a variety of mechanisms including selection pressures associated with habitat refugia, predator pressure, and/or hybridization. As part of a larger collaborative study on rapid morphological change in cichlids of the Lake Victoria basin, we looked for evidence of phenotypic change in haplochromine cichlids of Lake Nabugabo that have shown signs of recovery. We compared collections of three species sampled in the early 1960's and archived at the British Museum of Natural History [*Astatotilapia velifer* (Trewavas, 1933), *Haplochromis annectidens* Trewavas 1933, *Paralabidochromis beadlei* (Trewavas, 1933)] with the same species sampled in 2005. Body shape was quantified using geometric morphometrics (whereby each fish was characterized using a set of landmarks); MANCOVA indicated significant differences between archived and contemporary in multivariate body shape traits. Shape variation reflected a smaller body depth, shorter head length, and forward displacement of the paired fins in recent collections. Such convergent change in the three species may indicate the need for increased maneuverability in structurally complex refugia (swamps) or in the face of predator attack.

0167 Poster Session I, Friday July 25, 2008

Higher-level Relationships of the Cypriniformes (Actinopterygii: Ostariophysi) Inferred from 238 Whole Mitochondrial Genome Sequences

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Fishes of the order Cypriniformes are almost completely restricted to freshwaters and number over 3400 species placed in six families, each with poorly-defined subfamilies and/or tribes. In the previous mitogenomic study based on 59 whole mitogenome sequences (Saitoh et al. 2006), we confirmed monophyly of the Cypriniformes and found four major clades comprising Cyprinidae, Catostomidae, Gyrinocheilidae, and Balitoridae + Cobitidae (Psilorhynchidae not available), with the latter two loach families reciprocally paraphyletic. Interrelationships of these major clades, however, were ambiguous despite the longer nucleotide sequences used in the analyses. Also unavailability of several unusual taxa (e.g., *Psilorhynchus*, *Ellopostoma*, *Paedocypris*) prevented us from drawing explicit conclusions. The present study represents the second step towards resolution of the higher-level relationships of the world's largest freshwater-fish clade based on more extensive taxon sampling from 230 cypriniforms (including 4 species of *Psilorhynchus*, 1 species of *Ellopostoma* and 2 species of *Paedocypris*). Unambiguously aligned, concatenated mitogenome sequences from 13 protein coding genes (11,328 bp) were divided into three partitions (1st, 2nd, and 3rd codon positions) and preliminary phylogenetic analyses based on partitioned maximum likelihood method using RAxML 7.0 were conducted. The resultant phylogenies are largely congruent with the previous findings in Saitoh et al. (2006), although the addition of 177 species provides a much more detailed picture of cypriniform relationships. As for the 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). We identify a number of long branches in the resultant tree that we hope to bisect by adding species to our data matrices in the hope of obtaining an even clearer picture of cypriniform relationships.

0599 Poster Session II, Saturday July 26, 2008

Diet of Tiger Salamanders in North Dakota, With Implications for Flow of Heavy Metals through Wetland Food Webs

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I used a series of larval and transformed *A. mavortium* from a population in northwest North Dakota and inspected gut contents in order to test the hypotheses that age, size, sex, maturation status, and life history stage influence food preferences. All sampled animals (n = 49) were collected from Swalls Lake, Ward Co. Stomachs were extracted, weighed, and prey content was keyed out to order. Number of each type of prey were counted. I used SVL, headwidth, sex, reproductive status (juvenile or sexually mature), and developmental stage (larval or transformed) as in a series of exploratory regression analyses (for SVL and headwidth) or ANOVAs (for sex, reproductive status, and development stage) in order to determine if any factor was associated with significant differences in prey type and abundance. Headwidth correlated significantly with prey variation and abundance. This means that salamanders with larger heads eat larger prey and more of them. The other significant factor was developmental status: larval salamanders (both paedomorphs and juvenile larvae) at different prey than transformed salamanders. Interestingly, all the prey in the guts of transformed salamanders were aquatic prey. This contrasts with the classic notion that transformed amphibians return to ponds only to breed. Supplemented with the observation that many of these transformed salamanders were juveniles, this suggests that salamanders return to pond for significant growth opportunities in addition to any reproductive potential.

0207 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Community Assembly Through Evolutionary Diversification and Dispersal in Middle American Treefrogs

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How are ecologically diverse organisms added to local assemblages to create the community structure we see today? In general, within a given region or community, a given trait (character state) may either evolve in-situ or be added through dispersal after having evolved elsewhere. Here, we develop simple metrics to quantify the relative importance of these processes and then apply them to a case study in Middle American treefrogs. We examined two ecologically important characters (larval habitat and body size) among 39 communities, using phylogenetic and ecological information from 278 species both inside and outside the region. For each character, variation among communities reflects complex patterns of evolution and dispersal. Our results support several general hypotheses about community assembly, which

may apply to many other systems: (1) elevation can play an important role in creating patterns of community structure within a region, (2) contrary to expectations, species can invade communities where ecologically similar species are already present, (3) dispersal events tend to occur between areas with similar climatic regimes, and (4) the first lineage to invade a region diversifies the most ecologically, whereas later invasions show limited change. We also contrast our analyses of community assembly through trait evolution and biogeography with inferences based on phylogenetic clustering of co-occurring species.

0427 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Sustainable Harvest of Wild Adult American Alligators in Florida

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Florida Fish and Wildlife Conservation Commission, Gainesville, FL, United States

Crocodylians have long generation times, high fecundity, and low egg and juvenile survival rates. Consequently, adult females have a high expected value to the population. Harvest of wild adult crocodylians has, therefore, been discouraged by conservation and wildlife trade organizations as a harvest strategy. In Florida, three American alligator (*Alligator mississippiensis*) management programs allow the harvest of larger alligators: nuisance alligators, private lands alligators, and alligators on public waters. We present harvest results and population trend data for harvests on public waters, which are open to the general public. During 1988-2007, adult alligators on 36 alligator management units (AMU) were intensively harvested at a target harvest rate of 6% per year. Harvest quotas were based on population estimates from 1-2 night spotlight surveys conducted each year. Actual harvest rates were somewhat less than 6% of the adult population. Of 35 areas that were harvested, adult alligator populations increased on 23, remained stable on 9, and declined on 4. One area was dropped from the harvest program because it could not sustain harvests. Approximately 21% of the harvest was adult-sized females during 2000-2006. Simultaneous 50% egg harvests were conducted on 22 AMUs, which also had adult harvests. Of these areas, 21 indicated stable to increasing populations. This study indicates that harvests of adult alligators can be sustainable. However, population monitoring needs to be conducted and regulations enforced to ensure that harvest levels are maintained within target ranges.

0048 Poster Session II, Saturday July 26, 2008

Comparative Ecology of Two *Crenicichla* Species (Teleostei: Cichlidae) in a Venezuelan Neotropical Floodplain River

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Feeding behavior and habitat use of two species of pike cichlids (*Crenicichla lugubris* and *C. af. 'wallacii'*) were studied in the Rio Cinaruco, a Neotropical floodplain river in the Venezuelan llanos. We examined 206 individuals of *C. lugubris* and 117 individuals of *C. af. 'wallacii'* from both the main channel and lagoons throughout the falling water phase of the annual hydrological cycle. *C. lugubris* was common in rocky habitats that contained woody debris in both lagoons and the main channel, whereas *C. af. 'wallacii'* was abundant in shallow areas containing leaf litter, and more abundant in lagoons than the main channel. Although we were not able to capture *C. af. 'wallacii'* in rocky habitats, they sometimes were observed in these habitats. *C. lugubris* is larger than *C. af. 'wallacii'* (mean SL = 197 mm and 45 mm, respectively). Examination of *C. lugubris* gonads indicated that the species matures at > 121 mm SL for females and 107 mm SL for males and average fecundity for 10 mature females was 1463 oocytes. *C. af. 'wallacii'* specimens with ripe gonads were not obtained during the study period, so it probably spawns during flood season. Analysis of stomach contents showed that larger (>100 mm SL) *C. lugubris* fed mostly on small fishes (e.g., characids, cichlids), but juveniles (<100 mm SL) consumed mostly aquatic insects, fish scales, and shrimps. *C. af. 'wallacii'* fed on aquatic insects and other autochthonous items associated with leaf litter substrates or submerged vegetation debris.

0226 Poster Session I, Friday July 25, 2008

Exploring Gobioid Phylogeny Using Morphology - Not a Lost Cause

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Exhibiting over 20 morphological apomorphies, the monophyly of the Gobioidae is perhaps the most thoroughly demonstrated of any major percomorph taxon. However, the internal relationships of the estimated 2500 extant species and 300 genera remains enigmatic. There is a paucity of comprehensive morphological treatments of gobioids. There are several reasons for this, but perhaps the most detrimental has been the general misconception that a prevalence of reductive evolution among gobioids precludes the use of morphology for examining phylogeny *a priori*. Indeed, gobioids are generally small and some taxa lack certain morphological elements, but until characters and their distributions have been analyzed, dismissal of morphology for phylogenetics is premature. Examining 55 characters in 50 genera, we describe examples of unique morphology from the pectoral girdle, pelvic girdle, gill arches, and hyoid arch that define clades of

gobioids. We hypothesize a monophyletic *Eleotris* group consisting of *Eleotris*, *Erotelis*, *Belobranchus* and *Calumia* based on a unique cleithral/supracleithral articulation, Baudelot's ligament to the first vertebra, and derived insertion of the *extensor proprius pelvicius*. We also hypothesize a sister group relationship of the 'eleotrid' taxa *Grahamichthys* and *Thalasseleotris* with the Gobiidae (gobioids with 5 branchiostegal rays) based on a posterior interhyal/ceratohyal articulation, presence of a cup-shaped process on the medial surface of the interhyal, absence of the 4th pharyngobranchial toothplate cartilage, articulation of the the 4th epibranchial with the 3rd pharyngobranchial, and a shortened 3rd basibranchial. Morphology of the Gobioidae can provide characters with informative variation important to understanding phylogeny.

0224 Fish Systematics I, Salons A&B, Friday July 25, 2008

Phylogenies without Synapomorphies - A Crisis in Systematics Or What We Don't Node - The Imperative of Character Evidence for Phylogeny Reconstruction

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The last 15 years has seen an explosion of published phylogenies of fishes. Despite the ever-increasing volume of data, little more (and sometimes less) is understood about relationships and evolution of fishes than in the early 1990s. This is due to the reliance on statistical measures of overall similarity to support proposed relationships rather than relationships being represented in terms of synapomorphy (homology). We examine several examples of recent fish phylogenies, focusing on those involving the Gobioidae, Percomorpha, and Acanthomorpha and find radically different topologies, often presented in consecutive studies by the same authors, that are equally well supported by statistical measures. Without evidence (characters) for nodes, there is no way to choose among these competing topologies, nor any basis for rational discussion. Altering taxonomy based on such fluid constructs is problematic, particularly as there has been no attempt to provide character definitions for identified groups based on testable synapomorphies. Without a return to homology (synapomorphy), the foundation of cladistics, the modern "phylogenetics" will have little to offer systematics, taxonomy or other biological disciplines.

0473 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Patterns of Habitat Use and Residency for Sand Tiger Sharks (*Carcharias taurus*) in Delaware Bay

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The sand tiger shark (*Carcharias taurus*) typically inhabits coastal waters and bays including Delaware Bay, which is thought to serve as important secondary nursery habitat as well as a foraging area for adults. Due to low reproductive potential and overharvest, sand tigers have experienced marked population declines. With this decline in mind, our objectives included collecting information on habitat utilization, depth selection, and residency patterns for sand tigers in Delaware Bay. We utilized both manual and passive tracking (VEMCO Ltd. VR-2) to monitor sand tiger habitat utilization patterns during their Delaware Bay residency. Sand tigers were implanted with standard acoustic (n=19) and depth sensing transmitters (n=10) during the summers of 2006 and 2007. Two sand tigers tagged in June of 2006 returned to Delaware Bay during the third week of June 2007, which closely corresponded to the time of our first successful captures that year. A total of 72,241 detections of telemetered sand tigers were collected on receivers during the 2006 and 2007 field seasons. Although their distribution overlapped, when the sand tiger data was segregated by sex, the males were more commonly found in the lower salinity middle portion of Delaware Bay whereas females were more common in the higher salinity waters at the mouth of the bay. We documented a significant difference in depth utilized by male and female sand tigers, with females typically occupying deeper waters than males. Through this study we hope to improve our knowledge of habitat requirements and residency of sand tigers in Delaware Bay thus providing a greater understanding of essential habitat for this species as well as enhance recovery of sand tiger stocks.

0721 Poster Session III, Sunday July 27, 2008

Distribution of Muscle Fiber Types within Chondrichthyan Muscles

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Vertebrate morphologists have long appreciated the importance of muscle fiber type composition. Although they vary widely in their size and distribution, different isoforms of slow and fast myosins comprise the bulk of all skeletal muscle tissue. Combined, these different myosins coordinate to perform a variety of important functions associated with locomotion, feeding and breathing. Evolutionarily, amniotes and anamniotes have shown a remarkable disparity in muscle fiber type distribution. In amniotes and adult amphibians muscle fibers show a mosaic

distribution with interspersed slow and fast fibers. In fishes, as well as in larval amphibians, muscle fibers show a zoned distribution whereby specific fiber types group together within muscles. Here we describe the distribution and relative proportion of fast and slow fibers in adult shark and skate muscles. Muscles were stained for a variety of specific myosins using standard immunohistochemical methods. Antibodies considered to stain all vertebrate myosins (based on data from a large number of amniotes and anamniotes) did not recognize myosins within many irregularly shaped muscle fibers in skate. While our results do not indicate the mosaic pattern seen in amniotes, they also do not fully support the strictly zoned fast and slow regions seen in most anamniotes. Antibodies against slow myosin stained the peripheries of certain larger muscle fibers, but stained entire smaller diameter fibers in other muscles as seen in anamniotes. Thus skate muscles may be comprised of a number of intermediate fiber types and consist of a unique pattern of distribution. It is likely that a range of intermediate muscle fiber types may be an ancestral character. We discuss the functional, evolutionary, and developmental implications of our data.

0157 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Are Caecilians Primarily Stegokrotaphic: Evidence from Larval Morphology

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One controversy in caecilian evolution concerns the origin of the completely covered skull roof. Adults of all living caecilians have skulls in which the dorsal skull is either completely closed by bone (stegokrotaphy) or with a temporal gap present between the squamosal and parietal (zygokrotaphy). In non-rhinatremitid, zygokrotaphic taxa, the primary jaw adductor musculature is confined to the adductor chamber and does not extend onto the dorsal side of the skull. This is in contrast to the condition in the Rhinatrematidae, the sister group to all other living caecilians, where the adductor musculature extends through the temporal opening onto the dorsal side of the skull. The implications for the ancestral condition of the morphology of the caecilian head have been widely discussed based on the observed adult morphologies, their phylogenetic distributions and putative sister groups. Recent fossil evidence suggests that the completely closed skull might be the primary condition. Several clades of living caecilians, however, are characterized by the presence of morphologically distinct, free-living larvae that undergo a metamorphic transformation into the adult-like morphology. Little attention has been paid to larval morphology and metamorphosis and its implications for the reconstruction of the ancestral condition of the caecilian head. We have investigated the morphology of larvae and adults of rhinatrematid, ichthyophiid, uraeotyphliid and caeciliid caecilians, covering all genera for which free-living larvae are known. Several

features of caecilian larvae are unreported or have previously been overlooked. The implications of our data for the evolution of stegokrotaphy in caecilians will be discussed.

0555 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

Post-Emerging Behavior of Hatchling Diamondback Terrapins (*Malaclemys terrapin terrapin*) at Jamaica Bay Wildlife Refuge, New York

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Post-emerging behavior of most turtle species is poorly known. Previous work suggests that some diamondback terrapins, *Malaclemys terrapin* hatchlings do not move directly towards water, as do other aquatic turtles. No in-depth studies have determined why terrapins behave so differently from other aquatic hatchlings. Aquatic environments can offer hatchlings some predator protection and a freeze-proof overwintering location. Vegetated upland locations could also offer predator protection or food availability. I recorded the terrestrial movements of hatchlings to clarify why they may choose terrestrial locations over aquatic habitats. Eleven drift fences were installed in four nesting areas in Jamaica Bay Wildlife Refuge (JBWR), part of Gateway National Recreation Area on Long Island, New York. Each area had at least two drift fences. Small pitfall traps were placed one meter apart along the fence line. I monitored each container daily before dusk during Summer/Fall 2006, Spring 2007, and Summer/Fall 2007. Each captured hatchling was uniquely marked and measured. Two hundred and thirteen hatchlings were found, one hundred and thirty six were later recaptured. Most hatchlings emerged in the evening hours in fall 06 and 07. Most fall emergences moved away from the water and travelled upland towards vegetation. Most spring emergences entered the water directly. Some hatchlings clearly overwintered on land. One hatchling was recaptured on land more than five weeks after its initial capture. Another was released in the water and was later recaptured on land seventy-two hours later. I suspect that terrapin hatchlings may spend a significant amount of time on land in order to avoid the osmotic stress.

0320 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008;
GRUBER

Using Ultrasound and Steroid Hormones to Determine Pregnancy in Seasonal Aggregations of Female Round Stingrays (*Urobatis halleri*) in a Coastal Estuary

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The round stingray (*Urobatis halleri*) is a common nearshore elasmobranch in southern California, known to breed in late spring. Despite a large seasonal aggregation of round stingrays in Seal Beach, CA, no behavioral or physical evidence of mating has ever been observed in this population. Mating in this population is thought to occur in nearby Anaheim Bay estuary, which is part of the Seal Beach National Wildlife Refuge (SBNWR). SBNWR is composed of 1.1 km² of estuary and four mitigation ponds. Round stingrays were sampled in mitigation ponds every month from June 2005 to September 2007. All captured rays were weighed, sexed, and examined for mating scars as evidence of recent breeding behavior. From June 2006 to September 2007 blood was sampled via the caudal vein from a subset of female rays and analyzed for progesterone and estradiol using radioimmunoassay. In addition to blood sampling, a subset of female rays were also examined using ultrasound to determine pregnancy state from July to September 2007. All females sampled during July and August exhibited developing embryos based on ultrasonography. In September 20% of the females sampled appeared to have pupped based on ultrasonography and physical appearance. Progesterone concentrations were elevated in females sampled through July and August (0.75 ng/ml), and decreased significantly to 0.16 ng/ml by September. September progesterone concentrations varied; one female who appeared to have pupped in September had non-detectable progesterone levels, while other pregnant females had progesterone levels ~0.24ng/ml. Our data suggest that ultrasound and steroid hormones can be sensitive indicators of reproductive status, and support the theory that this coastal estuary serves an important function in round stingray reproduction. Female round stingrays may be entering these warm shallow ponds to increase the gestation rate, purported to be three months, which is relatively short for a live bearing elasmobranch.

0528 General Ichthyology II, Salons 6&7, Saturday July 26, 2008

***Soleichthys* Species (Pleuronectiformes: Soleidae) Occurring in Marine Waters Off Queensland, Australia**

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Members of the pleuronectiform genus *Soleichthys* are small to medium-sized species of right-sided flatfishes. Species of *Soleichthys* occur in marine waters from East Africa to the western Pacific; most have not been collected in abundance. Many species are colourful featuring bold pigmentation patterns consisting of bands, blotches or spots. A smaller number of species, in contrast, feature only uniformly drab pigmentation. To date, 10 nominal species are placed in *Soleichthys*. However, the taxonomy and systematics of these fishes is complicated because original descriptions of five nominal species are based on unique holotypes and several others are based on three or fewer specimens. Many of the nominal species overlap extensively in meristic features, and most earlier descriptions lack sufficient detail to adequately distinguish the nominal species. Previously, four species of *Soleichthys* had been recorded from waters off Queensland, Australia. Recently, an extensive trawling survey conducted off Queensland collected eight species of *Soleichthys*, including *S. heterorhinos*, *S. microcephalus*, *S. maculosus*, *S. serpenpellis*, *S. oculofasciatus* and three undescribed species. Distinctive features, relative abundances, frequency of capture and ecological data are highlighted for all species of *Soleichthys* occurring off Queensland.

0021 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Lives at Risk in the Slow Lane- Sharks and Other Fishes

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Life in the slow lane is not all that it is cut out to be. Animals such as most sharks, that grow slowly, also mature late, have a long life-span and have a small number of young annually. Such K-selected life-history parameters result in a low intrinsic rate of increase (r), and low resulting rebound potential to fishing mortality. Thus sharks, whales, and sea turtles, all K-selected, have shared similar rapid stock collapses when subjected to moderate or high mortality in fisheries. In addition some long-lived, late-maturing teleosts like the sebastine rockfishes, and epinepheline groupers that do not precisely fit the K model because of high fecundity, also have been prone to rapid stock collapse and slow recovery from overfishing. Very high natural egg and/or larval mortality in the rockfishes results in low and infrequent year-class recruitment. Overfishing removes the largest most fecund individuals, thus reducing the probability of recruitment even further. Many of the groupers are protogynous so that all the older fish are males. Because of natural mortality during the adult life-

span, males represent only a small part of the population which, when overfished, leads to an insufficient number of males for successful spawning.

0211 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Are there Cascading Ecosystem Effects of Depleting the Oceans' Great Sharks?

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Top-down control can be an important determinant of ecosystem structure and function, yet has rarely been demonstrated in oceanic ecosystems, where the cascading effects of predator removals by fishing could be significant. Here, we present evidence from a case study on the U.S. east coast, which draws upon multiple research surveys, meta-analysis, long-term field observations, and controlled experiments. We show that as abundances of all 11 great sharks, which consume other elasmobranchs, fell over the past 35 years, 12 of 14 of these prey species increased in abundance. Effects of this community restructuring appear to have cascaded downward from one elasmobranch mesopredator, the cownose ray, whose enhanced predation on its bay scallop prey was sufficient to terminate North Carolina's century-long scallop fishery. Analogous cascading effects may be a predictable consequence of depleting populations of large sharks, and we conclude by exploring the evidence to date for them in other regions.

0617 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Central Pacific Survey Reveals Lower Reef Shark Density near Human Population Centers

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Biennial surveys (2000-2007) of coral-reef shark populations were conducted around 50 U.S. Pacific Islands in several regions: the Hawaiian Archipelago, the Marianas Archipelago, the Line Islands, the Phoenix Islands, and the American Samoa Archipelago. Two fisheries-independent census methods were implemented by divers: stationary point counts and towed-diver surveys. Five species of sharks were recorded in sufficient frequency to allow meaningful statistical analyses: grey reef shark (*Carcharhinus amblyrhynchos*), galapagos shark (*Carcharhinus galapagensis*),

whitetip reef shark (*Triaenodon obesus*), blacktip reef shark (*Carcharhinus melanopterus*), and tawny nurse shark (*Nebrius ferrugineus*). Preliminary analyses showed a highly significant negative relationship between grey reef and galapagos shark densities and proximity to human population centers (e.g., proxy for potential fishing pressure and other human impacts). Average combined numerical density for these two species near population centers was less than 1% of densities recorded at the most isolated islands (e.g., no human population, very low present or historical fishing pressure or other human activity). Even around islands with no human habitation but within reach of populated areas, gray reef and galapagos shark densities were only between 15 and 40% of the population densities around the most isolated near-pristine reefs. Trends in whitetip and blacktip reef shark numbers were similar, but less dramatic. Tawny nurse shark densities were low around most islands. This study is the first fisheries-independent large-scale survey of reef shark populations in the central Pacific. From our preliminary results we infer that some shark populations near human population centers are severely depressed.

0330 AES Food & Feeding, Kafka/Lamartine, Saturday July 26, 2008

Feeding Behavior of the Megamouth Shark, *Megachasma pelagios* (Lamniformes, Megachasmidae)

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Since the discovery of the first megamouth shark in 1976 to date (March 31, 2008), 40 individuals have been captured, landed or witnessed in the world. However, very few is known about its biology, except some spotty information. The megamouth

shark is known to feed on planktonic animals, same as the basking shark and whale shark. A female megamouth of 5440 mm in total length, which is the 10th individual and was captured in Mie Prefecture, Japan, was dissected to resolve the feeding behavior of the megamouth shark. The morphological examination of the specimen disclosed that the megamouth shark has a suite of unique characteristics among sharks, such as a large mouth, a long bucco-pharyngeal cavity, a large tongue, a flat and wide chondrocranium with a deep rostral groove below rostral cartilages, extremely elongate jaw cartilages, long hyomandibular and ceratohyal cartilages, long palatoquadrate levator and preorbital muscles, a wide "palatorostral" ligament, long ethmopalatine ligaments, and elastic skin around the pharynx underlain by two layers of very loose elastic connective tissue. The basking shark is known to perform continuous ram-filter feeding, and the whale shark performs suction and ram-filter feeding. The megamouth shark was considered to be a suction feeder before, but such unique characters in the megamouth shark mentioned above suggest that the megamouth shark developed an engulfment feeding that is typically seen in the rorqual and humpback whales.

0722 Poster Session II, Saturday July 26, 2008

Population-level Comparisons of Enzyme Activities in Venom of the Florida cottonmouth, *Agkistrodon piscivorus conanti*

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Snake venom composition is known to vary both among and within species, and this variation may translate into differences in prey acquisition and digestion. Published studies have shown strong correlations between local diet and venom composition in viperid snake species. In this study, we determined general protease and hyaluronidase activity from venom samples collected from three different populations of Florida cottonmouth, *Agkistrodon piscivorus conanti*. We hypothesized that there would be variation in the enzyme activity due to a difference in venom composition and these differences would correlate with differences in diet. We predicted that snakes from an insular population would have the lowest activity, because these snakes subsist mainly by scavenging carrion (fish dropped or regurgitated by colonially-nesting birds), rather than by actively envenomating prey like most mainland populations do. Cottonmouths were collected from three geographically-distinct populations in Florida: an insular population on the island of Seahorse Key (SHK), located ~11 km off the west coast; Lower Suwannee National Wildlife Refuge (LS), located adjacent to SHK on the mainland; and Paynes Prairie Preserve State Park (PP), located ~100 km east of LS. Venom was extracted from anesthetized snakes and lyophilized. Individual venom samples were reconstituted and assayed for general protease and hyaluronidase activity using a modified spectrophotometric microplate assay. Here we report on these enzymes in terms of kinetics values, activities per protein, and total activity potential per snake. We also examine natural intrapopulation variation and potential interpopulation activity and diet correlations.

0178 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Road-kill Survey of Alabama Red-bellied Turtles on the Mobile Bay Causeway

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A systematic, road-kill survey was conducted (by bicycle or automobile) on the Mobile Bay Causeway from April 2001 to December 2007 to assess the numbers of Alabama red-bellied turtles (*Pseudemys alabamensis*) killed by automobile traffic. A federally endangered species, *Pseudemys alabamensis* has been designated as the official "Alabama state reptile." A total of 553 road-killed Alabama red-bellied turtles were recorded over the seven-year study: 420 hatchlings, 116 adult females (most gravid), 13 juveniles, and 4 males. A majority of hatchlings (96%) overwintered in the nests to emerge during the following Spring (March-May). Fewer

numbers of hatchlings (4%) emerged during the Fall (October and November) of the same year. Direct hits by hurricanes apparently resulted in fewer roadside mortalities of hatchlings (as they were drowned or emerged prematurely). The mortality of adult females (N=116) was greatest (92%) during the nesting season: May, June, July. Each year from 5 to 34 (mean=16.6) nesting females, mostly gravid, were killed by vehicular traffic on the road. Because of the limited availability of favorable nesting sites in the lower delta, gravid females are apparently attracted to the shoulders of elevated roadsides where they deposit eggs (and may incur mortality). A chain-link fence is currently being installed by the Alabama Department of Transportation to reduce the road-side mortality of turtles along the Mobile Bay causeway. Partial funding was provided by the Alabama Department of Conservation & Natural Resources and the U. S. Fish and Wildlife Service.

0391 Fish Ecology II, Salons A&B, Monday July 28, 2008; STOYE ECOLOGY & ETHOLOGY

Effects of Latitude and Depth on Fish Species Diversity of the Northwest Atlantic Ocean

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Numerous explanations for gradients in species diversity have been developed over the past century. Previous evidence suggests that gradients of depth and latitude may explain patterns of marine fish diversity. Macpherson and Duarte (2002) found that diversity increased with depth and decreased with latitude; however, mid-domain models predict diversity peaks at intermediate levels along a gradient. I documented patterns of species diversity across latitudinal and depth gradients in the Northwest Atlantic Ocean. I predicted that diversity would be highest at intermediate levels along both depth and latitudinal gradients, following mid-domain models. Winter fish surveys were conducted in January, from 2005-2008. Fishes were collected using a 10.1m yankee otter trawl. During 2005-2007, diversity was highest at southern latitudes and also in deeper water, suggesting mid-domain effects do not influence species diversity. During January 2008, I implemented a study design to more effectively test for mid-domain effects with transects that covered six latitudes (39°54.29'N-36°02.99'N) and three depth strata (0-96.3m). In January 2008, 17,671 fish were caught, comprising 25 different species. Rarefaction was used to compare species diversity at the highest common abundance for depth and latitude. The deepest depth stratum (70-96.3m) was the most diverse, consisting of 17 species. The most diverse fish communities (12 species each) occurred at extreme latitudes (39°04.88'N (northern) and 37°01.46'N (southern)). Therefore, mid-domain models did not accurately predict peaks of species diversity for fishes of the Northwest Atlantic Ocean. Depth may have the greatest influence on species diversity of winter fish assemblages; however, the interaction of depth and latitude on fish species diversity requires further investigation.

0571 Fish Ecology II, Salons A&B, Monday July 28, 2008

What Makes Mangroves Good Habitats For Fish? Spatial Variations in Mangrove Fish Communities at South Caicos, Turks And Caicos Islands

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Mangroves serve as essential fish habitat, often acting as nursery areas and providing shelter or food for many species of reef fish. While protected in US waters, mangroves lack protection throughout much of the Caribbean, and subsequently the species they support are often vulnerable to anthropogenic disturbance. Mangrove and nearby seagrass fish communities and habitats were quantified around South Caicos, Turks and Caicos Islands, between 24th July and 20th October 2007 using visual surveys. Seventy three species of fish were identified from 250 visual surveys conducted at 10 different sites. Ninety three percent of these species are associated with reefs as adults. Fish community diversity and abundance were site specific (Kruskal-Wallis $P < 0.01$), and principle component analysis identified four groupings of mangrove sites based on species densities. Diversity, abundance and sizes of five important fish families (snapper, grunts, barracuda, parrotfish, and mojarra) were compared with six environmental variables: distance from reef, minimum water depth, proximity to deep water, mangrove prop root density, benthic composition and seagrass biomass. Mangrove community diversity showed positive relationships with prop root density ($R^2 = 0.50$) and macroalgal coverage ($R^2 = 0.13$), but negative relationships with turtle grass coverage and biomass ($R^2 = 0.72$ & 0.48 respectively). Abundance and diversity peaked at the mangrove-seagrass interface, and declined with increasing distance from the mangrove fringe (Kruskal-Wallis, $P < 0.01$). Variations in size compositions of the five fish families were compared using cluster analysis, and will be discussed. South Caicos is threatened by escalating tourism development, with mangroves still unprotected in the Turks and Caicos Islands. It is essential that the factors that make mangroves suitable habitat for fish are understood to enable effective management of mangroves, fish and the fisheries that are dependent upon them.

0659 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT SYSTEMATICS/EVOLUTION

Dewlap Color and Reproductive Isolation in *Anolis distichus*

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The dewlap of *Anolis* lizards is a characteristic trait that features prominently in male signaling displays. It varies widely in color and pattern both amongst and within species, and has long been thought to play an important role in speciation and diversification during the adaptive radiation of anoles. I explore this concept in the *Anolis distichus* group, which represents six species and over twenty subspecies that exhibit striking polymorphisms in dewlap color and pattern. I use phylogenetic analyses of mitochondrial and nuclear markers, and assays of gene flow based on microsatellite markers to test whether dewlap coloration correlates with reproductive isolation.

0385 Poster Session II, Saturday July 26, 2008

Ecology And Natural History Of The Knight Anole, *Anolis equestris*

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While many species of anole lizards exist, few have been studied in any detail, and nearly nothing is known regarding canopy dwelling species. The Knight Anole, *Anolis equestris*, is a canopy dweller and one of several species classified as a "crown-giant" ecomorph. Little is known regarding crown-giant ecomorph ecology and natural history as their cryptic coloration and elevated habitat preferences make them difficult to study. We studied a population of *A. equestris* in Miami, FL to test hypotheses regarding home range size and spatial arrangements and to investigate its natural history. We compared and contrasted our results to those of other anoles, and show that while some similarities exist, *A. equestris* lifestyles are quite different from better studied *Anolis* species. Generalizations are difficult to make until other crown-giant species are investigated and compared but it seems clear that canopy dwelling imposes restrictions and alters potential spatial arrangements and conspecific interactions not experienced by more ground-dwelling species.

0488 Poster Session III, Sunday July 27, 2008

Effect of American Beaver Dams and Impoundments on Endangered Okaloosa Darters

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The American beaver (*Castor canadensis*) is considered an ecosystem engineer because it builds and maintains dams that profoundly alter biotic and abiotic conditions in lotic systems. Once on the brink of extinction, limits on harvesting and extirpation of natural predators have resulted in explosive population growth and range expansion of this keystone species. One consequence of this demographic success story is that high densities of beavers can impound significant portions of streams and adversely affect species that prefer lotic conditions. We report herein on a 'natural experiment' in which beavers colonized and impounded one of our long-term sites (Rogue Creek) used to monitor population status of endangered Okaloosa darters (*Etheostoma okaloosae*). Okaloosa darters are restricted geographically to six small stream systems that flow into Choctawhatchee Bay in northwestern Florida. These streams are relatively clear with moderate flow and extensive sandy substrate. Okaloosa darters reside mostly along the margins of these streams in association with aquatic plants, roots, and other forms of cover. Construction of a beaver dam immediately downstream of our monitoring site on Rogue Creek resulted in impoundment, increased water depth, greatly decreased flow, accumulation of flocculent organic material, variable water temperatures, and increased abundance of larger, potentially predatory fishes. Abundance of Okaloosa darters at Rogue Creek decreased significantly within one year of impoundment, but did not decrease at our other monitoring sites. Subsequent removal of the beaver dam led to restoration of pre-dam hydrologic conditions and re-colonization by Okaloosa darters within one year. This study supports the hypothesis that beavers are ecosystem engineers and indicates that endangered Okaloosa darters are resilient to transient and localized changes in hydrologic conditions. We are now conducting a spatially extensive study incorporating a broad range of stream sizes and types to more fully evaluate the effects of American beaver on Okaloosa darters.

0503 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Molecular Systematics Of The Geckos Of New Zealand

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The gecko fauna of New Zealand comprises 18 recognized species of extant geckos, and one extinct form, in two genera, *Hoplodactylus* and *Naultinus*. However, past research using allozymes and more recent molecular work using mtDNA sequence data found evidence for up to 37 independently evolving lineages. Both data sets

yielded strong support for three monophyletic species groups within *Hoplodactylus* as well as a monophyletic *Naultinus* clade, but patterns of interrelationship between these clades were incongruent. I used a combination of nuclear (RAG-1 and phosducin) and mitochondrial (ND2 and 16S) markers to estimate relationships between 158 specimens representing all species, both recognized and proposed, using maximum parsimony, maximum likelihood and Bayesian inference. I found strong support for most of the putatively new species proposed in earlier analyses. *Naultinus* and *Hoplodactylus* are not reciprocally monophyletic, as *Naultinus* is nested within the subclades of *Hoplodactylus*. Each of the subclades of *Hoplodactylus* retrieved by the earlier analyses (the *maculatus*, *pacificus* and *granulatus* groups) is well supported, as are two distinct monotypic lineages (*H. rakiurae* and *H. stephensi*) identified in this study. Although mitochondrial and nuclear data support differing topologies, there are no strongly conflicting nodes between the data sets and a combined analysis produced the best estimate of the relationships of New Zealand geckos. Divergences within the subclades range widely in their relative ages. The earliest cladogenesis within New Zealand geckos appears to be mid-Tertiary in age and may post-date the Oligocene marine transgression, but relationships of the New Zealand clade as a whole to its closest relatives in New Caledonia and Australia may reflect Gondwanan connections.

0066 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Rearing of Mantas and Mobulids

Kiyonori Nishida, Hiroshi Obata, Minoru Shimomura, Hideto Nakagawa, Takahiro Inoda

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Osaka Aquarium KAIYUKAN has been engaged in exhibiting elasmobranch fishes since its opening in 1990. Especially, a manta ray (*Manta birostris*) is one of popular species as well as a whale shark (*Rhincodon typus*) due to its unique shape and its size. Subfamily Mobulinae including two genera (*Manta* and *Mobula*) and 10 species (Nelson, 2006) inhabit the waters from the tropical to the temperate zone. Four species such as *Manta birostris*, *Mobula eregoodootenkee*, *M. japanica* and *M. tarapacana* are well known to inhabit the sea region around the Japanese archipelago. KAIYUKAN built the Osaka Aquarium Biological Research Institute of Iburi Center in Iburi, Tosashimizu City, Kochi Prefecture on the coast of the Pacific Ocean, and has been engaged in collection and research of exhibiting sea life. The research has been continued for our exhibition, since in the fisherman's set-net around the research center, three species such as *Manta birostris*, *Mobula eregoodootenkee*, and *M. japanica* are sometimes captured with other fishes. KAIYUKAN transported *Manta birostris* which was captured in the set-net off Tosashimizu to the Osaka Aquarium taking about 14-16 hours. KAIYUKAN has tried to keep and exhibit it five times in the Pacific Ocean tank which water capacity is 5,400 tons until now. The shortest exhibiting period was two days and the longest one is updating its period since its carrying in on December 14, 1999 (DW: 1800 mm) in good condition. Its disc width reached 3000 mm on November 1, 2007. KAIYUKAN transported *Mobula eregoodootenkee* to the Osaka Aquarium and has observed the behavior of it (DW:

about 600-700 mm) in the fish pen installed in the port in front of our research center and in the large tank which containing 1600 tons of water. KAIYUKAN has not done long-distance carriage of *Mobula japonica* to the Osaka Aquarium yet, but has kept it in the large tank of Iburi Center since January 23, 2008 (DW: 2200 mm). This article introduces the appearance in the water around our research center, the information gained in the fish pen and the large tank of our research center, skills of long-distance carriage to Osaka and information acquired from rearing in the large sized exhibition tank.

0172 Poster Session II, Saturday July 26, 2008

The Effects of Density on the Reproductive Success of Alternative Mating Tactics in Male Wood Frogs (*Rana sylvatica*)

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Alternative mating tactics are a form of resource polymorphism where males diverge in their morphology or behaviour to compete for females. Anurans have been classified as utilizing a reversible conditional strategy where the same individual can employ multiple tactics. Demographic and ecological variables have been suggested to be important factors affecting the fitness of conditional strategies; however, few studies have tested their effects on the reproductive success of alternative tactics. I will test how density affects the reproductive success of conditional mating tactics in wood frogs, in southern Ontario, from 2008 to 2009. This will be accomplished by drift fencing four ponds and creating high and low-density treatment plots. Approximately 500 frogs will be captured, marked, toe-clipped and measured each year. Males and females will then be randomly assigned to a plot and male behaviour classified using scan sampling. Egg masses will be collected and parentage will be assessed using four polymorphic microsatellite DNA loci. The proportion of eggs sired by a male will be used as a measure of his reproductive fitness. I hypothesize that under high-density situations a calling male's reproductive success will decrease due to a greater abundance of satellite males and the greater probability of multiple paternity. This study will be a significant progression in our understanding of how density-dependent effects maintain male polymorphisms in animals and will aid in generating more sophisticated conditional strategy models.

0603 Fish Ecology II, Salons A&B, Monday July 28, 2008

The Simultaneous Effects of Egg Size and Ration on Fry Survival and Growth in Oceanic Threespine Stickleback (*Gasterosteus aculeatus*)

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Egg size is a life-history trait that may often be subject to strong selection, yet the effect of selection varies as a function of the environment in which the offspring exists, and also as a function of the abilities of competing offspring. Using two oceanic populations of threespine stickleback from the Cook Inlet region of Alaska, we conducted a competition experiment to estimate the simultaneous effects of egg size and ration on juvenile size at one month of age. This is approximately the age at which these juveniles leave the spawning grounds for the ocean environment in which they will grow for 1-2 years. First-feeding fry from clutches of known egg size competed for planktonic food offered at three levels: ad lib, moderate, and low. Each experimental replicate paired fry from two sets of parents in which the female's egg size was known, with the relative difference in starting egg size in the pair-wise competition experiments ranging from 15% to 33%. The proportion of fry surviving to one month of age increased with ration, but no direct, independent effect of egg size was observed; a weak interaction between egg size and ration was present, however. The size of surviving fry at 30 days of age was a positive function of both ration and egg size. Slopes of the length-mass relationship did not differ for large or small eggs, or for rations of different size. However, mass adjusted for SL ("condition") was greatest at the lowest ration. The strength of the egg size effect was moderated by the difference in the starting egg sizes of competing fry.

0614 Poster Session I, Friday July 25, 2008

Evaluation of a Magnetic Barrier on Juvenile *Negaprion brevirostris*: Preliminary Results

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Nets used to protect human-populated beaches from sharks are a significant contributor to elasmobranch mortalities. Mechanisms that can reduce these types of mortalities are then desirable. Recent evidence suggests that elasmobranchs avoid strong magnetic fields. We investigated the behavior of captive juvenile lemon sharks (*Negaprion brevirostris*) towards a magnetic barrier dividing a pen enclosure. This barrier was constructed along the diameter of the cylindrical pen and contained two 0.25 m² openings on either end of the fence. The magnetic opening (treatment) was surrounded by four C8 BaFe₂O₄ permanent magnets which measured approximately 400 Gauss at the surface. The control opening was surrounded by four clay bricks of similar size and shape to the magnetic treatment with no

measurable magnetic field. The sharks were encouraged to swim from one side of the pen to the other by introducing fish juice (blood, fish oil, etc.) into the region of the pen opposite the sharks. Results indicated that *N. brevirostris* detected and were sensitive to the magnetic flux and avoided the magnetic treatment while swimming through the control a greater number of times. The sharks demonstrated greater avoidance behavior (i.e. accelerations away from, 90° or 180° turns) to the region containing permanent magnets when compared to the controls. These data suggest that a selective shark exclusion magnetic barrier, in addition to the shark-nets on human populated beaches, may reduce elasmobranch mortality associated with shark-nets.

0049 Poster Session III, Sunday July 27, 2008; STORER ICTHYOLOGY

Developing a Basis for Convergence: Ontogeny of the Zebrafish Pharyngeal Jaw Apparatus

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Cypriniforms (cyprinids, balitorids, catostomids, and cobitids) are an interesting group of fishes in that they possess a number of morphological novelties of the pharyngeal jaw apparatus (PJA). These include: (1) a muscular sling controlling movement of the lower pharyngeal jaws; (2) loss of the upper pharyngeal jaws; and (3) a pharyngeal pad on the basioccipital that has taken the place of the upper pharyngeal jaws. The cypriniform muscular sling originates on the neurocranium and inserts on ceratobranchial 5, and serves to adduct the pharyngeal jaws against a horny pad on the basioccipital. We hypothesize that the muscular sling is formed from a posterior shift and change of insertion point of the levator posterior muscle, much like that found in the muscular sling of the PJA in cichlids. This indicates that the muscular slings of these fishes have evolved convergently. Before we can assess whether they are indeed convergent we need to understand early development of this novelty. Using a popular cypriniform model organism, *Danio rerio*, we examined the cypriniform PJA from a developmental perspective, with emphasis on the development on the musculature of the pharyngeal sling. Here we present developmental data of musculoskeletal structures going from larvae to adults. Morphological analyses using clearing and staining, histology, and immunohistochemistry revealed that the muscles of the PJA develop in larvae as early as 4 days post fertilization. However, some bony elements (epi- and pharyngobranchials) do not form until the fish is 4.4 mm in length, at which point larvae are approximately two weeks of age. These findings suggest that the musculature of the pharyngeal sling is established early on in development, well before the fish is feeding. As a result, we are provided with key developmental time points on which future convergence studies of the muscular sling can be based.

0564 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

Artificial Maturation, Fertilization and Early Development of the American eel, *Anguilla rostrata*

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The catadromous life cycle of the American eel, coupled with spawning occurring somewhere in the Sargasso Sea, has limited our understanding of the reproductive biology of the species. While gametogenesis begins in the freshwater phase, final maturation and spawning have never been observed. The American eel is a panmictic species, and some evidence suggests it is in a state of decline. This decline may be the result of eels spending many years accumulating contaminants and then passing these on to offspring during reproduction, and therefore reducing spawning success. This study was designed to determine if American eels could be reproducibly matured and fertilized in the laboratory. Eels were collected while migrating from freshwater at the onset of the silver migration in the fall of 2007. Males were maintained in a recirculation freshwater system and received weekly injections of Human Chorionic Gonadatropin (HCG). Females were maintained in a flow through marine system that was maintained at 20 °C and given weekly injections of Salmon Pituitary Extract (SPE). Males produced viable sperm after 4 weeks of injection and females reached maturity in 7-11 weeks. Final maturation in females was determined by a combination of 1) increase in body weight and 2) increase in egg size and developmental stage, determined by biopsy. Upon reaching final maturation females were induced to ovulate by a single injection of (17 α ,20 β -Dihydroxy-4-pregen-3-one; DHP). Fertilization could be confirmed after 4 hrs by the observation of embryos at the 16-32 cell stage. Somite formation was observed after 24 hrs and hatching occurred 42-72 hrs after fertilization. This is the first laboratory fertilization that has resulted in complete embryogenesis and hatching for the species and provides an opportunity to examine aspects of the reproductive biology previously unavailable.

0072 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Reproductive Biology of the Crocodile Shark, *Pseudocarcharias kamoharai* (Matsubara, 1936), from the Southwestern Atlantic Ocean

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The monotypic crocodile shark, *Pseudocarcharias kamoharai*, is commonly caught, as by-catch, in the tuna longline fishery worldwide. Despite its common occurrence, many details of its reproductive biology are still poorly known. We studied the reproductive biology of crocodile sharks using 490 specimens (313 females and 177 males) captured in 2005-2007 by the commercial tuna longline fleet operating in the southwestern Atlantic Ocean. Maximum observed total lengths (TL) were 122 and 109 cm for females and males, respectively, with a mode in both sexes at 90-100 cm. Sexual maturity was attained at about 84- 94 cm TL in males and at about 90 cm TL in females. Results suggested that the crocodile shark gives birth throughout most of the year, peaks in July when the frequency of females bearing near-term pregnant specimens was highest.

0403 Fish Systematics III, Drummond, Saturday July 26, 2008

A larva of *Grammicolepis brachiusculus* (Zeiformes, Grammicolepididae)

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While sorting through unidentified larval fishes in the collections of the Southeast Regional Taxonomic Center (Charleston, SC), we found the first larval example of the thorny tinselfish *Grammicolepis brachiusculus*. The tinselfishes, family Grammicolepididae, comprise three genera (*Macrurocyttus*, *Xenolepidichthys* and *Grammicolepis*), all meso- to bentho-pelagic zeiform fishes with worldwide distributions. The family is distinctive in the possession of narrow, vertically elongate scales, a feature that develops preciously and allowed easy identification of our small flexion specimen (7.8 mm NL; 7.5 mm SL). The larva is further characterized by elongate first pelvic and second dorsal-fin spines, a serrate supraocular ridge on the frontal, two serrate ridges on the preopercle, thin elongate spines on the opercle and scattered pigment with concentrations on the caudal peduncle, jaws and head. The larva of *Grammicolepis* is more elongate than that of *Xenolepidichthys* and lacks an elongate anal spine. The larva of *Macrurocyttus* is unknown.

0554 General Ichthyology I, Drummond, Saturday July 26, 2008

New Snailfishes of the Genera *Careproctus* and *Paraliparis* (Liparidae) from the North Pacific Ocean, Bering Sea, and Sea of Japan

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Progress in the taxonomy of liparids of the genera *Careproctus* and *Paraliparis* from the North Pacific will be described. A morphological and molecular examination of *Careproctus rastrinus* and *C. trachysoma* was conducted on material collected in the Gulf of Alaska, Bering Sea, Aleutian Islands, Sea of Japan, and off the Pacific coast of Japan. Neither *C. rastrinus* nor *C. trachysoma* was found to be monophyletic. Two clades of "*C. trachysoma*" were identified from the Sea of Japan, although their relationships are unclear. Four clades of "*C. rastrinus*" were resolved within the North Pacific, including two in the Bering Sea and two in the Sea of Japan and off the Pacific coast of Japan. The nomenclatural status of three names that have previously been considered synonyms of *C. rastrinus* will be discussed. Work on new species of *Paraliparis* will also be described, including the descriptions of two new species from the Bering Sea slope. One of the new species is similar to *P. dipterus*, known only from the holotype collected in Japan, and the other is similar to *P. pectoralis*, a species common along the coast of North America from Alaska to California.

0625 Poster Session I, Friday July 25, 2008

DeepFin Research Coordination Network Update: News and Opportunities to Build the Tree of Life of Fishes

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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 2008 to provide funding for undergraduate and graduate students with new research opportunities. These students are 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 will be used to cover travel and room & board expenses for students visiting other labs for periods of up to three months. During 2008 a new data base with phylogenetic resources, especially molecular markers will become available online. Commonly used genetic markers, methodological information, and their phylogenetic utility will be available at the Deepfin home page (www.deepfin.org). Other resources and opportunities for collaboration will be displayed on the poster.

0736 Fish Systematics II, Salons A&B, Friday July 25, 2008

Phylogeny and Time-frame for the Diversification of Sticklebacks based on New Fossil Evidence and Nuclear Gene Sequences

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Phylogenetic relationships among genera of the family Gasterosteidae have been notoriously difficult to resolve with confidence in spite of significant effort to synthesize evidence from morphological, behavioural, and mitochondrial DNA data. We present new evidence from DNA sequences of ten nuclear genes currently being used for broad-scale phylogenetic studies of euteleosts. Maximum likelihood and Bayesian analyses of these sequences alone and in combination with previously published data result in a new hypothesis for the evolution of this family of fishes. Available fossil data in combination with a recently described fossil of *Gasterosteus aculeatus* are used to establish upper and lower bounds for the diversification of this group under a Bayesian framework of molecular dating.

0698 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Evolutionary Ecology of Fossorial Specialization in *Plestiodon reynoldsi*: A Comparison with *Plestiodon egregius* in the Florida Scrub

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Despite their marked differences in morphology, ecology, and life history, recent phylogenetic analysis has confirmed the close relationship of the sand skink (*Plestiodon reynoldsi*) and mole skink (*Plestiodon egregius*). The sand skink, a fossorial lizard with highly reduced limbs, is restricted in range to scrub and sandhill habitats on the ridges of central Florida, an ecosystem that is considered a relic of the xeric conditions of the late Pliocene. While the mole skink has a larger range that extends beyond Florida, molecular evidence shows that all current populations of both species have radiated from their respective Lake Wales Ridge populations. This sympatry of their ancestral populations in an ecosystem that has changed little over millions of years creates a unique system in which the conditions that have contributed to their divergence can be studied. We captured both species at a site in Davenport, FL, located on the central portion of the Lake Wales Ridge. Habitat data from 210 trap arrays were used to define the microhabitats of each species based on capture results (n=560 sand skinks, 47 mole skinks). Temperature logger data from their respective microhabitats were compared with the results of preferred temperature trials conducted in the laboratory. Preliminary analyses indicate that species are aggregating within smaller areas of the trapping site and that the presence of each species is correlated with differing habitat characteristics. The significantly higher temperature preferred by the sand skink in the laboratory is consistent with its occurrence in open, low-shade areas and its warmer mating season. The morphological differences between *P. reynoldsi* and *P. egregius* were also quantified using ten morphometric measurements of each individual captured, and the observed morphological, ecological, and physiological differences are compared with published trends of fossorial specialization in other genera.

0655 Poster Session I, Friday July 25, 2008

Population Genetic Patterns among Phenotypically Divergent Thorny Skate (*Amblyraja radiata*) Populations from the Western Gulf of Maine

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Within the western Gulf of Maine, we have identified two different size groups of the thorny skate, *Amblyraja radiata*: a larger group of sexually mature skates that has an average total length of 91.5 cm, an average weight of 16.5 lbs, and an average age of 15.1 years, and a smaller group of sexually mature skates that has an average total

length of 59 cm, an average weight of 4 lbs, and an average age of 9.4 years. In order to determine whether these two groups are genetically isolated from each other or from populations in Canada that are phenotypically similar to the small Gulf of Maine group, we developed microsatellite loci to examine population genetic structure. The following two hypotheses were investigated: 1) smaller, early-maturing thorny skates are migrating from Canadian waters into the Gulf of Maine, and 2) large and small size groups of sexually mature thorny skates are reproductively isolated and do not belong to a single genetically cohesive species. Preliminary data from 5 microsatellite loci suggest that the two Gulf of Maine groups are not genetically isolated from one another nor is either group distinct from the Canadian skates ($F_{ST} = 0.013$). Data from additional microsatellite loci will be incorporated, and the levels of exchange between the two Gulf of Maine phenotypic groups between the Gulf of Maine and Canada will be reported. (Supported by the New Hampshire Sea Grant Program)

0658 Poster Session III, Sunday July 27, 2008

Habitat Suitability Index Models for the Wood Frog (*Rana sylvatica*) and Boreal Chorus Frog (*Pseudacris triseriata maculata*) in the Foothills Parkland Natural Sub-region and Bow River Basin, Alberta

Zachary Otke

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A habitat suitability index model was developed for the wood frog (*Rana sylvatica*) and the boreal chorus frog (*Pseudacris triseriata maculata*) in the Foothills Parkland Natural Sub-region and Bow River Basin in west-central Alberta. The habitat suitability index models are based on habitat characteristics that had significant relationships with the maximum ranks determined from night calling surveys. The models were first derived from literature that was related to wood frog and boreal chorus frog habitat and then verified in the field. For the wood frog and boreal chorus frog, fish presence, water movement, and dominant vegetation were significant habitat variables. The significant habitat variables for each amphibian were integrated into a model that can be used to determine the baseline quality of habitat within the geographic area. The habitat suitability index models can also be used to determine how future changes in the geographic area will impact each amphibian's population dynamics. The models may not be very accurate due to a small sample size and one sampling season, but the models show habitat variables that need to be taken into account for future research and conservation of each amphibian. The acceptable output of the models can be increased as more research on wood frog and boreal chorus frog habitat within the geographic area is conducted.

0405 Poster Session II, Saturday July 26, 2008

The Developmental Effects of Coprophagy and Identification of Cellulolytic Bacteria in Green Frog Tadpoles, *Rana clamitans*

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We investigated coprophagy in green frog tadpoles, a nutritional strategy known to be beneficial in the development of other species of anuran larvae. Tadpoles were raised from a single egg mass deposited in late summer. After hatching, larvae were housed individually in the laboratory to eliminate any density dependent effects on development. Tadpoles were provided with rodent food high in cellulose. Half of the tadpoles were given access to their feces, and the other tadpoles were separated from their feces by mesh fabric attached five mm above the bottom of each container. Both groups developed at the same rate as assessed by Gosner stage. However, tadpoles with access to their feces were longer and weighed more than tadpoles without access to their feces. Coprophagy in green frogs may allow individuals to metamorphose at larger body sizes. Standard microbiological techniques were used to confirm the presence of cellulose digesting bacteria. Initial results suggest that the cellulolytic actinomycete, *Cellulomonas*, is present in the gut and on free feces. These bacteria could provide increased nutritional benefit by digesting cellulose within the intestine and by growing on feces that are later consumed.

0592 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Effect Of Thyroid Hormone Concentration On The Transcriptional Response Underlying Induced Metamorphosis In The Mexican Axolotl (*Ambystoma*)

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Thyroid hormones induce gene expression programs that orchestrate amphibian metamorphosis. In contrast to anurans, many salamanders do not undergo metamorphosis in nature. However, they can be induced to undergo metamorphosis via exposure to thyroxine (T₄). We induced metamorphosis in Mexican axolotls (*Ambystoma mexicanum*) using 5 and 50 nM T₄, collected skin from the head at four time points (days 0, 2, 12, 28) and used microarray analysis to quantify mRNA abundances. All animals exposed to 50 nM T₄ initiated morphological and transcriptional changes earlier and completed metamorphosis by day 28. Initiation of metamorphosis was delayed in animals exposed to 5 nM T₄ and none of these animals completed metamorphosis by day 28. We identified 402 genes that were statistically and two-fold differentially expressed between T₄ treatments at one or more non-day 0 sampling times. In addition, we used linear and quadratic

regression to identify 542 and 709 genes that were differentially expressed by greater than two-fold in the 5 and 50 nM T₄ treatments, respectively. We found that T₄ concentration affected the timing of gene expression and the shape of temporal gene expression profiles. However, essentially all of the identified genes were similarly affected at both dosage levels. Our results indicate that while many common genes underlie the transcription profile during metamorphosis in salamanders and frogs, characterized in *Xenopus laevis*, there are a substantial number of differences.

0192 Fish Morphology & Histology II, Salons 6&7, Saturday July 26, 2008

A Multivariate Approach To Understanding The Mechanics Behind Ram Suspension Feeding

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Filter feeding fishes consume vast numbers of tiny (5-3000 microns) prey by filtering immense quantities of water through their oropharyngeal cavity. Differential anatomies between cartilaginous and bony fishes suggest differences in suspension feeding mechanisms. Endoscopic video has demonstrated that some pump suspension feeding teleosts (eg. goldfish, shad and several species of tilapia) filter food particles by some form of cross-flow filtration. Conversely, models of ram suspension feeders (eg. herring, anchovies, mobulas, etc) suggest that the gill rakers likely function as a sieve or sticky filter, separating food particles from the egressing water. Computational fluid dynamic (CFD) models of ram suspension feeding fish have helped visualize water flow through the oropharyngeal cavity, yet the method of particle retention remains unexplored. To better understand the role morphology and fluid flow play on particle retention in a simplified cylindrical buccal cavity we measured retention of an array of particle sizes (40-2000 microns) of a simple physical model of a ram feeding fish. We varied the buccal length, flow speed and the architecture of the gills slits; including the number, size, orientation, pore size, and permeability of the model. Models were placed in a recirculating flow tank with neutrally buoyant plankton-like particles collected at the oesophagus at a swallowing rate of 8.2 mL water/min and at the gill rakers to locate the highest density of particles accumulation. At low gill permeability and high water velocity, particles were captured primarily through sieve filtration. Increasing gill number resulted in selectivity for swallowing smaller sized particles and also decreased sieve clogging while increasing the velocity of the vortex located near the oesophageal valve. Reduced buccal length increased particle ejection out the mouth. The optimum pore size for ingestion without sieving was approximately 1000 microns. These results suggest that the filtration mechanics of suspension feeding is closely linked to the structural design of the buccal cavity and gill slits.

0695 Poster Session I, Friday July 25, 2008

Reproductive Aspects of the “Mariquita” Stingray, *Dasyatis marianae*, of the Northeast Brazil

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The mariquita stingray, *Dasyatis marianae*, is a small species with a restricted distribution along the shallow and reef waters of Northeast Brazil. Although this is a regular catch compound of the local artisanal fisheries, only recently it was recognized as a valid species and formally described. As part of a larger program to provide biological information on poorly known batoid fishes under fishery effort, we started to sample specimens from the artisanal fishery of Almofala beach, State of Ceará, Brazil. Seventy seven specimens (22 males and 55 females) were daily sampled from October/2007 to March/2008 and preserved in formalin for laboratorial analysis of reproductive and feeding aspects. Males ranged in size from 148 to 295 mm disc width-DW and females from 140 to 366 mm DW. Females mature at 300 mm DW and males mature between 240-255 mm DW (based on clasper growth). Birth seems to occur when embryos reach 140 mm DW (the smallest free swimming specimen recorded was 140 mm DW and the largest embryo was 150 mm DW). Uterine fecundity was always only one embryo per litter, and ovarian vitellogenesis was concomitant with pregnancy. Only the left ovary and the left uterus develop for reproduction, while the right counterparts remain undeveloped. These reproductive features allied to its high endemism bring concern on the conservation of the species and possible local extinctions where it is presently exploited.

0083 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

Movements and Foraging Success of Blacktip Reef Sharks, *Carcharhinus melanopterus*, at Palmyra Atoll: A Predator Dominated Ecosystem

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Understanding the ecological impacts of apex predators in pristine habitats can provide baseline information for more effective conservation and fisheries management. We utilized acoustic telemetry and stable isotopes to correlate movements with foraging ecology of blacktip reef sharks, *Carcharhinus melanopterus*, at Palmyra Atoll, a US Federal Wildlife Refuge. Palmyra consists of two large lagoons and sharks rarely showed movements between lagoons. Sharks in the west lagoon had small home ranges, showed selection for ledge habitats, and utilized patches that were 3 - 17 % of the scale of their home range. Sharks in the west

lagoon had larger body condition indices, and longer residence times than those in the east lagoon. Stable isotopes show that shark length has no influence on trophic level for sharks in the west lagoon, as opposed to those in the east lagoon which show a linear increase in trophic position with shark length. Together these findings suggest that foraging success of sharks is greater in the west lagoon, and also highlights the importance of habitat on the ecology of apex predators, even over small spatial scales.

0744 Herp Reproduction, Salons 4&5, Sunday July 27, 2008

Change in pheromone quality in snakes after low-temperature dormancy

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Hibernation is a critical period in the lives of most temperate vertebrates, and its role in affecting the quality and timing of reproduction has not been adequately assessed in reptiles. The red-sided garter snake (*Thamnophis sirtalis parietalis*) synchronizes its maximal reproductive effort with emergence from hibernation when mate density is highest. In the Interlake Region of Manitoba, Canada, thousands of red-sided garter snakes emerge from limestone hibernacula, with males exhibiting robust, intense courtship behavior in response to the female's sexual attractiveness pheromone. Mate choice in this system is mediated through the quality of the female's pheromone profile, and the pheromone's composition is dependent upon body size (large females are more attractive than small females). Previous research found that female pheromone profiles differed seasonally between fall and spring, and the goal of this project was to determine how that difference may be attributable to changes occurring during hibernation. We collected pheromone samples from females in the fall, during hibernation, and in the spring (n=8 each). We found that pheromone profiles changed over the course of hibernation to become dominated by heavier molecular components, which we know to be more attractive to males. Moreover, individual pheromone profiles were most variable in the fall and became most similar by spring, suggesting that low temperature dormancy may be critical for synchronizing not only male behavior in this system but also female attractivity.

0745 Poster Session III, Sunday July 27, 2008

Female mimicry in garter snakes: the role of estrogen

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Species that rely solely on chemical signals to determine the sex of conspecifics serve as good models for understanding the effect of hormonal manipulation on signal production. Red-sided garter snakes (*Thamnophis sirtalis parietalis*) emerge in the thousands every spring in the Interlake region of Manitoba, Canada, and large mating balls form as males compete for females. Females elicit courtship via the sexual attractiveness pheromone, but some males in the population ("she-males") produce the female pheromone and can thus elicit courtship from other males in the den. We investigated the ability of steroid hormones to induce female pheromone production in male snakes. We created four groups (n=12 ea.) in the summer of 2006: SHAM, GX (castrated), E2 (17 β -estradiol implant), and GXE2 (castrated + E2 implant). The snakes were hibernated in the lab and transported to the field for behavioral tests at the den in the spring of 2007. The E2 and GXE2 groups elicited more courtship from males than did the SHAM and GX groups in two types of mating trials: arena trials with 10 courting males and mating ball tests in the den. Further, trailing experiments with wild males from the den showed that trails produced by estrogen-treated males were indistinguishable from large female scent trails and preferred over trails left by small females, wild she-males, and SHAM males. These results suggest that pheromone production in she-males is regulated by estrogen, which implies that exogenous estrogen may alter the sexual phenotype of adult male vertebrates in other species that rely solely on chemical signals for sex recognition.

0132 Herp Behavior, Salons A&B, Thursday July 24, 2008

Frogs Call at a Higher Pitch in Traffic Noise

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Male frogs call to attract females for mating and to defend territories from rival males. Female frogs of some species prefer lower-pitched calls which indicate larger, more experienced males. Acoustic interference occurs when background noise reduces the distance over which an acoustic signal can be detected (the active distance). Birds are known to call at a higher pitch (frequency) in urban noise, decreasing acoustic interference from the low-frequency noise. We investigated the effect of traffic noise on the pitch of advertisement calls in two species of frogs, the southern brown tree frog *Litoria ewingii* and the common eastern froglet *Crinia signifera*, using Bayesian linear regression. We found good evidence that *L. ewingii* calls at a higher pitch in traffic noise, with an average increase in dominant frequency of 4.1 Hz/dB of traffic noise, and a total effect size of 123 Hz. This

frequency shift is smaller than that observed in birds, but is still large enough to: 1) be detected by conspecific frogs; and 2) confer a significant benefit to the caller. Mathematical modelling predicted a 24% increase the active distance of a *L. ewingii* call in traffic noise with a frequency shift of this size. *Crinia signifera* may also call at a higher pitch in traffic noise, but the evidence for this was less compelling. As frog calls are innate rather than learned, the frequency shift demonstrated by *L. ewingii* may be an evolutionary adaptation to noisy conditions. The phenomenon of frogs calling at a higher pitch in traffic noise could therefore constitute an intriguing trade-off between audibility and attractiveness to potential mates.

0134 Poster Session III, Sunday July 27, 2008

Trading Off the Value and Impact of Ecological Field Studies: A Case Study of Toes, Swabs, Tadpoles and Tail Tips

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Ecologists and conservation biologists encounter many practical and ethical issues when designing field surveys. The scientific value of a study, the welfare of individual study organisms, and the interests of the population or species as a whole may be in conflict. Although these tensions are commonplace, they are rarely addressed systematically by researchers. I will present a method for explicitly considering conflicting values (scientific knowledge, the welfare of individuals and the welfare of the population) when designing a field study, using a case study of the population genetics of an endangered frog species. A researcher plans to assess how frequently frogs disperse between isolated urban populations, using microsatellite genotyping. S/he must decide how to collect DNA samples from the study animals: by 1) clipping a single toe from an adult frog; 2) taking a buccal swab from an adult frog; 3) collecting a whole tadpole; or 4) clipping the tail of a tadpole. The population-level impact of collecting tadpoles or clipping their tails is likely to be lower than that of collecting toe clips or buccal swabs from adult frogs. However, to gather an equivalent level of scientific information, the impacts on individual animals will be higher. This method for trading off the value and impact of a field study does not necessarily isolate one clearly-superior survey method, but it identifies where different values are in conflict, and can be used to rule out methods that are obviously inferior.

0686 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

A New Home Range Estimator for Sedentary Species that Move Along Corridors

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The most common methods used to estimate home range sizes are minimum convex polygons (MCPs) and kernel estimators. These estimators make assumptions about how animals move in the environment that are occasionally inaccurate or misleading. This has been recognized for some riparian mammal species, and various authors have modified these methods. In estimating home ranges of *Nerodia sipedon* living along an urban stream in Pennsylvania, we applied these methods and compared our results to those obtained by other researchers for the same species at other sites. We found that for our snakes, which occupied riparian habitats and exhibited high site fidelity, MCPs overestimated space use by including large terrestrial areas that were never occupied by and were unsuitable to snakes, while kernel methods underestimated space use by producing multiple small, disjunct contours. These methods often largely or completely excluded the stream. Limited data on stomach contents of snakes at our site suggest snakes fed exclusively on fish even though they were rarely found in the stream. To address these problems we devised another estimator of space use, which we call the "corridor home range." This method sums the MCPs encompassing all of a snake's locations within 100 meters of each other (the maximum distance moved over land) and adds the area of stream connecting the most upstream and downstream locations. This estimator attempts to include all of the animal's known locations and the most parsimonious route of travel between distant locations (and in this case the food resource), while omitting large, unused areas. This method may be applicable to other relatively sedentary species that move long distances through habitat corridors.

0017 Herp Behavior, Salons A&B, Thursday July 24, 2008

Variation In Spatial Learning Within And Between Two Species Of North American Skinks

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Many small lizards run directly to under retreats when pursued by predators; the only way they could know the locations of these retreats is through spatial learning. The Little Brown Skink, *Scincella lateralis*, which evades predators by running into piles of leaves, is able to learn the location of a retreat in a laboratory study, but only if individuals have previous experience in the experimental chamber. The Five-Lined Skink, *Plestiodon (Eumeces) fasciatus*, may be better at spatial learning because it escapes from predators by running under more discrete structures like rocks and logs. I tested this hypothesis by placing a lizard in an experimental chamber with two retreats and chasing it until it ran under the pre-determined "correct" retreat.

Eight trials were run: a decrease in the amount of time the lizard took to escape to underneath the “correct” retreat from the first through the eighth trial indicates spatial learning. Though Five-Lined Skinks generally performed better than Little Brown Skinks, the more dramatic result was the tremendous variation within species: for both *P. fasciatus* and *S. lateralis*, there were several individuals which were very good at spatial learning and several others which were very poor. These results suggest learning abilities differ dramatically among individual lizards.

0154 Fish Systematics III, Drummond, Saturday July 26, 2008

Revision of the Neotropical Genus *Saccodon* Kner (Ostariophysi, Characiformes, Parodontidae)

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Species of the parodontid genus *Saccodon* were studied regarding its taxonomy, with the scope of recognizing valid species. For that, specimens from all basins where they occur were analyzed, as well as literature concerning to all species of the genus. Meristic and morphometric data totalizing 55 features were taken from each specimen. According to that analysis, three species were recognized as valid among eight nominal species: *S. dariensis*, *S. terminalis* e *S. wagneri*. For recognizing those species, a key for identification was elaborated. Descriptions including diagnoses are provided, as well as information about geographical distribution of the species along biological features, emphasizing presence of breeding tubercles, and remarks about published papers encompassing species of *Saccodon*.

0552 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

The Use of Randomized-probabilistic Survey Data to Assess the Effects of Agriculture on Fish Assemblages and Biodiversity in the Mid-Continent Great Rivers, USA

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The US EPA has implemented probabilistic surveys to assess biological condition at large scales across the United States since the early 1990's. Recently, the Environmental Monitoring and Assessment Program-Great River Ecosystems (EMAP-GRE) completed sampling for the Upper Mississippi, Missouri, and Ohio Rivers. The resultant data is an excellent opportunity to assess the major impacts of agriculture and other stressors on fish assemblages in these rivers. A multi-metric biological index, the **Great River Fish Index (GRFI)** was developed to assess the biological integrity of large reaches within the Great Rivers. Fish were sampled at 412 sites in the upper Mississippi, Missouri, and Ohio Rivers from 2004-2006 using standardized daytime electrofishing methods. The GRFI showed no longitudinal patterns for the upper Mississippi and Ohio Rivers. In contrast, scores for the

Missouri River increased (improved condition) upstream from Kansas City, MO. Additionally, GRFIN scores generally decreased as percent agriculture and urbanization increased in the all 3 rivers, suggesting that both agriculture and urbanization are having detrimental effects of Great River fish assemblages. Additionally, I will present the Index of Centers of Density (ICD) which can help identify areas of high fish biodiversity and prioritize fish conservation efforts in the Great Rivers of the Central basin.

0595 Poster Session II, Saturday July 26, 2008

The Ecology of an Introduced Cichlid, *Archocentrus nigrofasciatus*, and Native *Herichthys* Cichlids in the Río Pánuco Basin, Mexico

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The convict cichlid, *Archocentrus nigrofasciatus*, is a popular species in the aquarium hobby, due largely to its hardiness and ease of breeding in captivity. These traits also increase its chances of establishment when introduced in non-native environments, however, and many established nonindigenous populations have been reported. A recent introduction of *A. nigrofasciatus* from an aquarium breeding facility has led to its establishment and spread in the Río Pánuco basin in east-central México. The ecological effects of this species in Río Pánuco communities have not yet been examined, but there appears to be a decline in the native cichlid species where it is present. In this study, we compared resource use of native *Herichthys* species in communities with and without introduced *A. nigrofasciatus* in order to examine niche overlap and to test for evidence of niche shifts where they co-occur. Additionally, we compared diet and habitat use of *A. nigrofasciatus* in Río Pánuco communities with data from its native range in Costa Rica. The dietary niches of *A. nigrofasciatus* and *Herichthys* species largely overlapped where they co-occurred, and diets of *Herichthys* were similar in communities with and without the non-native cichlid. In Pánuco communities, *Herichthys* species and *A. nigrofasciatus* gut contents consisted largely of filamentous algae, detritus and aquatic insect larvae. Other studies have shown that *A. nigrofasciatus* has similar feeding habits in its native range. Our results suggest that the introduced cichlid may compete with native *Herichthys* species for food resources, but other interactions, such as interference competition for nesting habitats, may be important. A better understanding of the ecological effects of this introduced species will be valuable for addressing the growing problem of non-native fishes in Mexican rivers.

0703 Poster Session III, Sunday July 27, 2008

Is There More Food for the Endangered Dusky Gopher Frog in Frequently Burned, Grass-Dominated Longleaf Pine Understory Than in Fire-Suppressed, Shrub-Dominated Understory?

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Fire suppression changes the dominant understory vegetation of longleaf pine forests from grasses such as *Andropogon* spp. to shrubs such as *Ilex* spp. We tested the hypothesis that this reduces the availability of food, primarily arthropods, for juvenile endangered dusky gopher frogs, *Rana sevosa*. We placed captive raised, newly-metamorphosed, unfed frogs in hardware cloth cages, 0.6 cm mesh, 48 cm diameter, 61 cm tall, containing an artificial burrow, for 8 d (Experiment 1) or 3 d (Exp. 2). In Exp. 1, 20 cages were divided among 4 sites with a grass-dominated understory and 20 cages were divided among 4 sites with a shrub-dominated understory in spatial blocks. We placed cages in Exp. 1 onto vegetation no taller than the cages, but within 0.5 m of a small shrub to provide shade, and covered the tops of the cages with a screen lid. In Exp. 2, 13 cages were divided among 3 grass sites and 13 cages were divided among 3 shrub sites in spatial blocks. We placed cages in grass-dominated sites in Exp. 2 as far from the scattered shrubs as possible, whereas we enclosed parts of large shrubs with cages in shrub-dominated sites in Exp. 2. The tops of the cages were left uncovered in Exp. 2. After we removed frogs from the cages we collected their feces for 1 d in the lab, then dried and weighed the feces as an index of food consumption. We also collected arthropods with 25.5 X 3.7 cm strips of fly paper suspended for 2 d in the middle of each cage after frogs were removed, as an index of food availability. Mean feces masses and the mean number of arthropods captured were similar in each habitat in both experiments, and did not differ significantly between habitats. Our results suggest that any degradation of terrestrial habitat for juvenile gopher frogs that may result from fire suppression is not related to food availability. Other differences such as a greater availability of burrows in longleaf forests with a grass-dominated understory than in those with a shrub-dominated understory may affect the survival and growth of juvenile gopher frogs.

0649 Poster Session III, Sunday July 27, 2008

Larval Fish Locomotion: Empirical Data, Swimming Signature and Model Prediction

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While the importance of functional motion analysis has long been acknowledged in ichthyology, quantitative methods for identifying differences in fish locomotion have not been widely developed. A repeated swimming cycle, such as fish locomotion, generates a constant pattern that can be summarized as a kinematic model. For the past 30 years, Lighthill's mathematical equation has been widely used but has never been validated nor challenged with empirical data. We developed a new approach based on empirical data captured from swimming routine videos of juvenile Arctic charr (*Salvelinus alpinus*). Semi-homologous landmarks (defining the outline shape and the median axis of the fish) positioned on a series of consecutive images provide coordinates from which swimming parameters (e.g., amplitude movement of the caudal fin, magnitude of body curvature, proportion of undulatory body) can be estimated on actual larval fish. Each swimming sample corresponds to a swimming equation referred to as the swimming signature. The accuracy as well as the intraindividual and intraspecific variation of these signatures are evaluated. In addition, we provide a quantitative comparison between Lighthill's equation and our empirical signature model. Although, both models fit the empirical swimming cycle, our model has a better fit minimizing over- and under-estimations. We demonstrated the feasibility of a simple and accurate semi-empirical approach to model the swimming signature of larval fish. In order to recreate virtual swimming locomotion, it becomes possible to manipulate directly and independently different parameters influencing swimming performance.

0173 Poster Session III, Sunday July 27, 2008

Cytochemical Study of the Nucleolar Cycle during Spermatogenesis of *Tilapia rendalli* (Teleostei, Cichlidae)

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Chromatoid body (CB) is a cytoplasmic structure of spermatogenic cells that has probable role in the RNA and protein reserve in the different stages of spermiogenesis. Some authors believe that CB is formed by extrusion of nucleolar material from the nucleus to the cytoplasm. This nucleolar cycle has been studied during spermatogenesis of some animal groups. The aim of the present study is to follow the nucleolar cycle in fish. The used specie was the *Tilapia rendalli*, specie brought from Congo (Africa) to Brazil, in 1953 and that, currently, it meets spread in all the dams of Brazil widely. The testes was removed, fixed and embedded in glycol-metacrylate historesin. Thick sections were obtained and tissue sections were

submitted to cytochemical procedures: Hematoxylin-eosin (HE), Toluidine blue (TB), modified Critical Electrolyte Concentration (CEC), silver ion impregnation (AgNOR) and Feulgen reaction. Some testes were prepared for cytogenetic analysis and they were submitted to AgNOR. HE stain was used to seminiferous tubules general analysis and the other cytochemical techniques demonstrated a fragmentation of the nucleolar material in the nucleus of primary spermatocytes, the distribution of this material inside of the nucleus and a reduction of the nucleolar volume in earlier spermatids. These facts indicate that it can have occurred migration of the nucleolar material to the cellular cytoplasm. The cytogenetic analyses had confirmed the occurrence of fragmentation of the nucleolar material, showing primary spermatocytes with fragmented nucleolar material distributed around of the chromosomes. These analyses had also evidenced primary (latter phases) and secondary spermatocytes with absence of the organized nucleolar material. The nucleolus was reorganized in earlier and latter spermatids however it presented a lesser volume. In conclusion, data demonstrated that there is disintegration of the nucleolus and, probably, a fraction of this nucleolar material migrates to the cytoplasm, where the CB is formed.

0258 Poster Session I, Friday July 25, 2008; CARRIER

Maternal Influences on Embryonic Condition and the Occurrence of Runts in Viviparous Sharks

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Pregnant Sandbar (N=26) and Atlantic sharpnose (N=20) sharks were collected from the north-western Atlantic Ocean and Gulf of Mexico. No significant relationship between litter size and maternal length was detected for either species. Equal numbers of embryos were noted in the right and left uterus of pregnant sandbar sharks. Pregnant Atlantic sharpnose sharks had significantly more embryos in the left than the right uterus. Embryonic lengths and weights were recorded and relative condition values were calculated. Runts were observed in 85% of sandbar and 45% of Atlantic sharpnose shark litters examined. Variation in embryonic relative condition was noted and potential causes were examined. Mean relative condition values of sandbar shark embryos increased over the duration of the gestation period. No relationship between litter size and mean or range of embryonic relative condition values were detected for either species. Mean embryonic relative condition values did not vary significantly with maternal length for either species. No relationship between maternal length and the range of embryonic relative condition values was detected for Atlantic sharpnose sharks. An inverse significant relationship between maternal length and the range of embryonic relative condition values was noted for the sandbar shark. This constriction of the range of relative condition values suggests that larger pregnant sandbar shark may be better able to provide consistent nourishment for all embryos. Embryos with greater relative condition values may exhibit lower natural mortality.

0297 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Landscape-scale Reptile Conservation: Experimentally Manipulating Canopy Cover to Restore a Reptile Assemblage

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Current research on reptile conservation is lacking manipulative, landscape-scale experiments to determine whether habitat can be altered to facilitate reptile colonization and use. However, vegetation has changed considerably since Europeans colonized both America and Australia, largely through the thickening of forest canopies due to the suppression of natural fire regimes. Forest thickening causes a decrease in the amount of open, sunny areas that many ectotherms require for thermoregulation. We experimentally removed trees from shaded rock outcrops to determine how changes in canopy cover influence the distribution and abundance of rock-dwelling reptiles. We monitored reptile usage of rocks in three types of habitat patches: (1) open, sunny patches; (2) shady patches where long-term vegetation overgrowth has occurred; and (3) treatment patches that were initially shaded by trees, but in which the shade trees were selectively removed. Tree removal successfully opened the canopy and increased temperatures within retreat sites used by reptiles. Several species of lizards and snakes, including the endangered broad-headed snake, colonized the newly created open sites. Our initial results suggest that selective tree removal is an effective technique for restoring overgrown habitats for reptiles.

0616 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Assessing the Effect of Habitat Heterogeneity on Among-Population Variation in the Isotopic Composition of Pigmy Rattlesnake (*Sistrurus miliarius*) Scale Tissue

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There is often a predictable relationship between the isotopic composition of consumer tissues and the isotopic composition of consumer food resources; thus stable isotopes are often used as dietary indicators. Our long-term research goal is to test the validity of the stable isotope approach for determining differences in pigmy rattlesnake (*Sistrurus miliarius*) diet composition among three Florida populations located less than 4km apart. We collected a scale clip from each of 186 rattlesnakes captured in the three study populations (65 Hog Island individuals, 62 Jones Island individuals, and 59 Uplands individuals). We determined the stable carbon and nitrogen isotope ratios for each scale clip sample. Scale tissue $\delta^{13}\text{C}$ values ranged from -18.1 to -23.9 and scale tissue $\delta^{15}\text{N}$ values ranged from 4.3 to 8.4. There was

considerable overlap among delta values of the three populations. However, each population had a sample of individuals whose isotope ratios were distinct, resulting in statistically significant among-population variation in isotopic composition of rattlesnake scale tissue. Hog Island average $\delta^{13}\text{C}$ values (-20.8 ± 0.13) were significantly enriched relative to Jones Island and Uplands average $\delta^{13}\text{C}$ values (-22.3 ± 0.13 and -22.1 ± 0.12 , respectively). Average $\delta^{15}\text{N}$ values of each population were significantly different from one another (Hog Island = 6.2 ± 0.08 ; Jones Island = 6.9 ± 0.07 ; Uplands = 5.8 ± 0.10). When trying to link the observed variation in scale isotope composition to among-population differences in diet composition, our interpretations were impacted by the degree to which we incorporated the effect of habitat heterogeneity on both prey abundance and prey isotopic composition within the study populations. Our work emphasizes that variability in the distribution of isotopes in natural systems is scale-dependent.

0367 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Phylogeny, Biogeography, and Species Boundaries within the Brook Silverside (Atherinopsidae: *Labidesthes sicculus*)

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Labidesthes sicculus (Teleostomi: Atherinopsidae) is a ubiquitous, schooling, top-water species that is abundant in streams, rivers, and lakes throughout eastern North America. Historically, two subspecies of *Labidesthes* have been recognized. The nominal form, *Labidesthes sicculus sicculus*, was described by Cope from the Detroit River, Michigan and is widely distributed in the Mississippi and Great Lakes basins and in several Gulf Coast drainages. *Labidesthes sicculus vanhyngini*, the Florida Brook silverside, was described by Bean and Reid, from Prairie Creek, near Gainesville, FL. Until recently, the taxonomic status of *L. s. vanhyngini* and the specific limits of its distribution have been in question. This present study was undertaken to determine the geographic pattern of genetic variation within *Labidesthes* across its range. Mitochondrial DNA sequence data (ND2) was obtained from more than 50 individuals and results indicate that there is a high level of genetic variation (>10%) between the putative subspecies and that the distribution of genetic variation is generally concordant with the proposed distribution of the taxa within the genus.

0336 Fish Ecology II, Salons A&B, Monday July 28, 2008

Effects of Habitat Persistence on the Distribution of Fish in Seasonally Drying Mediterranean Streams

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Mediterranean streams are characterized by seasonal droughts occurring each year in summer-early fall, which vary markedly in intensity across multiple spatial and temporal scales. The dry season involves a spatial gradient of habitat contraction and loss of connectivity, resulting in highly patchy and heterogeneous mosaics of habitats, which differ in persistence and stability depending on stream hydrology and geomorphology. As a consequence, the spatial variation in population attributes and assemblage structure should be largely contingent upon the distribution of persistent habitat patches and dispersal opportunities across the stream network. However, mechanisms and patterns of habitat use by fish are still poorly understood, and effects of habitat persistence and stability on fish distribution remain uncertain. This study addresses these issues by examining the distribution dynamics of one cyprinid, *Squalius torgalensis* that dominates stream fish assemblages in the south western Portugal. Fish and habitat surveys were carried out for 18 months, at sixty sites distributed along two 2-km stream reaches. Populations were confined to persistent habitat patches during the summer dry season, but ephemeral reaches were colonized soon after the flow resumed in autumn. However, less fish tended to be found in ephemeral than in permanent sites throughout the wet season. Habitat stability also appeared influential, as some negative relationships were found between variables reflecting variability in habitat conditions and fish density. These results indicate that dry-season habitat dynamics may strongly mediate the distribution of fish in Mediterranean streams, with core areas for fish concentrating in persistent and stable habitat patches.

0743 Poster Session III, Sunday July 27, 2008; STORER HERPETOLOGY

Population Dynamics and Demography of a Bog Turtle (*Glyptemys muhlenbergii*) Population in a Piedmont Meadow Bog

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The bog turtle (*Glyptemys muhlenbergii*) is a small, elusive turtle that occurs in isolated populations in the mountains and western Piedmont of North Carolina. Fragmentation and alteration of bog turtle habitat resulting from anthropogenic development have led to federal and state protection of this species. Habitat fragmentation results in the creation of small, isolated populations whose viability is

threatened by demographic stochasticity, inbreeding depression, and lowered genetic diversity. Understanding the dynamics of isolated populations will provide information crucial to both directed conservation efforts and generalized management practices. We intensively sampled one such isolated population in the Piedmont of North Carolina. Using historical mark-recapture data and program MARK, we modeled adult survivorship and population growth from 1992 to 2007. We found a constant adult survivorship of 0.896 (SE = 0.022) and a constant population growth of 0.935 (SE = 0.020). Recapture probabilities varied temporally. Jolly-Seber models predicted an initial adult population size of approximately 42 turtles (SE = 3.72). Current adult population size is estimated at approximately 17 turtles. Data from this study indicate that this population is steadily declining, potentially as a result of low juvenile recruitment. Demographic factors such as low juvenile recruitment and adult emigration are often associated with environmental factors such as reduced habitat quality. Effective management of wetland habitat is crucial for the continued survival of this population. However, in the absence of sufficient habitat connectivity, long-term population viability will remain uncertain.

**0459 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008;
GRUBER**

The Population Genetic Structure of the Round Stingray in Southern California

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Round stingrays (*Urobatis halleri*) are very common along the coast of Southern California, but little is known about the genetic structure of this species. Stingrays were collected from various locations in Southern California including the San Gabriel River outfall site in Seal Beach as well as the Seal Beach National Wildlife Refuge (SBNWR), San Diego Bay, and Santa Catalina Island. Santa Catalina Island is separated from the mainland by a deep channel and that may pose as a geographic barrier to the stingrays. Results from microsatellite loci indicate that there is no variation in the genetic structure between the San Gabriel River outfall site, SBNWR or Sand Diego Bay. This is representative of a large, homogeneous population in coastal Southern California. However, the stingrays from Santa Catalina Island exhibited a different genetic structure than the other locations sampled suggesting that the deep water separating the island from the mainland represents a barrier to gene flow.

0497 Poster Session II, Saturday July 26, 2008

The Distribution and Movement of the Northern Dusky Salamander (*Desmognathus fuscus*) within a Third Order Stream System

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Northern Dusky Salamanders (*Desmognathus fuscus*) are reported to concentrate their nests in the headwaters of first order streams and hatchlings exhibit a 9-12 month aquatic larval period. Larval salamanders may be subjected to downstream drift and salamanders of all life history stages may be found throughout the stream channel. To investigate this, we are testing three hypotheses pertaining to the distribution and movement of salamanders within the stream drainage: (1) Salamanders participate in a 'colonization cycle' whereby eggs are laid in the headwaters, larvae drift downstream and adults compensate by returning upstream to oviposit; (2) *Desmognathus fuscus* may be part of a source-sink dynamic in which the headwaters act as a source, and the downstream area, a sink; (3) *Desmognathus fuscus* do not exhibit any linear movement suggesting that nesting occurs throughout the stream channel, but habitat quality and thus density varies from upstream to downstream reaches. We are conducting a two-year mark-recapture study along the upper 3.5 km of Baisman's Run, a third order stream system located in Baltimore County, Maryland, USA. Here, we present the data collected in four sampling events in May-November 2007. We captured and marked, using Visible Implant Elastomers, 1749 juvenile and adult *D. fuscus*, 176 of which have been recaptured at least once. Results indicate that the distribution of juvenile and adult *D. fuscus* conforms to the distribution of nests and that the species exhibits minimal movement. Greater than 71% of the individuals were found in the top one-third of the stream. The mean linear distance moved was ~4 m. Previous reports indicate that *D. fuscus* moves ~3 m over 15-87 days. Movement did not vary by age class, sex, or season. To date, salamanders did not exhibit a significant up or downstream bias in movement.

0630 Poster Session II, Saturday July 26, 2008; CARCNET/RÉCCAR

Evaluating Predictive Habitat Models based on Presence/Absence Data for the Threatened Spring Salamander *Gyrinophilus porphyriticus* in Quebec, Canada

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Developments in statistics and GIS tools along with plentiful computing power have contributed to the rapid growth of predictive habitat modelling in ecology. For rare or scarcely known species, usually only historic observations (presence data) are available. A wide variety of techniques based on linear and non-linear regressions, regression trees, environmental envelopes, and machine-learning approaches have been developed for presence/absence data, each claiming certain advantages. The current study generates multiple models of the distribution of the spring salamander

in Quebec using remotely-sensed habitat attributes and georeferenced presence data from Quebec, Vermont, and New York. The predictive output of each candidate model is evaluated using an independent dataset collected by the author (work in progress) according to a stratified random sampling scheme. The proposed method may serve as a template for the predictive modelling of other rare or scarcely surveyed species of conservation concern.

0010 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

The Structure of Rathke's Glands in the Softshell Turtles *Apalone mutica* and *A. spinifera*

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Rathke's glands (RG), found widely among recent turtles, are thought to be the oldest known amniote integumental gland. We investigated the macro, micro, and ultrastructural anatomy of RG in the softshell turtles, *Apalone mutica* and *A. spinifera*. Rathke's glands of both species are structurally similar and consist of two pair of anatomically similar glands, an axillary and an inguinal pair. Both glands are large exocrine glands derived from epidermal epithelium that appear to be specialized for the production and extrusion of a secretion onto the body surface. Glands consist of one of more apparent holocrine secretory lobules encased in a muscle and connective tissue capsule. Secretory cells examined near the basal epithelium revealed not only two types of developing vacuoles (sv-1 and sv-2), but also diffuse clusters of osmophilic granules. The granules appear to be mostly-round, electron-dense lamellar bodies, each ranging approximately 1-2 μm in diameter. Type 1 secretory vacuoles are loosely encased within their individual epithelial cells. The function of RG in turtles is unknown, but it has been suggested that the gland secretions contribute to shell maintenance, have antimicrobial and pheromonal properties, warn or repel predators, and function in excretion.

0464 Poster Session II, Saturday July 26, 2008

Trophic Ecology of Thresher Sharks *A. pelagicus* Nakamura 1935 and *Alopias superciliosus* (Lowe, 1839) in Ecuadorian Pacific

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The thresher sharks *Alopias pelagicus* and *Alopias superciliosus* are species found in oceanic waters of tropical and subtropical seas. There is few biological information on trophic studies of these sharks worldwide. In Ecuador both species were the 37% of the total shark capture in Manta, Ecuador. Our objective is to know the ontogeny changes in the feeding habits in both thresher sharks in the Ecuadorian Pacific from an analysis of stomach contents and isotopic analysis ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) in vertebrae. The stomach contents of 233 thresher sharks were analyzed, which 111 correspond to *A. pelagicus* and 122 to *A. superciliosus*. The individuals of each species were separated by sex and maturity stages (mature and immature). Finding 24 preys in *A. pelagicus* and 27 in *A. superciliosus*. According to the relative importance index (IIR), the main prey of *A. pelagicus* were *Dosidicus gigas* (IIR= 33 %) *Benthoosema panamense* (IIR= 15 %) and *Sthenoteuthis oualaniensis* (IIR= 1.5 %) keeping the same preys by sex and mature stage. Whereas for *A. superciliosus* the main prey were: *Larimus argenteus* (IIR = 58.4%), *Merluccius gayi* (IIR= 13.0%), *D. gigas* (IIR = 11.0%) and *B. panamense* (IIR = 9.3%). We found few differences between sex and stage mature in the *A. superciliosus* diet. According to isotopic analysis, the mean values of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ in vertebrae of *A. pelagicus* were: -16.7 ± 0.38 ($\delta^{13}\text{C}$) and 9.4 ± 0.34 ($\delta^{15}\text{N}$); whereas in *A. superciliosus* was -16.7 ± 0.54 ($\delta^{13}\text{C}$) and 10.1 ± 0.33 ($\delta^{15}\text{N}$). Using the Levin index, *A. pelagicus* like *A. superciliosus* were specialist predators, where *A. pelagicus* had more affinity to feed in oceanic areas; while *A. superciliosus* feed more on coastal and oceanic areas. This data on trophic habitat was corroborated with the isotopic values of $\delta^{13}\text{C}$.

0509 Poster Session I, Friday July 25, 2008

Population Genetics of Devil Rays

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The lack of information on devil ray populations precludes the development of a realistic management program. Almost nothing is known about basic aspects of their ecology, population biology, movement patterns, and migration. Available information is typically anecdotal or based on dead specimens, providing little insight into the biology of living manta rays. In this light, population genetic studies can provide important information for conservation of a species by helping to define conservation units on the basis of genetic stocks, and provide information on size and direction of migration, mating system and other topics. Using genetic techniques, we will attempt to answer the following questions, focusing on *M. japonica* and *M. munkiana*: 1) What is the spatial scale and connectivity of genetically

defined populations or stocks of the mobulids *M. japonica* and *M. munkiana*; 2) How do indirect estimates of dispersal and connectivity of *M. japonica* and *M. munkiana* based on genetic data compare to direct estimates based on tagging data; 3) What insights about the mating system (especially sex biased dispersal) of *M. japonica* and *M. munkiana* can be obtained from the genetic data; 4) Parentage analysis of same-size schools of *M. munkiana*; 5) What are the phylogenetic relationships within the family Mobulidae, and what characteristics (life history or other) are important in the separation of these species? This project is in early stages: currently we are trying to collect samples of both devil rays from locations in the Gulf of California and on the Pacific side of Baja, mainland Mexico, Costa Rica, Panama and Peru; samples of *M. japonica* will additionally be collected from Hawaii, New Zealand and the Philippines.

0103 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008; GRUBER

Spines of Swimming Sharks: Kinematics and Morphology from Five Species

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Maneuverability is a characteristic of animal locomotion that can be quantified in a number of ways, for example, as turning radius, turning speed, or translational and rotational acceleration. Flexibility is a morphological measure that correlates with maneuverability and is defined as the maximum lateral displacement in a swimming animal. The flexibility of a shark is influenced by the vertebral column and the musculotendinous system pulling on the vertebral column. In bony fishes, increasing vertebral column flexibility has been modelled in two ways either by increasing vertebral number or angle at the intervertebral joint while holding the other variable constant. Despite that relatively simple model of vertebral column flexibility, previous research on three species of Carcharhinid sharks has shown total vertebral number does not correlate with flexibility suggesting that other aspects of vertebral column morphology might affect flexibility. The goals of this study were to quantify flexibility in five shark species with varying swimming modes and describe the morphology (number of vertebrae, angle between vertebrae, shape of vertebrae, intervertebral joint length) of the vertebral column. I quantified maneuverability by filming sharks housed in southern California aquaria. Vertebral column morphology was obtained from live sharks when possible or from museum and lab specimens. I found that total vertebral number does not correlate with flexibility. However, vertebral centrum shape and overall shape of the shark may make significant contributions to increasing flexibility in swimming sharks. Additionally, I obtained kinematic data from a range of sizes for three species to further examine the effects of shark shape on maneuverability. The overall shape of species changed with increasing total length, but flexibility changed with increasing total length only in one species. These data are a detailed description of axial skeleton morphology and maneuvering kinematics during swimming in sharks.

0575 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Investigation of an Aggregation of Whale Sharks (*Rhincodon typus*) at Mafia Island, Tanzania, Utilizing Placard Identification and Pop-Up Archival Satellite Tags and Photo-Identification

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Whale sharks (*Rhincodon typus*) feed primarily on plankton. In areas where plankton can become concentrated, whale shark may be observed aggregating to feed. A whale shark aggregation site has recently been identified in the waters of Mafia Island, off the coast of Tanzania in the Indian Ocean. This island sits just off the Rufiji River delta, and the nutrient runoff may cause high concentrations of plankton in the water. The population of whale sharks using this area was looked at in two field seasons. Individuals were identified by the attachment of numbered placard-style tags attached in-situ via speargun and photo-identification via spot pattern using two different software programs. In addition, eight PAT-style tags were deployed in early 2007 with durations ranging between 2 and 12 months. Analysis of tagging data indicates a population estimate of between 50-60 whale sharks using this area. The population includes juvenile sharks in the 2-8m range and is highly dominated by males in a ratio of about 3.5:1. Satellite tag telemetry shows use of a relatively small area off east Africa, dominated by time around Mafia Island, but using waters in other areas of Tanzania and possibly southern Kenya. This area may be used by the juvenile sharks as they grow and approach maturity, at which time they may transition to a more pelagic lifestyle.

0647 Conservation in Canada, Salons 4&5, Saturday July 26, 2008; CARCNET/RÉCCAR

Predicting Recruitment Success in Amphibians in a Forest Remnant in Southern Québec

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Estimates of amphibian abundance make an implicit assumption that the most easily observable individuals, usually breeding adults, correlates with breeding success, i.e. recruitment. We assessed how well the occurrence of metamorphosing individuals could be predicted from surveys of breeding adults, eggs or tadpoles. Surveys of calling adults, egg masses, dip-netting and funnel trapping surveys, and time-restricted searches, were performed at 24 breeding sites in a 467-hectare forest remnant in southern Québec, Canada. Four pond-breeding amphibian species, *Rana sylvatica*, *Ambystoma maculatum*, *Bufo americanus*, and *Pseudacris crucifer* were studied in 2006 and 2007 in order to determine how well the occurrence of each stage of the life cycle predicts occurrence of the next. Jaccard's similarity indexes, contingency tables and logistic regression were used to evaluate which stage(s) were the most reliable indicators predicting recruitment success. The detected occurrence of calling

or breeding adults was a very poor predictor for recruitment success, whereas the detection of eggs and tadpoles were sometimes included in the best logistic regression models predicting recruitment success although they did not contribute substantially to explain variance in the detection of metamorphs. Numbers of adults and egg masses found were variable among sites and between years, and were positively correlated only for wood frogs in 2006. Our results indicate that monitoring protocols for pond-breeding amphibians via calling surveys or egg mass counts may be poor predictors of recruitment success and, therefore, of amphibian abundance at local scales.

0519 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Evidence for Behavioral Thermoregulation after Mating by Wild-living Adult Female Nurse Sharks, *Ginglymostoma cirratum*

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The annual fall gathering of recently mated female sharks in a shallow lagoon in the Dry Tortugas, FL, provided the opportunity to study the thermal preferences of a wild population of adult sharks. Nine adult female nurse sharks, *Ginglymostoma cirratum*, were captured during or subsequent to observed mating events in June of 2005 and fitted with acoustic transmitters. Six of these females were also fitted with external temperature loggers. In 2007, after over two years at liberty, one of the females carrying a temperature logger was recaptured. By comparing the temperature record on the shark-borne logger to data from stationary temperature loggers and examining the record of her movements from acoustic receivers, it was possible to determine that the female shark exhibited temperature preferences for several months within the period during which we presume she was gravid if she had been successfully impregnated. In the fall of 2005 she moved into shallow waters during periods when the water temperature exceeded that available in deeper water, but as the surface waters cooled, she spent more time in deeper locations which provided higher temperature. In the summer and fall of 2006, when the female was not observed to mate or visit the lagoon, her on-board temperature logger showed that she did not seek warmer water as she had the previous year. A summary of eleven mature females transmitted between 2002 and 2006 also exhibited heat-seeking behaviors in October. This is the first study to present temperature data showing that this behavior is not seen in the non-mating year. We believe that these results indicate that the female sharks were behaviorally thermoregulating after mating and that the probable cause of this behavior is to enhance development of embryos.

0393 Fish Ecology I, Drummond, Thursday July 24, 2008

Substrate Variation in the Wabash River During Three Years: Effects on Fish Assemblages

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We quantified substrate variation at 28 sites in the middle Wabash River, Indiana in 2005-07 using a method that was modified from ORSANCO (Ohio River Sanitation Commission). Our objective was to test for changes in substrate size and depth among these years. Our previous analyses resulted in substrate variation and depth as strong predictors of the abundance of several fishes in individual years. We predicted that temporal variation in substrate would control the abundance of fishes. Substrate composition is subject to variation in hydrologic variables that we expected to be effected during high discharge events.

0532 Poster Session II, Saturday July 26, 2008

Preliminary Investigation of Microhabitat Use of *Agkistrodon piscivorus* Inhabiting a Floodplain

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Obtaining information about the habitat use of organisms is central to understanding their ecology and has significant implications for conservation. Even in apparently homogenous habitats, species may utilize microhabitat differentially depending on ecological and physiological requirements. In temporally dynamic ecosystems, selection could favor organisms with less specific microhabitat requirements. The Texas Parks and Wildlife's Old Sabine Bottom Wildlife Management Area (OSBWMA) is subject to seasonal floods that vary in intensity and duration annually. Following a flood in September 2007, we used radio-telemetry to monitor habitat use of five male *Agkistrodon piscivorus* in the OSBWMA. We obtained quantitative data for 14 structural habitat variables from 26 snake locations and 52 random sites. Multivariate analysis of variance revealed that snake locations differed significantly from random sites. *Agkistrodon piscivorus* utilized areas with less canopy closure and ground cover. Snakes were also located close to water and fallen logs with no locations occurring in ecotones. Individuals in this population appear to avoid open areas while maintaining close associations with water. This likely reflects the hydrology of the floodplain with water persisting in forest pools which maintain prey availability.

0718 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Influence of Habitat Structure on Pond-Breeding Amphibians

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Habitat quality varies greatly for both wetland and upland amphibian habitats. Examining the effects of this variation in habitat quality is important, not only for understanding its role in amphibian ecology, but also because habitat loss and alteration is one of the major causes of worldwide amphibian declines. Pond hydroperiod and predator community composition are two habitat-related features that have been shown to influence amphibian communities, but habitat structure (vegetation structure and canopy cover) may also be important for population regulation and community composition of pond-breeding species. I used a combination of experimental approaches (pond mesocosms, laboratory microcosms, behavioral observations, and locomotor performance trials) to test for effects of variation in aquatic vegetation structure, pond canopy cover, predator exposure, and competitor density on larvae and juveniles of several species of pond-breeding amphibians. I found positive effects of vegetation on survival of larvae in the absence of crayfish predators, but vegetation had negative effects on survival when crayfish predators were present. The nature of this vegetation x predator interaction was the same for multiple amphibian species and multiple crayfish species, suggesting that our results may be generalizable to a variety of amphibian prey and crayfish predators. Contrary to some findings in the literature, I found a positive effect of canopy cover (closed canopy) on mass at metamorphosis for American toads (*Bufo americanus*); this may be explained by higher quality food resources in low-light (closed canopy) environments. Finally, I observed a trade-off between terrestrial locomotor abilities (speed and endurance) of American toad metamorphs; the nature of this trade-off differed depending on the toads' larval pond habitat (open v. closed canopy ponds). These findings justify further examination of the effects of habitat structure on aquatic and terrestrial stages of pond-breeding amphibians.

0052 Fish Ecology I, Drummond, Thursday July 24, 2008

Fish Assemblages of Shallow Inner Bend Habitats of the Wabash River During Thirty Years of Human Impact

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Existing samples of 17 inner bend Wabash River sites by seine in 1977 and 1997 provided an ideal opportunity to test for long-term changes in these fish assemblages. We resampled the sites in 2007 using the same methods and collected 36 species (earlier collections were 33 and 36, in 1977 and 1997). Species richness among years, with rarefaction, was not significantly different. Similarly, mean species richness per site with rarefaction, was not significantly different among years. Mean site Shannon-Wiener diversity, Evenness, and abundance for all years

were similar. We used a detrended correspondence analysis (DCA) to further test for similar patterns among sites and years. The DCA resulted in distinct assemblages in each collection-year, and major shifts in assemblage composition among years. We suggest that these changes in assemblages were caused by changes in water quality, hydrology, and other disturbances. This analysis demonstrates that the fish assemblages of inner bend habitats of a large river contain high diversity and likely provide an important refuge from predation for these small-bodied individuals.

0227 Poster Session II, Saturday July 26, 2008

Distribution of Anguilliform Leptocephali in the Gulf of Mexico, with Preliminary Data on Stable Isotopic Composition

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Anguilliforms are ecologically important community members in a variety of habitat types. One characteristic of all anguilliforms is the leptocephalus, a morphologically distinct, open ocean larval stage. The prolonged leptocephalus stage allows eels to disperse great distances to suitable settlement habitats within entire ocean basins. In the Gulf of Mexico (GOM), the species composition and general distribution of leptocephali are fairly well known. The objective of this study was to expand this knowledge of leptocephali in the GOM, specifically focusing on distribution across depth and time of day at four continental slope sites. Leptocephali were collected in August 2007 from the surface to 1447 m over four sites (AC601, GC852, AT340, VK826), during both day and night using midwater Tucker trawls and surface plankton nets. Overall, 186 stations were sampled yielding 668 leptocephali representing 42 species from 9 families. Leptocephali were most abundant in the upper 350 m of the water column at night, with a trend for a deeper occurrence (> 350 m) during the day. Species richness was similar (20-21 species) at all sites except AC601 (9 species) and species composition was different at AT340 (located near the GOM Loop Current). Leptocephali were most abundant (56% of total catch) at VK826, which was the shallowest site (442-688 m depth). *Paraconger caudilimbatus*, *Rhynchoconger flavus*, *Ophichthus gomesii*, *Ariosoma balearicum*, *Gymnothorax ocellatus* complex, *Hoplunnis macrura*, *Dysomma anguillare*, and *Nettenchelys pygmaea* were the most abundant species at all sites. Length-frequencies of *A. balearicum* and *R. flavus* were significantly different ($p < 0.05$) among sites. We also investigated the trophic position of leptocephali using stable isotope analyses. Preliminary data revealed differences in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ among species and sites, and with growth. Stable isotopes may provide insight into the trophic dynamics of this unique larval stage.

0716 Fish Conservation, Drummond, Sunday July 27, 2008

Dynamics of Hybridization Among Native and Introduced Black Basses in the Savannah River, SC

Joseph Quattro

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Non-authorized introductions of black bass species in the Savannah River reservoirs have adversely affected native populations of Redeye Bass, *Micropterus coosae*. We describe the distribution of redeye bass throughout the Savannah River drainage, subsequent unauthorized introductions of non-native species, and document the impact of introgressive hybridization among these species. We argue that the unique lineage of Redeye Bass inhabiting the Savannah River watershed faces extirpation through introgressive hybridization.

0511 Herp Biogeography, Salons 4&5, Saturday July 26, 2008

Explosive Diversification of Australian Desert Skinks

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Australian skinks in the *Sphenomorphus* group represent one of the most diverse continental radiations of amniotes known. Although this clade contains 15 genera, just two – *Ctenotus* and *Lerista* – account for approximately 75% of the total species diversity. Here we present a molecular phylogenetic analysis of major lineages within *Ctenotus* and use these historical data to test whether among-lineage variation in diversification rates explains the high disparities in extant diversity among major groups of this radiation. We first test the monophyly of *Ctenotus* to exclude the possibility that the high species diversity of this genus is simply a taxonomic artefact. We then use a likelihood framework based on the birth-death process to test whether high species diversity within *Ctenotus* is the outcome of increased diversification rates within the genus, or whether it reflects a decline in diversification elsewhere in the radiation. Our results indicate a dramatic increase in diversification occurring in the lineage leading to *Ctenotus* and its sister taxon *Lerista* and suggest that arid-adapted lineages may have diversified explosively in response to the expansion of the Australian arid zone over the past 20 million years.

0490 Poster Session II, Saturday July 26, 2008

Winter Activity and Behavior of Yearling Gopher Tortoises (*Gopherus polyphemus*) in Southern Mississippi

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Few studies have investigated the daily activities of juvenile turtles. We present preliminary data on the winter activity of 1-year-old Gopher Tortoises (*Gopherus polyphemus*) at Camp Shelby Joint Forces Training Center in southern Mississippi. From 15 December 2007 to 24 February 2008, automated video systems recorded diurnal and evening activity of 9 headstarted yearlings (18-46 observation days individual⁻¹, mean = 36). Excluding days when researchers visited sites and observations associated with burrow collapse and construction, tortoises emerged on a mean of 47% (range = 25-67%) of monitored days in December, 12% (0-29%) in January, and 57% (16-82%) in February. Reduced January activity coincided with lower air temperatures on January sampling days relative to December and February sampling days. Tortoises typically only emerged from their burrows at air temperatures above 9°C (mean = 18°C). However, under unusual circumstances, such as burrow flooding, tortoises emerged at temperatures as low as 1°C. Aside from such events, tortoises generally emerged around midday (mean = 1135 h CST, range = 0657-1508 h), spent 3.1 h (range = 0.1-8.7 h) above ground, and retreated into their burrows in mid-afternoon (mean = 1452 h). Tortoises usually descended before dark, but on two occasions, a tortoise remained above ground nearly an hour after sunset. When active, tortoises spent greater than 99% of their time within ~20 cm of their burrows and sometimes shuttled between surface and burrow microhabitats. We observed foraging and short-duration (≤ 45 min) trips away from burrows when air temperatures were above 19°C (mean = 24°C) on 3 days in December and 5 days in February. Night activity was rare and included emergence during burrow flooding events and movements inside burrow entrances. Overall, yearling winter activity was greater than that of adult conspecifics in two previous studies also conducted in southern Mississippi.

0175 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR

Maternal Investment in Clutch Size and Egg Size in the Spotted Turtle, *Clemmys guttata*.

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An individual's fitness is dependent upon the production and survival of its offspring. Females with greater energy stores should be able to invest more energy

into offspring, thereby increasing their fitness. In nature, trade offs occur due to finite resources. Female turtles can increase investment by either increasing clutch size (Optimal Egg Size Theory) or increasing egg size (Bigger is Better Theory). Physical constraints such as pelvic aperture may limit egg size in small species. In this situation, eggs may not have reached the optimal size, and investment in offspring may occur as increases in both clutch size and egg size as body size increases and the physical constraints are removed (Physical Constraints Theory). We investigated these three theories of maternal investment in a central Ontario population of Spotted Turtles (*Clemmys guttata*) using a combination of radio telemetry and x-ray photography. Body condition was estimated using a length-adjusted mass such that females in good condition are heavier than predicted by their body size (carapace length). Nests were located by radio tracking gravid females, excavated, and eggs measured within 24 hours of oviposition. Pelvic apertures were measured from x-ray photographs of gravid females. Physical constraints were not found to influence egg size. Overall, females in relatively better condition were more likely to invest resources in fewer, larger eggs than females in poor condition, showing support for the Bigger is Better Theory.

0120 Herp Behavior, Salons A&B, Thursday July 24, 2008

Nest-guarding in Tuatara (*Sphenodon punctatus*)

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Although parental care is generally rare among reptiles, nest-guarding occurs in some species and is generally attributed to defence against nest predation. Nest-guarding also occurs in the tuatara (*Sphenodon punctatus*), but nest predation does not appear to be a significant threat to nesting success in this species. We studied a population of colonially-nesting tuatara on Stephens Island, New Zealand over four years and tested the hypothesis that female tuatara guard their nests to defend them from excavation by conspecific females. We located 73 nests for which females could be assigned based on observations during oviposition. Nearly 25% of these nests were subsequently excavated by another female, but only 56% of the nests were guarded by the females that constructed them. Guarded nests were less likely to be excavated than unguarded nests. Additionally, female tuatara were more likely to guard their nests, and guarded nests for longer, as the activity of other females on the date of oviposition increased. Nest-guarding in tuatara appears to be adaptive in that it reduces the likelihood of nest excavation by other females, but social interactions may influence females' propensity to guard, as guarding behaviour was influenced by the activity of conspecifics at the time of oviposition.

0486 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Quantifying Energy Flow to Assess Ecological Roles of Amphibians: A Case Study of Ambystomatid Salamander Assemblages

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Larval amphibians are a dominant consumer in many freshwater systems, yet limited data on energy transfers between aquatic food resources and larvae and between metamorphosed larvae and adjacent habitats preclude an accurate assessment of their roles as links between aquatic and terrestrial food webs. I derived prey-specific assimilation efficiencies, analyzed stomach contents, and intensively sampled ambystomatid salamander assemblages in four forest ponds to quantify the trophic basis of larval production. Using estimates of the contribution of each prey taxon to larval production, I constructed quantitative food webs and assessed variation in pathways of energy flow associated with emergences. Overall, metamorphosed salamanders exported 3–8% of total prey production (range = 2.3–16.6 g C m⁻² yr⁻¹), required to account for total larval production, from ponds to adjacent forest. Aquatic insects, zooplankton, and amphibian prey were most important to energy flow associated with emergence (mean ± 1SE = 0.29 ± 0.14 g C m⁻² yr⁻¹); amounts of larval production attributed to each of these prey types shifted during development and varied among salamander taxa. The majority of variation in the trophic basis of production among species was attributed to copepods (Cyclopidae) and three families of aquatic insects (Chironomidae, Chaoboridae, and Culicidae). Dominant prey types contributing to production of metamorphosed salamanders varied among ponds, representing different pathways for energy transfers between aquatic resources and forest habitats. Quantifying changes in species diversity and richness is important for understanding changes in the structure of ecosystems affected by amphibian declines; however, this may not provide an accurate assessment of changes in ecosystem functioning. These findings further our understanding of the ecological roles of amphibians and thus the consequences of amphibian declines and extinctions.

0587 Poster Session III, Sunday July 27, 2008; STORER HERPETOLOGY

Typha angustifolia* and *Phragmites australis* May Differentially Affect *Rana clamitans* and *Rana catesbeiana

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Invasive species can cause considerable change to ecosystems through multiple mechanisms and with varying affects. Invasive plants especially can change the community structurally by out-competing native species and limiting habitat diversity; exude novel compounds into the community which may directly harm other organisms; change the nutrient and chemical profiles of an ecosystem; change

the microbial community; and change the amount and/or quality of detritus available for decomposition. These changes may be more pronounced in aquatic situations where chemicals move more freely than in soil. At the same time, one of our most at-risk ecosystems is wetlands. Wetlands are distinct in their flora and often fauna as well, when compared to surrounding habitats. Wetlands are also crucial for many taxa, including amphibians which are currently in decline in many areas. This study examines the effects of two invasive plants- *Typha angustifolia* and *Phragmites australis*-on the wetlands which they have invaded, and how those changes may affect amphibians especially *Rana clamitans* and *Rana catesbeiana*. While both plants are correlated with distinct changes in their environment, the changes are in very different directions. The changes correlated with each of the plants could be biologically relevant to amphibians and other organisms. The directions of these changes may also indicate differing degrees of risk to amphibians associated with the different plants. These are preliminary results and part of a larger dissertation project concerning these four species and their interactions.

0572 Herp Genetics, Salons A&B, Sunday July 27, 2008

Estimating Gene Flow between Black Salamander (*Aneides flavipunctatus*) Populations: A Multi-locus Coalescent Approach

Sean Reilly, Sharyn Marks, Bryan Jennings

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The Black Salamander (*Aneides flavipunctatus*) is a terrestrial salamander associated with lowland coastal forests of northwestern California. This species is composed of at least five populations, which exhibit marked geographic variation in color pattern, microhabitat preference and external proportions (Lowe 1950, Lynch 1981). A major zone of differentiation occurs in northern Mendocino County where three of these populations come into contact with each other. Abrupt transitions from one morphotype to another are observed in this region, and one of the transitions seems to be associated with the ecotone between the coastal coniferous forests and the inland oak/pine forests. Historical gene flow among these populations is being assessed using a statistical-coalescent multi-locus approach. The use of unlinked and presumably selectively neutral loci in a coalescent framework provides a statistically powerful new approach to gene tree-based speciation studies. By measuring gene flow between these populations, particularly with respect to the observed morphological and ecological variation, we hope to determine if any of these populations are reproductively isolated and therefore warranting new species status.

0208 Fish Systematics I, Salons A&B, Friday July 25, 2008

A Morphology-based Phylogeny of the Neoplecostomine Armored Catfishes

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The Neotropical loricariids have been the subject of great interest by systematists and taxonomists in the last several years. In this study we used parsimony to analyze a data matrix of 310 morphological characters from 71 terminal taxa of the subfamily Neoplecostominae and relevant outgroups. We included all described species of the subfamily as well as several still undescribed species to propose a new phylogenetic hypothesis. Nona and Winclada were used to perform a Ratchet analysis and obtain a strict consensus tree of 2273 steps, CI=0.21 and RI=0.66. According to our analysis, Delturinae is the sister-group of all other loricariids except *Lithogenes*, Loricariinae and Hypostominae are successive sister-taxa of the Neoplecostominae plus Hypoptopomatinae. As previously demonstrated, Neoplecostominae is not monophyletic and comprises a sequence of successive sister-taxa leading to the more derived Hypoptopomatinae. Within Neoplecostominae there is a main dichotomy formed by one branch that includes *Pareiorhaphis* and a new genus with five new species, and second branch composed of the remaining Neoplecostominae + Hypoptopomatinae. In this second branch the first dichotomy separates *Isbrueckerichthys* and *Neoplecostomus* as sister taxa to each other from the remaining. Further traveling up the cladogram we have *Pareiorhina* as sister to *Kronichthys* plus the hypoptopomatines. Quite surprisingly, all previously described genera turned out to be monophyletic, including the largest and variable *Pareiorhaphis*. The subfamily Neoplecostominae, however, is paraphyletic if kept apart from the Hypoptopomatinae, and should be placed in the synonymy of the latter.

0352 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

Taking a Community-level Approach to Ecotoxicology: Insights from Amphibians

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Global declines in amphibian populations is a major conservation concern with a multitude of causes. In some parts of the world, population declines are correlated with upwind use of pesticides, but the concentrations are quite low relative to the concentrations that are known to be lethal. In this talk, I will detail a number of recent mesocosm experiments from my research group in which we demonstrate that very low and ecologically relevant concentrations of common pesticides can cause substantial mortality to larval amphibians either through previously unknown direct toxic effects, synergistic effects with biotic stressors, or via indirect trophic cascades. Collectively, these experiments demonstrate that very low concentrations of

pesticides can have much larger impacts on amphibian survival than was previously known.

0607 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Problems Associated with Local-scale Management of Amphibian Populations: Spotted Salamanders across a Fragmented Landscape

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Habitat loss and fragmentation are the major causes of population declines and loss of biodiversity. As humans continue to encroach on natural landscapes and habitat is lost, altered, and fragmented, populations of most species become smaller and connectivity among populations is reduced. Although understanding dynamics of populations over large spatial scales is a central issue in conservation biology, many of our management techniques continue to focus on individual populations. For example, if individual wetlands and associated amphibian populations are protected, the most frequently implemented management strategy is establishment of critical upland habitat immediately surrounding the wetland. In this study, we addressed the effects of habitat loss and fragmentation on spotted salamander (*Ambystoma maculatum*) populations in the greater Charlotte, North Carolina area. Our primary objective was to examine the effectiveness of preserved critical upland habitat in conserving population genetic variation across a primarily urbanized landscape. To do so, we used a combination of microsatellite DNA analysis and GIS to compare six populations of salamanders that varied in distance from nearest neighboring population and in quality of surrounding habitat within an upland habitat zone size determined from the literature. Additionally, we examined changes in quality of habitat over a 75-year period using historic aerial imagery. We found (1) no relationship between genetic similarity and distance between pairs of populations and (2) no relationship between quality of habitat in the surrounding buffer zone and population genetic variation. To conserve wetland species across a landscape, we not only need to conserve critical upland habitat surrounding wetlands, but we must also preserve ecological connectivity among breeding populations. Otherwise, landscape-scale processes that maintain genetic diversity of populations and biodiversity of communities will be lost. We hope this research will help to facilitate a shift in focus for wildlife managers.

0733 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Reproduction of the Smooth Back River Stingray *Potamotrygon orbignyi* in the Araguaia/Tocantins Basin, Brazil

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The smooth back river stingray, *Potamotrygon orbignyi*, is a small to medium size Neotropical freshwater stingray with a wide distribution along the Amazon and Araguaia/Tocantins basins. Although not frequently consumed as fish meat, this species has an ornamental economic value and is periodically exported from Brazil when legislation permits. In order to evaluate the ornamental fishery impact on regional populations of the smooth back river stingray, several specimens (162 specimens; 97 females and 65 males) were collected at the Paranã River, a tributary of the Araguaia/Tocantins basin, and their reproductive aspects were studied. All collects were performed from January 2002 to September 2003 by longline and spear and specimens were conditioned in formalin (4%) for posterior laboratory analysis. The female reproductive system consists of two ovaries (the left one is usually larger), two anterior oviducts, two nidamental glands and two uterus. The male reproductive system consists of two testis, two epididymis (head, body and tail), two ductus deferens and two seminal vesicle. The sexual maturity (DW_{50}) was estimated to occur in 251 mm disc width-DW for males and 260 mm DW for females. The uterine fecundity *per* gestation was just one embryo and the parturition occurred along the rainy season for most of the reproductive population (September to February). The neonates are estimated to have 115 mm DW and 60 grams of total weight, which corresponds to a weight increase of 1605% in relation to the initial ova weight (3,8 g). The hepatosomatic index variation along the year indicates a lower hepatic reserve condition in the dry season and higher reserve hepatic condition in the rainy season. Based on preliminary readings of vertebral rings, the sexual maturity was estimated to occur at the age of 5 with a maximum longevity of 10 years.

0295 Poster Session III, Sunday July 27, 2008

Ontogeny of the Branchial Muscles of the Ohrid Trout (*Salmo letnica* Karaman, 1924)

Milica Ristovska¹, B. Karaman¹, Barbara De Kegel², Walter Verraes², Dominique Adriaens²

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The ontogeny of the branchial muscles of Ohrid trout *Salmo letnica* (Karaman, 1924) was studied from hatching until the age of 92 days post-hatching. The aim of this study was to provide insight in the ontogenetic origin of these muscles, as well as on their morphology and homology. The ontogeny of the muscles of the branchial basket has been described in detail in seven different stages using serial sections and

3D-reconstructions. Based on ontogenetic evidence, as well as the literature, an asynchrony in the development of the consecutive branchial muscles was observed. At one day post hatching, only the transversus dorsalis is present in the dorsal part of the branchial basket, while at the ventral part four pairs of obliqui ventrales and a transversus ventralis posterior are present. During further development, the ventral branchial muscles develop prior to the dorsal ones. The obliquus posterior is the last muscle becoming differentiated, and is observed for the first time at 92 dph. In order to investigate to what degree the myology of the branchial muscles of the Ohrid trout is special, the results are compared with data of other salmonids, as well as some non-salmonid teleosts.

0706 Poster Session III, Sunday July 27, 2008

Mixed Stock Analysis of Adult Male Loggerhead Sea turtles (*Caretta caretta*) from Cape Canaveral, Florida, USA

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Relatively little is known about male sea turtles compared to their female counterparts. While genetic studies have shown that males are not restricted to mating only with females from their natal beach, freeing them from the geographic constraints such a restriction might place on their movements, it is still unclear where males spend the majority of their lives. Unlike females, whose nesting activity makes them easily observable, males are seldom seen. Loggerhead sea turtles (*Caretta caretta*) in the North Atlantic are well studied, with genetically identifiable nesting populations. Using this information, several studies have been conducted to determine the natal origins of mixed aggregates of subadult loggerheads, particularly in the south eastern United States. However, analyses of this type are typically incapable of detecting differences between males and females. Given previously published genetic studies describing different mating strategies for the two sexes, as well as temperature dependent sex determination allowing for different sex ratios on thermally dissimilar beaches, an understanding of the sex-specific composition of mixed aggregates is important information to consider in conservation management decisions. Here, 39 identifiable males and 27 undifferentiated subadults from a mixed feeding assemblage at Cape Canaveral, Florida - a known biogeographic "break" in sea turtles - are analyzed to determine potential natal beach contributions. This unique data set provides further insight into male loggerhead sea turtle life histories.

0761 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Reptile and Amphibian Responses to Large-Scale Wildfires in Southern California

Carlton Rochester, Cheryl Brehme, Denise Clark, Drew Stokes, Stacie Hathaway, Robert Fisher

United States Geological Survey - Biological Resources, San Diego, California, United States

In 2003, southern California experienced several large fires that burned thousands of hectares of wildlife habitats and conserved lands. In order to investigate the effects of the fires on reptile and amphibian communities, we compared the results from pre-fire sampling to those from the second and third years post-fire among 38 burned and 17 unburned plots. The sampling plots were spread over four vegetation types and four open space areas within San Diego County. Our capture results indicate that burned chaparral and coastal scrub lost herpetofaunal species diversity post-fire and displayed a significant shift in community structure. In these vegetation types, the average shrub and tree cover after the fires decreased by 55% in chaparral and 76% in coastal scrub. Post-burn herpetofauna community structure was more similar to unburned grassland. We found no differences in herpetofaunal species diversity or community composition in grasslands or woodland/riparian vegetation where shrub and tree cover did not change. At the individual species level, *Sceloporus occidentalis* was the most abundant reptile both before and after the fires. We saw increased net capture rates for *Aspidoscelis tigris*, *Phrynosoma coronatum*, and *Uta stansburiana* in burned chaparral and *Aspidoscelis hyperythra* and *Uta stansburiana* in burned coastal scrub. The toad, *Bufo boreas*, was detected at significantly fewer burned plots in chaparral after the fires. Additionally, we documented decreases in the area occupied by *Elgaria multicarinata*, *Batrachoseps major*, *Coluber constrictor*, *Lampropeltis getula*, *Pituophis catenifer*, and *Masticophis lateralis* in coastal scrub and chaparral. We discuss these individual species results as they relate to specific life history traits, such as susceptibility to initial mortality and post-fire changes in habitat suitability and prey availability. We foresee that a continued unnatural fire regime for southern California will result in a simplification of the southern California reptile and amphibian communities.

0147 General Herpetology I, Salons 4&5, Sunday July 27, 2008

Diet of Burmese Pythons in South Florida

Michael Rochford¹, Matthew Brien¹, Michael Cherkiss¹, Skip Snow², Kenneth Rice³, Michael Dorcas⁴, Laurie Wilkins⁵, Frank Mazzotti¹

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Burmese pythons (*Python molurus bivittatus*) are native to southeast Asia, but are an invasive, non-native species that has become established in the Southern Everglades, and potentially other conservation areas in south Florida on both the mainland and the Florida Keys. They are generalist predators that consume a wide variety of mammal and bird species, as well as reptiles, amphibians, and fish. Our purpose is to understand the diet of Burmese pythons in order to assess their impact on native fauna and to predict what species are at risk. Prey species in the digestive tracts of Burmese pythons were identified by examining hair, bone, and teeth. Fourteen species of mammals, five species of birds, and one species of reptile have been found in the digestive tracts of pythons collected and examined in Florida, including several federally endangered Key Largo woodrats (*Neotoma floridana smalli*); one threatened species, the American alligator (*Alligator mississippiensis*); and two species of special concern, the limpkin (*Aramus guarauna*) and the white ibis (*Endocermus albus*). We have also found the remains of a bobcat (*Lynx rufus*), and white-tailed deer (*Odocoileus virginianus*). Given the diverse dietary habits of the Burmese python, it is possible that other federally endangered or threatened species in Florida may be at risk as prey. In addition to the Key Largo woodrat, protected species believed to be at risk include the Florida panther (*Puma concolor coryi*), mangrove fox squirrel (*Sciurus niger avicennia*), Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*), wood stork (*Mycteria Americana*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), and American crocodile (*Crocodylus acutus*).

0089 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

Agrochemicals Increase Trematode Infections in a Declining Amphibian Species

Jason Rohr¹, Thomas Raffel¹, Neal Halstead¹, John Romansic¹, Anna Schotthoefer², Hunter Carrick³, Jason Hoverman⁴, Catherine Johnson⁵, Lucinda Johnson⁵, Camilla Lieske², Marvin Piwoni⁶, Patrick Schoff⁵, Val Beasley²

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Global amphibian declines have often been attributed to disease, but ignorance of the relative importance and mode of action of potential drivers of infection has made it difficult to develop effective remediation. In our field study, the widely used herbicide, atrazine, at measured concentrations less than 1 µg/L, was the best of over 240 plausible predictors of the abundance of larval trematodes (parasitic flatworms) in the declining northern leopard frog, *Rana pipiens*, and the effects of atrazine were consistent across trematode taxa. The combination of atrazine and phosphate, major agrochemicals in global corn and sorghum production, accounted for 74% of the variation in the abundance of these often debilitating larval trematodes. Path analysis of the field data and mesocosm experiments support a causal mechanism whereby these agrochemicals increase exposure and susceptibility to larval trematodes by augmenting intermediate hosts and suppressing amphibian immunity. These results raise concerns about the role of atrazine and phosphate in amphibian declines and illustrate the value of quantifying the relative importance of multiple plausible drivers and mechanisms of disease risk.

0055 General Ichthyology II, Salons 6&7, Saturday July 26, 2008; STOYE GENERAL ICHTHYOLOGY

Phylogenetic Systematics of the Flatfish Family Pleuronectidae (Percomorpha: Pleuronectiformes)

Dawn Roje

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The pleuronectiform family Pleuronectidae contains 60 species of primarily dextral flatfishes, in 23 genera. They occupy mostly benthic marine habitats and maintain a broad distribution, inhabiting all oceans of the Northern Hemisphere. Previous phylogenetic analyses, utilizing characters of adult osteology and external morphology, recovered four major lineages of the Pleuronectidae. To test monophyly of these lineages, and to determine intergeneric relationships, DNA sequences (totalling approximately 2300 bp) from the nuclear recombination activating gene 2 (RAG 2), and the mitochondrial genes, NADH dehydrogenase

subunit 1 (ND1) and NADH dehydrogenase subunit 2 (ND2), were obtained for 20 pleuronectid genera. Sequence data were analyzed using parsimony and Bayesian methods, and the reconstructed phylogenies are presented. General trends in, and the phylogenetic significance of, external larval morphology of the Pleuronectidae are also discussed. Larval characters are presented as an additional line of evidence to support the phylogenetic position of genera within the Pleuronectidae.

0022 Poster Session III, Sunday July 27, 2008

The Conservation Status of the Southern Cavefish *Typhlichthys subterraneus* in Arkansas

Aldemaro Romero, Michel Conner, Granville Vaughan

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We investigated the status of the southern cavefish (*Typhlichthys subterraneus*) in Arkansas. Its presence in the state represents the western-southern limits of its distribution. Three localities have been confirmed that contain individuals of this species: Richardson Cave (Fulton County), Alexander Cave/ Clark Spring (Stone County) and Ennis Cave (Stone County). A fourth locality has been cited as a well in Randolph County, but because the exact location is unknown, its presence has not been confirmed. There are also a number of unconfirmed localities for “cavefishes” in the region. Populations of this species in Arkansas seem to be small (less than 100 individuals) which is common among populations of hypogean amblyopsids elsewhere. All the confirmed localities are in areas either under controlled access by the private owners or by the federal government. No immediate threat to these populations was found by either overcollecting or other anthropogenic causes. Yet long-term monitoring of the recharge zones is recommended since pollution of these areas has been the major ecological problem for this and other hypogean amblyopsids species elsewhere. Current work suggests that the populations in Arkansas may represent a new species of *Typhlichthys*.

0187 General Ichthyology I, Drummond, Saturday July 26, 2008

The Hypogean Fishes of China

Aldemaro Romero, Yahui Zhao, Xiaoyong Chen

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China has 91 species of hypogean (cave and artesian) fishes described so far. That is nearly one third of all the hypogean species that have been described in the world (298). That figure places China as then country with the largest proportion of those kinds of fishes. Of all Chinese hypogean fishes 55 species show troglomorphisms, i.e., adaptations that have been correlated to the hypogean environment such as reduction and/or loss of eyes, pigmentation, and the swim bladder. Additionally, two other characters seem to be unique to some of the hypogean species of China: presence of a horn-like structure and hyperdevelopment of the dorsal area similar to

a humpback. Despite the fact that the first written account of a cave fish took place in China in 1540, almost all the new descriptions occurred in the last 20 years mostly in papers written in Chinese and/or in journals of difficult access outside China. We summarize all the basic knowledge about the hypogean fishes of China and put them in context regarding all the hypogean fishes in the world.

0271 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Comparison of Feasible Demography and MSY Models and Their Predictions for Terrapin Management

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We analyzed a twenty-year mark recapture data set of the diamondback terrapin, *Malaclemys terrapin* using both a feasible demography and a maximum sustainable yield (MSY) approach. The terrapin is a species with delayed maturity, low reproductive rates, and low juvenile survivorship. The feasible demography technique uses a life table approach to determine how variation in survivorship in different age classes affects population stability. The MSY technique evaluates the effects of removal (harvest) on population size and recruitment potential. Both approaches indicate that removal of 2-3% of the adults per year from this population would result in population decline, indicated as a net reproductive rate of less than 1 for the feasible demography approach and a reduction in brood stock and recruitment potential by the MSY approach. Thus, terrapin populations cannot sustain a viable commercial harvest. A key component of the success of the MSY technique was the availability of a long-term mark-recapture data set to estimate the parameters incorporated into the model. Although the Maryland legislature closed the terrapin fishery through legislative process in 2007, the regulatory agency was prepared to establish a moratorium on the fishery based on the outcome of the MSY approach in case the legislation failed. Our results suggest that MSY models can have similar predictions to the feasible demography approach. However, both rely on the availability of accurate, long-term data sets to ensure accurate parameters are included into the models.

0417 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Widespread Occurrence of *Batrachochytrium dendrobatidis* in the Southeastern United States

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The chytridiomycete fungus, *Batrachochytrium dendrobatidis* (BD), has been associated with amphibian population declines in other areas but its prevalence and host taxonomic associations in the southeastern United States are unclear. From 1999 to 2006, we sampled >1,000 amphibians for this fungal pathogen at 27 sites in 9 states of the southeastern U.S. Using histological techniques or PCR assays, we detected BD infection in 10 species of aquatic-breeding amphibians in 6 states. The prevalence of BD infection was 17.8% for samples of postmetamorphic amphibians examined using skin swab-PCR assays ($n = 202$ samples from 12 species at 4 sites). In this subset of samples, anurans had a much higher prevalence of infection than caudates (39.2% and 5.5%, respectively). Mean prevalence in ranid frogs was 40.7%. The only infected salamanders were *Notophthalmus viridescens* at 3 sites in 3 states. The results of our study indicate that the taxonomic breadth of species known to be infected with BD in this region is broader than was previously understood. We found infected amphibians from late winter through late spring and in 1 autumn sample. Despite the ubiquity of BD infection, we confirmed only 8 cases of probable chytridiomycosis involving individuals found dead or exhibiting clinical signs of disease. Although we observed other mortality events at 6 sites, the die-offs were not attributed to BD. In general, we observed a pattern of widespread and apparently subclinical infections. However, because most of the sites in our study were visited only once, we cannot dismiss the possibility that chytridiomycosis is adversely affecting some populations.

0508 Poster Session II, Saturday July 26, 2008

No Evidence for Sex-Biased Dispersal in Eastern Foxsnakes (*Elaphe gloydi*) within Two Disjunct Regional Populations in Ontario

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Dispersal is a key life history attribute of animals and has a direct impact on the genetic structure and persistence of populations within a species. New molecular techniques have allowed for quantification of dispersal and gene flow across spatial scales, and also permit the estimation of sex-biased dispersal. Sex biased dispersal can result in differential genetic structure for males and females and has been widely studied in mammals and birds. In striking contrast, there are few estimates for reptiles. Our study, one of the first for snakes, assesses whether sex biased dispersal exists within two regional populations of eastern foxsnakes (*Elaphe gloydi*) using eleven high resolution DNA microsatellites developed for the eastern foxsnake. Using comparisons of mean A_{IC}, variance in A_{IC}, F_{st} and F_{is} between males and females, we found no evidence for sex-biased dispersal in either regional population. This may be due to dispersal (and concomitantly gene flow, which is evident among sites within regions) occurring during the juvenile stage of the snakes' life history, before dispersal decisions based on sex are typically made. Alternatively, this species of snake may not be strongly influenced by the factors promoting sex-biased dispersal for other taxa.

0672 Poster Session II, Saturday July 26, 2008

Daily Movements and Activity of Stinkpot Turtles (*Sternotherus odoratus*) in a Southwestern Michigan Lake

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Studies of activity, habitat use, and home range size can lend insights into foraging behavior and limitations on energy acquisition. We used radiotelemetry to study movements of Stinkpot Turtles (*Sternotherus odoratus*) in a small southwestern Michigan lake over two summers. *Sternotherus odoratus* moved mainly within the littoral zone but one individual used a stream and its adjacent terrestrial habitat. Turtles moved greater distances during the late morning and late afternoon hours when compared to early morning and mid-day hours indicating some degree of crepuscular activity. Daily distances moved averaged less than 100 m d⁻¹ and there were no significant effects of weather conditions or sex on mean total daily distance moved. Shell surface temperatures more closely paralleled water temperature at the littoral zone bottom (ca. 50 cm) than at the water's surface (ca. 2 cm) suggesting that turtles spent much of their time on the bottom. Mean total daily distances moved were positively correlated with mean daily air and water temperatures indicating

some temperature limitations on movement. Minimum convex polygon home range size estimates for turtles in the lake averaged less than 2.5 ha and did not vary between sexes.

**0042 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR**

Genetic and Morphologic Analysis of a Hybrid Zone in Toads, *Bufo americanus* and *B. hemiophrys*, in Southeastern Manitoba

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Hybrid zones (narrow regions where genetically distinct populations may interbreed to produce hybrids) are good “natural laboratories” to study processes involved in evolution, the creation of new species and the maintenance of genetic barriers. The present study aims to investigate a hybrid zone in southeastern Manitoba using mitochondrial DNA markers, nuclear DNA markers and morphometric analysis. Two species of toads, *Bufo americanus* and *B. hemiophrys*, interbreed in this region and produce fertile hybrids. Previous studies of this hybrid zone described its general location and form using morphological characters and data from isozyme electrophoresis, but the level of concordance between characters encoded by nuclear genes with each other and with mtDNA haplotypes is unknown. Mitochondria are known to spread through populations across hybrid zones between species. Because mitochondrial genes are routinely used to study species-level evolution and taxonomy, using DNA barcoding for example, it is important to understand how well mitochondrial and nuclear genomes actually match each other. This project allow us to better understand the dynamics of this hybrid zone, leading to further research on specific isolating mechanisms, and eventually help us understanding more general processes as speciation through hybridization and species boundaries.

0351 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

Phylogeographic and Demographic History of the Milk Snake, *Lampropeltis triangulum*: The Impact of Glacial Cycles on a Pan-tropical and Temperate Vertebrate

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The milk snake (*Lampropeltis triangulum*) is one of the most widely distributed squamates in the New World, ranging from the northeastern U.S. and southern Canada, across the U.S. and into northern South America. Thus, they are a prime candidate to investigate phylogeographic structure and demographic responses to glacial cycles. We identify several major lineages of milk snake found in specific geographic areas using inferences from the cytochrome b gene. Additionally, relaxed phylogenetic divergence dating and coalescent information revealed that fluctuations in population size might be tied to glacial cycles. Finally, to corroborate these results, we have produced an anonymous loci library of independently evolving nuclear genes.

0318 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Dive Characteristics and Movement Patterns of Acoustic and Satellite-Tagged Manta Rays (*Manta birostris*) in the Revillagigedos Islands of Mexico

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Individual manta rays (*Manta birostris*) were tagged with either PAT or coded acoustic tags for a period of 12 days at two separate Islands (San Benedicto and Roca Partida). Three subsurface recorders were placed around San Benedicto and continuous movements of animals were monitored around the island and between the islands and the Baja California peninsula. Analysis of recorded data indicated that the animals are within range of the fixed recorders less than two percent of the total time and that attendance appears to be primarily between 0100 hrs and 1300 hrs. Animals fitted with PAT tags travelled between the attachment sites and areas adjacent to the Baja California peninsula. Travel routes to and from the peninsula were similar in both animals. Total travel distances were 2249 and 1063 km., at calculated average speeds of 8.8 and 2.5 km/hr. respectively. Initial analysis show that both mantas move in sinusoidal cycles from the surface and between 72 and 80 meters during the period of travel. Hours of sunlight were spent at shallower depth than those during the night, where animals appear to be following the lower boundary of the thermocline. Several descents exceeded 200 meters, with a maximum of 450 meters, ranging between surface temperatures of 28 C to 10 C at depth.

0714 Poster Session I, Friday July 25, 2008

Photo-Identification of the Manta Ray, *Manta birostris*, in the Revillagigedos Islands, Mexico

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Photographic samples have been obtained for a population of manta rays for the past three decades. Based on differences in color and marking pattern we have established the presence of two forms, referenced here as chevron and black morphs. Chevron and black animals compose 70.2% and 29.8% respectively of the known population and do not differ significantly in either size or sex ratio. Dissimilar individual markings occur in both morphs and do not appear to change over time. The use of a four-point grid matching technique of the ventral surfaces has allowed us to recognize 225 individuals to date. Seventy-one (32.5%) of the animals have been resighted and one individual has been seen 13 times. Three are known for a period of fifteen years. Females represent 55.9% and males 44.1% of the sexed individuals (n= 111). Known populations of manta rays in the Pacific and Indian Oceans appear to lack the black morph. Chevron individuals in these populations show recognizably different markings on both the surfaces which appear to be regionally specific. They are also of smaller body size and seem to reach reproductive maturity at sizes well below those of this population. These differences may suggest ecotypes as a function of differences in food availability or character displacement as well as the absence of gene flow.

0609 Poster Session II, Saturday July 26, 2008

Multiple Estimates of Terrapin Clutch Size at Gateway National Recreation Area, New York and New Jersey: What is the “real” average?

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One-year studies are often used to assess clutch size parameters in turtle populations. However, can a single year of data provide a good estimate of the “real” average clutch size? How large must samples be to provide reliable estimates? At Gateway National Recreation Area in New York and New Jersey, diamondback terrapin (*Malaclemys terrapin*) clutch size data were collected 1998-2001, 2004-5, and 2007. A total of 400 nests were counted from the main island, Rulers Bar Hassock (average 12.5 eggs/clutch). Clutches from another 29 nests were collected from two islands (Little Egg Marsh and Ruffle Bar) in Jamaica Bay; they had an overall average of 12.9 eggs/clutch. The overall average size was 12.6 eggs/clutch. Clutch size on these islands was not significantly larger than on Rulers Bar Hassock. We also examined 169 clutches from Sandy Hook, the southern section of GNRA and potentially a different breeding population, where the average clutch size was 10.5 eggs. This was significantly smaller than that of the Jamaica Bay population. We conducted a series of tests to determine which year we achieved a good estimate of

clutch size, and found that the data from 1999, 2000, 2001, 2005, and 2007 were not statistically different from the overall average. In one case, a sample size as small as 13 nests was very close to the overall average. However, in 2004, when data were collected from 142 nests, the average was significantly different from the overall average. This suggests that in some cases 142 nests may not be enough to determine the average clutch size of a population. Given that clutch size data are not usually normally distributed, simulation experiments will be needed to estimate the number of nest samples needed in order to obtain a robust estimate of average clutch size.

0549 AES Physiology/Conservation, Kafka/Lamartine, Sunday July 27, 2008

Acquisition, Husbandry and Release Techniques for the Giant Manta Ray (*Manta birostris*) At Atlantis Resort, Bahamas

Keisha Russell

Atlantis Resort, Nassau, Bahamas

Over the past 7 years the Atlantis Resort has successfully displayed 8 Giant Manta Rays (*Manta birostris*) with 3 of them currently on exhibit in a 2.3 million gallon lagoon that also features other tropical marine species. As the only aquarium facility in the Western Hemisphere displaying Giant Manta Rays, we have been afforded the unique opportunity to observe how mantas behave, feed and interact with each other, each displaying distinguishing characteristics and different personalities. Recent tracking programs using satellite tags has provided further insight to some of the natural habits of this species.

0610 Poster Session III, Sunday July 27, 2008

Predicting Suitable Habitat for the Northern Prairie Skink (*Plestiodon septentrionalis*) in Manitoba

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The northern prairie skink (*Plestiodon septentrionalis*) is the only lizard found in Manitoba, Canada and is currently listed as endangered, in part, due to its limited Canadian distribution. The prairie skink's range appears to be limited to the sandy habitats in the southwestern portion of the province in several disjunct populations roughly 150 kilometres from the nearest southern population. In this study, we used coarse-scale environmental features (soil characteristics, temperature and land-use patterns) to predict habitat suitability for *Plestiodon septentrionalis*. We identified suitable habitat using the locations from historical captures provided by the Manitoba Conservation Data Centre, locations of our own field captures from 2006, and literature reports on the habitat requirements of this species. Using a Geographic Information System (GIS) and data available from the Manitoba Land Initiative (MLI), three qualitative habitat suitability indices (low, moderate, high) were derived from specific combinations of soils, climate and land use criteria. Our model

identified suitable habitat centred around the Carberry and Lauder Sandhills; both areas are within the known distribution for this species. In addition, the model predicted suitable habitat in the Portage Sandhills and in the southeastern portion of Manitoba, neither of which have known prairie skink populations. We used field captures from summer 2007 to test the accuracy of the habitat suitability model. This habitat suitability model will aid in defining critical habitat for this endangered Canadian species.

0732 Fish Systematics IV, Salons A&B, Monday July 28, 2008

A Preliminary Molecular Phylogeny of Syngnathid Fishes

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Syngnathid fishes are a diverse, unique, and charismatic group that include over 50 genera and at least 278 valid species of pipefishes, seahorses, sea dragons, and pipehorses. Many syngnathids are heavily exploited for traditional Chinese medicines and the aquarium trade, and they occur in some of the ocean's most threatened habitats. Management of syngnathids is undermined by their challenging alpha taxonomy, and systematic relationships are unresolved at multiple levels. Many genera are monotypic, yet no study has measured the degree of evolutionary uniqueness of these lineages. Here, we present comparative nucleic acid sequence data derived from mitochondrial CO1, 12S, 16S and nuclear intron RP-1 of ribosomal gene S7. Fifty-two species from 36 genera were sequenced for a total multi-gene aligned sequence length of 4260 base pairs. Phylogenetic relationships were reconstructed using parsimony and Bayesian methods, with node support calculated through full heuristic bootstrap resampling. Caudal fin and brood pouch morphology, two characters previously applied to morphological phylogenies, were mapped onto the resulting phylogenetic hypotheses. The results do not support division of this group into the Hippocampinae (seahorses) and Syngnathinae (all other syngnathid lineages). Syngnathids exhibiting the tail brooding strategy (Urophori) do not form a monophyletic clade, with the abdominal brooding strategy (Gastrophori) sister to one clade of Urophori. While a suite of well supported clades suggest diversification patterns among some species and genera, including (Micrognathus + Syngnathus), (Filicampus + Trachyrhamphus), ((Kaupus + Pugnaso) + (Histiogamphelus) + (Vanacampus) + (Hypselognathus)), and (Doryrhamphus + Maroubra)), the relationships among these clades are unresolved. The weedy and leafy sea dragons form a monophyletic clade, but Haliichthys, the ribboned "sea dragon", is only distantly related. The 'pipehorse' genera Solegnathus, Syngnathoides, Acentronura, and Idiotropiscis are particularly problematic. Additional nuclear markers and thorough taxon sampling are needed to produce a molecular phylogeny sufficiently robust to support syngnathid taxonomy, systematics, biogeography, and conservation.

0015 General Ichthyology I, Drummond, Saturday July 26, 2008

Piscatorial Travelogue of the 2006 Expedition to Mongolia

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In August 2006 the All Catfish Species Inventory and Cypriniform Tree of Life Project sponsored a joint expedition to northeastern Mongolia to collect fishes and aquatic invertebrates. A total of 16 sites in four major drainages was sampled: Selenge, Kerulen, Onon and Halhin/Buyr Lake. The expedition yielded 12,308 fish specimens (12,302 formalin fixed plus 6 preserved for skeletons) representing approximately 35 species in 29 genera and 12 families. Tissue samples were preserved for approximately 300 specimens representing nearly all taxa from multiple drainages. The expedition website (<http://silurus.acnatsci.org/ACSI/field/Mongolia2006>) displays 115 images of live and preserved fishes plus additional images of collecting sites and habitats. The Amur catfish, *Silurus asotus*, was found in the Kerulen and Onon basins and Buyr Lake. Where sampled Buyr Lake was devoid of large adult fishes, apparently as a result of severe over-fishing. Two species found in the lake are newly reported for Mongolia and appear to have been recently introduced: *Abbottina rivularis* (Chinese false gudgeon; Family Cyprinidae) and *Rhinogobius* cf. *lindbergi* (Amur goby; Gobiidae). Highlights of the fish, fluvial and lacustral diversity of eastern Mongolia will be presented.

0014 Fish Systematics I, Salons A&B, Friday July 25, 2008

Revision of Recent *Doras* Lacepède, 1803 (Siluriformes: Doradidae) with Descriptions of Three New Species

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Recent *Doras* are newly diagnosed among Doradidae by the unique combination of maxillary barbel long and fimbriate; mesethmoid with rostral lateral margins converging towards pointed tip; single cranial fontanel anterior to epiphyseal bar and contained largely within frontals and anteriorly by mesethmoid; anterior nuchal plate wide, pentagonal to hexagonal, sharing distinct lateral suture with epioccipital and isolating supraoccipital from middle nuchal plate; nuchal foramina absent; coracoid process short, posterior tip finishing well short of that of postcleithral process; dentaries with acicular teeth; and skin ventral to postcleithral process perforated with conspicuous pores. One fossil species, †*D. dioneae*, and two nominal recent species, *D. carinatus* and *D. micropoeus*, are recognized as valid. Three additional recent species, *D. "phlyzakion"*, *D. "higuchii"* and *D. "zuanoni"*, are newly described from the middle Amazon and tributaries, lower Amazon tributaries,

and rio Araguaia (Tocantins drainage), respectively. *Doras* “phlyzakion” and *D. zuanoni* form a monophyletic group that is found in lowland, lentic habitats, and is characterized by numerous pores in skin on breast and abdomen, a trait unique among doradids and perhaps among all catfishes. The remaining recent species, *D. carinatus*, *D. higuchii* and *D. micropoetus*, with uncertain relationships, are found in upland, lotic habitats. The occurrence of *D. carinatus* in the Orinoco basin suggests a historical link between right-bank tributaries of the lower Orinoco (e.g., Caroní) draining the western Guiana Shield and more eastern rivers (e.g., Cuyuní-Essequibo) that drain the Shield directly into the Atlantic Ocean.

0493 General Herpetology I, Salons 4&5, Sunday July 27, 2008

Developmental and Ecological Impacts of European Buckthorn Invasion on Amphibians

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Emodin, a metabolic compound found throughout tissues of the invasive shrub European buckthorn, has been demonstrated to cause endocrine disruption in mammals. Given the aggressive growth of buckthorn around amphibian breeding ponds, effects of emodin on amphibian development are of great interest. We used FETAX (Frog Embryo Teratogenesis Assay-*Xenopus*) to determine if emodin affects development of amphibian embryos. The FETAX had 5 treatments; a negative control (Ringer's solution), a positive control (6-animonicotinamide), and emodin treatments of 1, 10, and 100 ppm. The negative control resulted in 18% mortality with 29% of surviving embryos exhibiting minor axial malformations. The positive control resulted in 42% mortality with 86% of surviving embryos exhibiting severe gut, tail, and notochord malformations. Emodin treatments of 1, 10, and 100 ppm resulted in 30%, 45%, and 100% mortality, respectively. In the 1 ppm emodin treatment, 90% of surviving embryos exhibited gut, tail, notochord, and eye deformities. In the 10 ppm emodin treatment, 100% of surviving embryos exhibited severe notochord and tail malformation, stunted growth, abdominal edema, and severe eye malformations. Development was too abbreviated in the 100 ppm emodin treatment to score malformations. To determine ecologically-relevant concentrations of emodin entering the ecosystem, High Power Liquid Chromatography was applied to European buckthorn leaves, fruit, and soil extracts. Soil samples from buckthorn-infested sites had emodin concentrations ≥ 2 ppm. Future work will include quantifying emodin in pond water. However, results presented here suggest emodin contamination resulting from invasive European buckthorn may represent an unrecognized threat to pond-breeding amphibians.

0731 Poster Session II, Saturday July 26, 2008

Histopathology of the Gills of *Astyanax fasciatus* and *Pimelodus maculatus* of Reservoir from Dam of Furnas, Brazil

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Fishes are often exposed to polluted water by industrial, agricultural and urban discharges. The gills play multiple functions such as respiration, nitrogen excretion wastes and ion- and osmoregulation and are the first organs contacting the external environmental. Histological studies focus on the cell structures and the severity of lesions to evaluate the organ function provides a useful tool to check pollution, sub-lethal and chronic effects and may be considered as a bioindicator. To evaluate the integrity of gills, fish (*A. fasciatus* and *P. maculatus*), water and sediment were sampled on six sites in the Furnas Power Plant reservoir, MG, Brazil, in July and December. The histopathologies were classified as hypertrophy and hyperplasia of gill epithelia, changes in mucous and chloride cells, blood vessels and necrosis. *A. fasciatus* shows hypertrophy of gill epithelia, lamellar epithelial lifting and rupture, hypertrophy and hyperplasia of chloride cells and rare focus of necrosis, while *P. maculatus* shows hypertrophy and hyperplasia of gill epithelia and chloride cells, complete fusion of several lamellae, lamellar epithelial lifting, aneurysms and focal necrosis. The presence of organochlorides and heavy metal on the water and sediment may be related to histopathological tissue damage in these species. Financial support: Furnas Centrais Elétricas S.A., FAPESP, CNPq, CAPES

0189 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

Historical and Emergent Stressors Acting on Amphibian Populations on Agricultural Landscapes: Assessing Risks, Effects, and Conservation Programs

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Based upon the results of an international workshop in St. Louis, Missouri, in 2007, intensive agricultural land use continues to cause dramatic changes to ecosystems worldwide. These changes occur primarily due to habitat loss and fragmentation, hydrologic alterations, and applications of pesticides and fertilizers. More recently, production of crops for biofuels, the use of genetically engineered organisms, and emergent diseases have become agents for further change to the ecological structure within agricultural landscapes. It also is clear that direct, indirect, and interactive effects of historical and emergent stressors must be considered within the context of climate change. Given overlap between amphibian species richness, land-use

changes within existing agricultural landscapes, and new conversions of native habitat to agricultural production, we need integrated assessments of the ecological effects agricultural practices cause in concert with other stressors and the effectiveness of conservation programs to mitigate them. In the midwestern United States, we are using geospatial and hydrologic analyses and modeling, linked to sampling *in situ*, to study risks and effects from these stressors for amphibian populations. We also are studying outcomes of the U.S. Department of Agriculture's Conservation Reserve Program (CRP) and Wetland Reserve Program (WRP) for amphibian populations. Results thus far suggest varying combinations of agricultural and non-agricultural stressors pose differential risks to amphibian populations across the Midwest. Populations persist, but trends in relation to stressors generally are unknown and continued reductions in the quantity and quality of habitat are likely. Consequently, conservation programs such as the CRP and WRP are critically important. While these programs have helped conserve and restore terrestrial and wetland habitats in heavily farmed landscapes, and we are working to evaluate resultant benefits for amphibian populations, placement of these sites might need to be considered more strategically from an ecological perspective.

0168 Poster Session I, Friday July 25, 2008

Interrelationships and Historical Biogeography of Cypriniform Fishes (Actinopterygii: Ostariophysii): Evidences from Mitochondrial Genomics Placed Familial/Subfamilial Branching and Intercontinental Exchanges Older Than Fossil Records

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Order Cypriniformes (Actinopterygii: Ostariophysii) comprises more than 3400 species placed in five to eight families and restricted almost entirely to freshwaters. Our previous study comparing whole mitochondrial genomes from 53 taxa, with rooting from six outgroup taxa, resolved many of the interrelationships among families and subfamilies. The present study includes seven additional mitochondrial genomes of *Gila conspersa* and *Mylocheilus caurinus* from Western North America, *Pseudogobio esocinus* from East Asia, *Paralaubuca typus* from South Asia, *Raiamas senegalensis* from Africa, *Labeo boga* from South Asia, *Ictiobus bubalus* from Eastern North America and re-sequenced *Crossostoma lacustre* from South Asia. Addition of these taxa makes our taxon sampling more geographically representative with at least one taxon sampled for subfamilies or tribes with intercontinental ranges. Unambiguously aligned concatenated sequences (14,594 bp) were divided into seven partitions (first, second and third codon positions of protein-coding genes, stem and loop regions of rRNA and tRNA genes). Partitioned maximum likelihood analysis

with RY coding for third codon positions of protein-coding genes strongly reconfirmed the framework of our previous Bayesian analysis. Lower bootstrap support for the ML tree and higher probabilities for alternative topologies indicated branches with low reliabilities and indicated problems to be solved in the future. Bayesian divergence time analysis based on the amino acid sequences with the sarcopterygian-actinopterygian split as a calibration point (4.19-4.72MA) revealed most branching nodes in Cypriniformes were much older than known fossil records. Dispersal-vicariance (DIVA), a parsimonious and gain-loss ratio analyses of historical taxon biogeography at the subfamilial level indicated the initial geographic range of the Cypriniformes was in south-eastern Laurasia (present-day South Asia).

0036 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008; GRUBER

Diet and Trophic Position of *Mobula thurstoni* and *Mobula japonica* as Inferred from Stable Isotopes of Nitrogen and Carbon

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Mobula thurstoni and *Mobula japonica* are two of the five mobulid species present in the Gulf of California. They have been an important component of the artisanal elamosbranch fishery of Mexico, but are presently protected as their populations are vulnerable to over-exploitation. Stable isotopes of nitrogen and carbon were used to infer the diet and trophic position of *M. thurstoni* and *M. japonica* in the SW Gulf of California. A total of 32 *M. thurstoni* and 6 *M. japonica* muscle samples were obtained from May 2006 to January 2007. Eleven monthly diurnal and nocturnal plankton tows were carried out from March to November 2006. We analyzed stable isotopes of *Nyctiphanes simplex* (a euphausiid, and the mobulid's most probable prey) as well as of herbivorous, carnivorous and omnivorous zooplankton. Based on isotopic fractionation between mobulids and their potential prey, we conclude that both mobulid species fed on *N. simplex* and not on other zooplankton groups analyzed. We calculated a trophic level of 3.43 for *M. thurstoni* and 3.48 for *M. japonica*. The isotopic signal of zooplankton varied with oceanographic conditions, with lower $\delta^{15}\text{N}$ values in times of higher productivity.

0468 Poster Session II, Saturday July 26, 2008

Biological Aspects of Some Sciaenid Species from the Marine Area Along the Via Parque Isla De Salamanca, Colombian Caribbean

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Monthly samples of fish captures using a chinchorro (dragging net) were carried out in the Caribbean marine shore of the Via Parque Isla Salamanca (departamento de Magdalena, Colombia). The sampling period covered two climatic seasons: rainy (September-November, 2006) and dry (February-April, 2007). The sciaenid species registered were *Larimus breviceps*, *Micropogonias furnieri*, *Stellifer venezuelae*, *Paralonchurus brasiliensis*, *Umbrina coroides*, and *Menticirrhus littoralis*. Some biological aspects, such as length-weight correlation, size structure, sex ratio, and maturity states, of the three more abundant species [shorthead drum (*L. breviceps*), whitemouth croaker (*M. furnieri*), and Venezuelan stardrum (*S. venezuelae*)] were studied. Size-weight regressions estimated for shorthead drum (n=67), whitemouth croaker (n=39), and Venezuelan stardrum (n=44) were $w = 0.0041 L^{3.4027}$, $w = 0.0057 L^{3.205}$, and $w = 0.0017 L^{3.7255}$, respectively; all species showed allometric growth. For shorthead drum a size structure ranging between 9 and 21.9 cm and a sex ratio of 2.94 females for each male were established. Gonad states were variable for this species: juveniles were found from February to March, and states II to IV were present along the whole study period. For whitemouth croaker the most abundant sizes were 17-23.9 cm and a sex ratio of 1.05 males: 1 female was found; gonad states were variable for this species: juveniles, maturing, and mature specimens were found in all months, but spent individuals appeared only in September and October. Most Venezuelan stardrum were captured between 13-14.9 cm, with sizes ranging from 8 to 16.9 cm, male-female ratio was 0.62:1. Specimens in states I, II, III, and IV were found between September and October and spent individuals appeared only in October.

0334 Poster Session I, Friday July 25, 2008

Age and Growth of the Silky Shark, *Carcharhinus falciformis*, on the West Coast of Baja California Sur, Mexico

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The age and growth of the silky shark, *Carcharhinus falciformis*, caught from August 2000 to October 2002 on the west coast of Baja California Sur, Mexico, are described. In total 252 sharks were registered, mainly between June and November. The ages of 145 organisms were estimated using vertebra growth marks. The females were between 88 and 230 cm total length (TL), and the males between 142 and 260 cm TL. The relationship of vertebra radius to TL showed a rectilinear tendency with a coefficient of determination $r^2 = 0.94$, indicating that vertebrae are useful for age estimates and description of growth in this species. It was assumed that growth

marks have annual periodicity and that the opaque band is formed during summer and fall. The estimated age for females was between 2 and 16 years, and for males between 3 and 14 years. No significant difference between sexes in size or age was detected. The estimated parameters for the growth model of von Bertalanffy for combined sexes were $L_{\infty} = 240$ cm TL, $k = 0.138$ year⁻¹ and $t_0 = -2.98$ years. According to the growth model, the silky shark averages 20 cm growth in the first year of life; 16 cm/year between 2 and 4 years; 10 cm/year from 5 to 7 years; 6 cm/year in the next 4 years and 3 cm/year or less after 11 years of age. It was determined that females and males reach sexual maturity between 7 and 8 years of age.

0689 Fish Systematics IV, Salons A&B, Monday July 28, 2008

A Molecular Phylogeny of the Grunts (Perciformes: Haemulidae) Inferred from the Nuclear RAG1 and COI Gene Sequences

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We infer a phylogeny of the haemulid genera using approximately 1386 base pairs of the nuclear Recombination Activation Gene-1 (RAG1) from 35 haemulid species representing 13 genera, one species of the closely related Inermiidae, and two species of the outgroup Sparidae. This analysis is corroborated using approximately 650 base pairs of the mitochondrial Cytochrome Oxidase I (COI) gene and RAG1-COI combined gene analyses. Results show strong support for a monophyletic Haemulidae. However, the placement of Inermiidae within the proposed superfamily Haemuloidea remains unresolved. The subfamilies Haemulinae and Plectorhinchinae are recovered from both maximum parsimony and maximum likelihood analyses using RAG1, COI, and RAG1-COI genes combined. The RAG1 gene phylogeny combined with distribution data also revealed a biogeographic pattern that suggests a specific radiation of haemulids. There was strong support for a basal paraphyletic Old World (coastal Eurasia, Africa, Australia, and western central Pacific) group, a derived monophyletic New World (coastal Americas) group, and an intermediate Old World-New World group, which can be accounted for by the closing of the Tethys Sea and widening of the Atlantic Ocean. In addition, molecular data using RAG1 and COI genes highlighted potential problems regarding the validity of several haemulid genera and suggest a re-evaluation of these genera. Finally, this study indicates that the nuclear RAG1 gene is useful for inferring phylogeny at the intrafamilial level for this percoid family of fishes.

0643 Poster Session I, Friday July 25, 2008

Histology of Lateral Line in Embryos of *Potamotrygon motoro* (Chondrichthyes: Potamotrygonidae)

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Potamotrygon motoro is a stingray restrict to freshwater environment. It exhibit benthonic habits, unrelated with morphological findings of neuromast pore channel distribution on the lateral line. The purpose of this study was examined by light and scanning electron microscopy the lateral-line sense organs in the embryos skin of freshwater stingray *Potamotrygon motoro* in four different stages of embrionary development. The neuromast is composed by a sensory hair cell, surrounded by support cell, mantle cell, and a jelly cupula. Some degenerated sensory cell was presented, and this fact is related with cell turnover. As the animals develop toward later embryo stages, the epidermis surface becomes thickened and the number of neuromasts higher. The neuromast morphology is similar in stage 3 and 4 of embrionary development.

0252 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Variation in Bufadienolide-Based Chemical Defenses of the Natricine Snake, *Rhabdophis tigrinus*, in Japan

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Recent studies have documented that the Asian natricine snake *Rhabdophis tigrinus* sequesters its chemical defenses from a dietary source. The defensive nuchal glands of *R. tigrinus* contain a variety of bufadienolide toxins that ultimately are derived from toads consumed as prey. Recent studies have identified 17 bufadienolides from nuchal glands of *R. tigrinus* and have revealed modest variation among snakes in bufadienolide composition (a measure of the type, number, and quantity of bufadienolides present). The observed variation in toxins of *R. tigrinus* may reflect patterns of chemical variation in their bufonid prey and likely has important implications for the efficacy of chemical defense in these snakes. In this study, we further examine variation in bufadienolide composition of *R. tigrinus* by comparing samples from 42 locations within Japan. We describe patterns of variation in composition between sexes, among syntopic individuals, and among individuals from different locations. We use multidimensional scaling (MDS) as a graphical tool for the visualization of differences in bufadienolide composition, and analysis of

similarity (ANOSIM) to detect statistical differences in composition. This study reveals considerable variation in bufadienolide composition among individuals of *R. tigrinus*. We identified more than 35 bufadienolides, including more than 20 new bufadienolides from *R. tigrinus* that will require further characterization. This variation may result from differences in the composition of ingested bufadienolides (perhaps reflecting regional variation among populations of toads) and/or modification of bufadienolides by the snakes. Whether the widely varying combinations of compounds observed among *R. tigrinus* differ in their effectiveness as defensive chemicals remains to be determined.

0674 Herp Systematics, Drummond, Friday July 25, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

A Time-Calibrated Phylogeny for *Anolis*

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The origins of terrestrial Caribbean fauna remain mysterious and competing hypotheses may be grouped into those proposing vicariance or dispersal. The lizard genus *Anolis* is notably diverse and ubiquitous on Caribbean islands, as well as being spread throughout neighboring continental regions. Our goal is to generate a time-calibrated molecular phylogeny for the anole radiation and to use this phylogeny to evaluate competing biogeographic hypotheses for the origin of the West Indian biota. Our phylogeny results from analysis of multiple nuclear genes and a 1,200 bp fragment of mitochondrial DNA. Although only one meaningful calibration for this phylogeny can be obtained from the fossil record, a growing number of biogeographic calibrations are becoming available. Use of these dates has the advantage of including a broad spectrum of calibration dates scattered across the phylogeny. Additionally, the diversity of anole lineages often permits calibration of multiple nodes with the same biogeographic event. Thus, whole-tree validation procedures allow for a thorough evaluation of individual calibrations and individual dating events.

0191 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Permanently Aquatic Salamander Dispersal Capabilities; Implications For Wetland Connectivity

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Amphibians inhabiting isolated wetlands rely on terrestrial landscape connectivity between wetlands for long-term population persistence. Research focusing on the role of landscape connectivity for amphibians has been restricted to species with a terrestrial life-stage component. Although permanently aquatic salamanders are commonly encountered in isolated wetlands, their movement ecology has yet to be conclusively determined. For these salamander species, temporary waterways formed during heavy rains may provide transient dispersal opportunities between otherwise isolated wetland patches. We assessed the vagility of two obligate aquatic salamanders, greater siren (*Siren lacertina*) and two-toed amphiuma (*Amphiuma means*), by running them on a Living Stream track under three simulated environmental conditions: terrestrial dispersal (damp but no standing water), shallow standing water (one centimeter of water), and complete submergence (approximately five centimeters of water). Both species demonstrated a trend towards exhaustion in the 0cm and 1cm treatments, and failed to move more than 8m in either treatment. As expected, animals in the fully submerged treatment were the most vagile and showed little to no tendency to exhaust. Physical characteristics (body length, mass, and condition) did not affect dispersal ability. An aquatic corridor in which these salamanders are completely submerged is the likely method of movement. Therefore, maintaining the surrounding landscape to allow formation of temporary waterways is important for successful inter-wetland movement. Human activities that alter flooding events and watershed connectivity, such as flood control regimes and roads, may have important implications for wetland connectivity, and thus metapopulation viability of permanently aquatic salamanders.

0203 Poster Session III, Sunday July 27, 2008

Patterns of Fish Diversification in the Lower Congo River Rapids Region of West Central Africa

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The Congo River forms one of the largest biogeographical barriers in Africa – yet we know remarkably little about the history of the system. Geologists estimate that perhaps as recently as 400,000 years ago the Congo was a large lake with no outflow to the Atlantic. At some point the Congo breached the Batéke Plateau in the region of present day Malebo Pool (ex-Stanley Pool), most of the lake was drained and a

“new” river cascaded down through gorges of the Crystal Mountain region, dropping 280m over 350km to reach the Atlantic Ocean. Today, some of the most spectacular rapids on Earth and a rich endemic fish fauna are found in the lower Congo River between Pool Malebo and the Atlantic. Its peculiar hydrology, with a linear array of variously sized rapids, pools and runs represents a biohydrologic model system for exploring patterns of species richness and endemism in the region. In this study, molecular and morphological differentiation is examined in endemic species from three genera of small cichlids, *Teleogramma*, *Lamprologus*, and *Thoracochromis*, and in the cyprinid, *Garra congoensis*, all of which are distributed throughout the lower Congo rapids region. For the morphological component, landmark based geometric morphometric studies were conducted, focusing on both whole-body external shape and cranial anatomy. Principal Components Analysis (PCA) revealed separation among many geographical populations, but with some overlap. In contrast, molecular analyses using mitochondrial CO1, ND2, and *cyt-b* revealed a marked separation between populations on opposite banks of the Congo, separated by an intervening rapid, at some localities; microsatellite data are now being assimilated to further elucidate these patterns. This hidden molecular diversity poses challenges to current taxonomy and illuminates patterns of differentiation across geographic axes, potentially elucidating mechanisms driving speciation in the lower Congo River.

0059 Poster Session III, Sunday July 27, 2008

Detection of Wood Frog Egg Masses and Implications for Monitoring Amphibian Populations

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Annual counts of egg masses have been promoted as an appropriate state variable for monitoring populations of some amphibian species. However, if some egg masses are not detected and detectability changes over time, the use of egg mass counts is unreliable. Variation in counts of egg masses may be indicative of variation in actual abundance or variation in detectability. We used closed capture-recapture models to estimate detection probability and evaluate potential sources of variation in the detectability of Wood Frog (*Rana sylvatica*) egg masses in a pond in Rocky Mountain National Park in 2003 and 2004. Model selection results and model-averaged estimates provided evidence that detection probability varied between years. However, we found no evidence of variation between observers within each year. The results of this study provide additional evidence that detection probability needs to be accounted for if egg mass counts are to be used to infer abundance and population trends in amphibian populations.

0471 Fish Systematics I, Salons A&B, Friday July 25, 2008

Molecular Systematics and Morphological Variation in Mountain Catfishes (Amphiliidae, *Amphilius*) in Guinea, West Africa

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A morphometric and molecular analysis was performed on specimens identified as *Amphilius* from Guinea, West Africa. Specimens and tissue samples of *Amphilius atesuensis*, *Amphilius rheophilus*, and *Amphilius platyichir* were collected in the streams of the Fouta Djallon, Zone Forestière, and coastal drainages during expeditions in 2003. A geometric morphometric (GM) analysis showed significant morphometric variation within the *A. platyichir* complex. The GM analysis also showed significant morphometric variation within the *A. rheophilus* complex. Phylogenetic analysis of partial sequences of mitochondrial cytochrome *b* gene revealed three distinct clades corresponding to *A. platyichir*, *A. atesuensis*, and *A. rheophilus*. Within the *A. platyichir* clade well supported deep divergence was observed between specimens from the Fataala River and those from the Konkouré, Gambie, and Senegal River basins. The *A. rheophilus* clade displayed well supported divergence between specimens from the Rio Corubal basin and those from the Senegal River basin. This divergence corresponds to the significant morphometric variation observed with the GM analysis.

0033 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008;
STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Occipito-Vertebral Gap: The Complex Structure of the Anterior Part of the Vertebral Column in Barbeled Dragonfishes (Stomiidae, Teleostei) and its Phylogenetic Implications

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The Stomiidae were traditionally placed in six separate families. Fink (1984, 1985), reanalysed stomiid intrarelationships, based primarily on osteological characters and parts of the soft anatomy, and presented evidence for uniting the six stomioid families into one. Today these families are designated as subfamilies within the Stomiidae (Nelson, 2006), but there is a high degree of homoplasy in the datasets, and existing morphological data suggest that most subfamilies are not monophyletic. In most stomiid genera there is a huge gap between the skull and the first fully ossified vertebra, within which only the flexible notochord persists. Several morphological studies in the early 20th century revealed that 15 stomiid genera have one to ten of the anteriormost vertebrae reduced or absent. However the restructuring of the anterior portion of the vertebral column has never been included as a character in phylogenetic analyses, because it is poorly understood. Comparative study of the insertion of the anteriormost myosepta in all 28 genera

provides new insight into the morphology of the anterior part of the vertebral column. Counting the spino-occipital nerves provides an additional source of information about the number of reduced vertebral centra, and investigation of larval morphology sheds light on how the absence of vertebral centra arises through ontogeny. With this new approach a revision of the previously reported number of reduced or absent vertebrae shows that only in two stomiid genera (*Chauliodus* and *Eustomias*) are vertebral centra indeed lost, with their respective neural arches and parapophyses persisting. In all other genera the extensive occipito-vertebral gap is not a consequence of reduced vertebrae, but of an elongation of the notochord. The complex structure and ontogeny of the anterior part of the vertebral column appears to offer valuable information for the elucidation of stomiid phylogeny.

0660 Poster Session I, Friday July 25, 2008

A Preliminary Revision of the *Dionda Episcopa* Complex

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Accurately defining species is critical to protecting biodiversity because species are usually the biological units that receive legal protection and are the elements of comparative studies. Several species concepts have been proposed in the literature and were grouped into four categories by Johnson *et al.*, 2004: 1) phylogenetic species concept; 2) similarity species concept; 3) ecological species concept; and 4) biological species concept. The diversity of *Dionda* inhabiting the Rio Grande Basin has had a confused taxonomic and systematic history, mostly due to the overall morphological similarity and the lack of a comprehensive study of the complex. This group of small North American cyprinids represents the currently restricted genus *Dionda sensu stricto*, separate from a new genus containing other species formerly in *Dionda* in Mexico (Schönhuth *et al.*, in press). Among all the species of *Dionda*, only *D. diaboli* has remained taxonomically stable since its original description, while the other nine described forms (*D. melanops*, *D. argentosa*, *D. serena*, *D. nigrotaeniata*, *D. couchi*, *D. texensis*, *D. papalis*, *D. flavipinnis*, *D. punctifer*) have been considered synonyms or subspecies of *D. episcopa* (Miller, 1991; Mayden *et al.*, 1992). *Dionda* currently includes at least six recognized and described species, but their boundaries, delimitation and characterization have never been satisfactorily addressed. In this study, we undertook a genetic survey (2 mitochondrial and 2 nuclear genes), to test species boundaries. These data reveal 12 species that currently comprise the genus *Dionda* and we propose some junior synonyms to be elevated to full species.

0348 Herp Genetics, Salons A&B, Sunday July 27, 2008

Genetic Population Structure of the Sand Skink (*Plestiodon reynoldsi*) within Scrubs in Florida

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The sand skink, *Plestiodon reynoldsi*, is a fossorial lizard that is restricted to scrub habitat on the central ridges of peninsular Florida. The sand skink is threatened throughout its range. Urban and agricultural development of its naturally fragmented habitat poses a conservation threat. As a result of natural fragmentation, barriers to gene flow may already exist at a fine-scale, and further development may have a negative impact on the genetic diversity of *P. reynoldsi*. Previous research finds genetic structure among discrete geographic samples across the range of *P. reynoldsi*. The goal of this study is to conduct a more fine-scale examination of the extent of gene flow within and between scrub patches using multiple microsatellite DNA loci. We screened multiple microsatellite loci in individuals ($n > 300$) from the scrub surrounding the Archbold Biological Station near Lake Placid, Florida. The Archbold region has patches of unsuitable wetland habitat, which may serve as barriers to gene flow, as well as regions of more homogeneous scrub habitat. We also screened individuals ($n = 10 - 50$) from multiple samples of a less fragmented scrub habitat and additional discrete geographic samples from central Florida. Individual-based assignment testing, estimates of genetic differentiation, and spatial genetic analyses will be used to investigate population structure among all individuals sampled. The Archbold sample (highly fragmented) will be compared to the other samples (less fragmented) to investigate the effect of fine-scale fragmentation on the genetic diversity of sand skink populations. Additionally, we will investigate possible effects of a managed burn regime on sand skink population structure within the Archbold samples.

0755 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Effects of Hurricane Disturbances on Herpetofaunal Communities in Southeastern Louisiana

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Reptile and amphibian community dynamics are understudied in Southeastern Louisiana even though major habitat changes and climatic events have occurred over the last several decades. Standard transect field surveys were conducted in levee and marsh habitats of the Manchac Wildlife Management Area and in a nearby swamp habitat, diurnally and nocturnally once a month from October 2002 to November 2004 and again in March 2005 to November 2006 to identify herpetofaunal communities. During the course of this study three hurricanes (Ivan, Katrina, and Rita) caused extensive flooding in the survey sites, which allowed us to compare

species richness, diversity, community assemblage, and abundance before and after hurricane events. We observed the highest herpetofaunal species richness in the swamp habitat (23 species), followed by levee (21 species) and marsh (15 species) habitats. Herpetofaunal diversity was greatest in marsh habitat ($H' = 2.082$), however the swamp habitat harbored the highest number of unique species. Overall, herpetofaunal diversity decreased and evenness increased in each habitat following hurricanes Ivan and Katrina. Most species showed a decline in abundance throughout the study, however species were differentially affected causing shifts in dominant species. Significant saltwater input was recorded in marsh and levee habitats, but not in the swamp. Changes seen in herpetofaunal diversity and abundance may amount to long-term effects to community structure and ecosystem dynamics of the study area.

0612 Herp Systematics, Drummond, Friday July 25, 2008

Phylogenetic Analysis of South American Liolaemini Lizards Using Nuclear and Mitochondrial DNA

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Phylogenetic relationships among over 90 species of Liolaemini lizards are examined using combined and separate analysis of mitochondrial and nuclear DNA sequence data. All major lineages within *Liolaemus* and *Phymaturus* are included. Over 3200 base pairs of nuclear DNA encoding TLR7 and GJA1 are analyzed using parsimony, maximum likelihood, and reversible jump Bayesian methods and subsequently combined with approximately 1750 base pairs of mitochondrial data from the region spanning ND1-COI. Phylogenetic hypotheses generated from both nuclear DNA regions are congruent with those derived from mtDNA data alone. Combined analyses provide robust support for relationships among most major clades of Liolaemini lizards. The utility of TLR7 and GJA1 as informative nuclear markers for herpetological systematics will be discussed.

0451 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Stability, Fragility and Resilience: Demography and Life History of Mt. Chappell Island Tiger Snakes

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In populations, stability can refer to the persistence of demographic structure when challenged by unpredictable change. One such change, loss of individuals of a particular age group, could imbalance this stability unless other ecological factors lead to recovery. This recovery is a collective variable known as resilience, an understanding of which may demonstrate the overall behaviour of the system. Mt. Chappell Is. in the Furneaux Group in Bass Strait, near Tasmania, with an area of about 300 hectares, supports a single species of snake, the tiger snake (*Notechis scutatus*: Elapidae), with the largest average adult body sizes of any conspecific population on islands or mainland areas. The great size of these adult snakes appears related to their sole prey, hatchlings of the short-tailed shearwater, or muttonbird (*Puffinus tenuirostris*). A quarter million shearwaters breed annually on Mt. Chappell Is. and chicks are available as prey for the snakes for only about five weeks. Seasonal sampling and metabolism of radioactive isotopes determined that adults must starve between feeding periods. Mark-release-recapture studies over 10 consecutive years of field work show that yearly adult population sizes average 2701 ± 568 and survivability estimates average 0.98 ± 0.21 . Growth models suggest 10 years for neonates to reach maturity. Adult male and female numbers are nearly equal and only half of the females are reproductively active each year. Nevertheless, annual reproductive potential is 11,250 neonates, with little apparent recruitment of juveniles into the adult population. Historical records show that in the 1950's 500+ adult snakes (18.5%) were removed from the island, most in only a few days. The mechanism of recovery in the current population is unknown. As a possible scenario, if juvenile mortality is due to starvation from intense intraspecific competition for small lizards and the inability of larger juveniles to catch small lizards, loss of adult females could reduce the number of young snakes born each year and raise the per capita availability of lizard prey. Greater juvenile survival to a size capable of swallowing a muttonbird chick could restore the adult populations to previous levels. This apparent resilience, speculative but believable, suggests that the adult population size may regulate the K-levels of juveniles.

0637 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Insights from Imperfect Data: Climate Change, Disease, and Amphibian Declines

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We review the evidence for the role of climate change in triggering disease outbreaks of chytridiomycosis, an emerging infectious disease of amphibians. Both climatic anomalies and disease-related extirpations are recent phenomena, and effects of both are especially noticeable at high elevations in tropical areas, making it difficult to determine whether they are operating separately or synergistically. Reports of amphibian declines from Lower Central America and Andean South America were compiled to create maps and construct statistical models to test our hypothesis of spatiotemporal spread of the pathogen *Batrachochytrium dendrobatidis* (*Bd*), and to update the elevational patterns of decline in frogs belonging to the genus *Atelopus*. Claims of climate change influencing the spread of *Bd* were evaluated by including error into estimates of the relationship between air temperature and last year observed. Similarly, we evaluated spatiotemporal patterns of pathogenic spread by incorporating error into estimates of dates of decline. Available data support the hypothesis of multiple introductions of this invasive pathogen into South America and subsequent spread along the primary Andean cordilleras. Additional analyses found no evidence to support the hypothesis that climate change has been driving outbreaks of amphibian chytridiomycosis, as has been posited in the climate-linked epidemic hypothesis. Future studies should increase retrospective surveys of museum specimens from throughout the Andes and should study the landscape genetics of *Bd* to map fine-scale patterns of geographic spread to identify transmission routes and processes.

0013 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Commercial Harvesting of Turtles: A Possible Disconnect Between Theory, Empirical Data, and the “Real World”?

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Historically, many freshwater turtle populations in North America have been harvested heavily for food and the pet trade. However, a series of recent field and simulation studies indicate that, for many (if not most) species of turtles, commercial harvests cannot be considered sustainable. Despite these studies, commercial harvests for turtles continue in many states and federal lands and other states have implemented restrictions only in the past few years. In addition, some resource agencies have declined to restrict harvesting on the basis of lack of evidence. In this

paper we (a) review the available literature on the impacts of harvesting on turtle populations, (b) review a series of case studies where turtle harvesting regulations have been proposed and either adopted or rejected, and (c) discuss why there appears to be a “disconnect” between field data and population models on the one hand, and actual practices by management agencies on the other.

0692 Poster Session I, Friday July 25, 2008

Evolutionary Relationships of the Frog Genus *Callulops* (Anura, Microhylidae)

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Papua New Guinea remains an area of high biodiversity, this is particularly true regarding amphibian richness. The frog amphibian communities are part of this high diversity and many species remain undescribed. Understanding alpha diversity is important and preliminary step to assess phylogenetic relationships for any group of organism. Among frogs, the family Microhylidae is represented in New Guinea by the subfamily Asterophryinae and these are among the frogs for which we have the least amount of data. Herein, we present preliminary data on the diversity and relationships of the genus *Callulops*. The genera *Xenobatrachus*, *Hylophorbus*, *Oreophryne*, *Austrochaperina*, and *Cophixalus* are used as outgroups. We sequenced a fragment of about 900 basepairs the 12S mitochondrial ribosomal.

0254 Fish Ecology II, Salons A&B, Monday July 28, 2008

What Happened to Small Scales? The Balance between Spatial Scales in the Distribution and Co-occurrence of Stream Fish Communities

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Contemporary ecology is greatly interested in understanding processes that take place at broad or regional scales, emphasizing spatial organization and dispersal of individuals as important agents linking and structuring aquatic systems. Although important, this view is compelling ecologists to focus in increasingly larger scales, neglecting variation at very small scales that perhaps are deemed no longer important. Given their physical constraints, stream systems are ideal to understand how different spatial scales influence community structure, species distributions and patterns of co-occurrence among fish species. Streams are often organized as a sequence of pools, riffles and runs. This organization allows replicated conditions at different spatial scales regarding habitat type (micro and macrohabitat) and environmental heterogeneity (within and across sites). In this study, we present the results of a field survey of several streams that aimed at assessing the links between

habitat variation and fish distribution at the microhabitat, reach and catchment scales. Our results indicate that a great proportion of the variation in fish distribution and co-occurrence occurs at the microhabitat scale, demonstrating the need of considering ecological patterns also at very small scales. In addition to describing these results, we will also discuss an analytical framework for determining the levels of variation in fish distribution and fish community-environment relationships at multiple scales.

0304 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Diet of the Kemp's Ridley Sea Turtle, *Lepidochelys kempii*, along the Upper Texas Coast

Erin Seney

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All life stages of the critically-endangered Kemp's ridley sea turtle, *Lepidochelys kempii*, seasonally inhabit the northwestern Gulf of Mexico. An ontogenic shift occurs at about age two, when juveniles leave pelagic *Sargassum* mats for coastal areas, where they forage on benthic invertebrates. Diet characterization, therefore, can be utilized to determine life history stage, as well as important prey types. Fecal samples were collected from 17 immature ridleys (18.6-41.2 cm straight carapace length [SCL], mean=32.3 cm, SD=5.5 cm) encountered in Galveston County, Texas as recreational hook-and-line captures (n=15) or strandings (n=2) during 2005-2007. Samples were also collected from a subadult (58.2 cm SCL) that stranded in Matagorda County and an adult female (62.8 cm SCL) captured offshore Jefferson County. Over half of the samples (53%) contained blue crab (*Callinectes sapidus*) or *Callinectes* spp., and other common prey included calico crab (*Hepatus ephiliticus*), hermit crabs, and worm tubes. *Sargassum* was found in 53% of samples, whereas 58% contained shell hash and/or rocks. Five ridleys (26.1-41.2 cm SCL) had consumed both *Sargassum* and bottom material, indicating the upper Texas coast serves as habitat for new recruits transitioning from the pelagic stage. In addition to providing foraging opportunities, this geographical region puts ridleys at risk for interactions with human activities, as evidenced by samples containing a candy wrapper (n=1), aluminum (n=1), and mullet (*Mugil* sp.), a common bait (n=1). The impacts of anthropogenic factors such as competition with commercial fisheries for prey, interactions with recreational fishing, and debris ingestion within this developmental habitat should be reviewed by managers to ensure the species' recovery. Future research will include sample collection during 2008 and subsequent analysis of 2005-2008 data. Staff at the NOAA Sea Turtle Facility assisted with turtle response, care, and sample collection. EES is supported by a Texas A&M University Tom Slick Graduate Fellowship.

0242 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Reproduction of Three Species from the Mobulidae Family in the SW Gulf of California, Mexico

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The highest mobulid catches in Mexico occur in the southwest Gulf of California. There is, however, a lack of information about the general biology and reproduction of the dominant species in the catch. During two years (2002 and 2004) we collected 358 mobulid samples in the fishing camp of Punta Arena de la Ventana. The most abundant species was *Mobula japanica* (37%), which we established that sexual maturity was reached at 200cm DW using the length and calcification of claspers in males from different sizes, and oocytes development and oviduct condition in females. We suggest that *M. japanica* gives birth during May and June, and mating occurred during July to August. The second most abundant species was *Mobula munkiana* (36%). There was size segregation and sex segregation depending on the time of year. *Mobula munkiana* individuals attained sexual maturity at 100 cm DW; we suggest that they give birth in May and June and mate in July and August. The least abundant species was *Mobula thurstoni* (27%). For this species the sexual maturity was attained at 150 cm DW. This species gave birth in July and August and mating occurred in September and October. We found that mobulid species analyzed, had functional only the left ovary and oviduct, and only one pup by reproductive cycle. The mating season happen during summer and fall; however the mating months were different in each mobulid species.

0615 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT SYSTEMATICS/EVOLUTION

An Introduction to FISH-BOL, the Fish Barcode of Life Initiative

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Indonesia is home to several hotspots of global biodiversity. One of them - Wallacea - includes the island of Sulawesi, the Moluccas, and the Lesser Sunda Islands. We have used DNA barcoding and also nuclear loci to test for areas of genetic endemism (AGEs) in the largest and second largest islands of the Wallacea hotspot, Sulawesi and Halmahera. On Halmahera, our results from 14 sympatric species of herpetofauna indicate that there is very little genetic between populations on different peninsulas, although these Halmahera species do appear distinct from those on surrounding islands. This story is contradictory in our findings in the neighboring island of Sulawesi. Our work on one group of *Limnonectes* frogs showed

genetic structure distributed congruently to paleo-island boundaries. For our future work, we will further use phylogenetic and population genetic approaches on other islands thus allowing for inter-island analysis in this complex region. We want to discover how species became distributed and their migration routes between these islands. Our studies can be used as background towards conservation management policies, especially concerning the connectivity between islands. So far our studies show on Halmahera and Sulawesi show a sharp contrast, which shows that for within island policies, these two islands must be treated differently.

0642 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Managing Amphibian and Reptile Biodiversity in California's Great Central Valley

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The Great Central Valley of California is one of the richest, most productive, and most intensively utilized agricultural landscapes in North America. It is also an area rich in both plant and metazoan biodiversity, with extremely high levels of endemism. The separation of the Great Central Valley from adjacent landscapes in southern California has been identified as one of the most significant phylogeographic barriers in western North America, and virtually every species of amphibian or reptile that has been examined shows a significant, potentially species-level divergence across the Tehachapi range in southern California. In addition, most species of amphibians and reptiles that inhabit the Valley have either been extirpated, restricted to marginal habitat at the periphery of their range, or are extremely rare, primarily because of agricultural activities and habitat degradation. Our recent work on the California Tiger Salamander, *Ambystoma californiense*, suggests that the species is deeply subdivided genetically across its Central Valley distribution, and that it is threatened or endangered across its range. Our multi-year landscape ecological study of the species demonstrates that individuals move several kilometres from their breeding sites in search of underground retreats, resulting in a requirement of 1000-2000 hectares of upland habitat to maintain a healthy population. Meshing this life history with intensive agricultural land use practices poses a very serious challenge to managers, and we suggest some innovative strategies that may help to maintain the species on some agricultural landscapes. Finally, we use both Ecological Niche Models and a novel Least Cost landscape genetic analysis to better predict how the species utilizes specific landscapes, and thus how to best protect the most critical landscape elements.

0317 Poster Session I, Friday July 25, 2008

Comparative Study of Prey Capture Mechanisms in Freshwater and Marine Stingrays

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The feeding behavior in elasmobranchs has been well documented for shark species; however, the knowledge for batoids still remains scarce. The aim of this study is to provide a comparison of feeding mechanisms between freshwater and marine stingrays under captive conditions. Specimens of *Potamotrygon motoro* (Potamotrygonidae) and *Dasyatis akajei* (Dasyatidae) were maintained in two acrylic aquariums. Video recordings were made using two high-speed cameras at 250 field s⁻¹ positioned at the side and under the aquarium. Twenty-eight video sequences were obtained (13 for *P. motoro* and 15 for *D. akajei*). Ram, bite manipulation, suction capture and suction transport composed the feeding behavior of both species; however, each species adopted somewhat distinct feeding tactics. After capturing the prey by suction or jaw protrusion, *P. motoro* manipulated the prey by expelling and engulfing it two or three times before suction transport. For *D. akajei*, the feeding behavior included prey capture by jaw protrusion and suction transport, usually without the expelling and suctioning phase. Apparently the manipulation phase occurred only for large preys. Anatomical details (e.g. relative mouth size and oral musculature) may explain the differences observed in prey manipulation by the stingray species.

0119 Fish Systematics II, Salons A&B, Friday July 25, 2008

Tempo and Mode of Morphological Diversification in the Anostomoidea (Characiformes): A Phylomorphospace Approach

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Understanding how and why certain clades on the tree of life diversify greatly in morphology while others do not remains a major theme in evolutionary biology. Within the South American fish superfamily Anostomoidea, the families Anostomidae and Chilodontidae demonstrate a remarkable range of skull morphologies and trophic ecologies, while their sister clade formed by the Curimatidae and Prochilodontidae are universally detritivorous and exhibit only two major skull types. This unequal morphological diversification could have been caused by a difference in tempo (the magnitude of morphological change expected per branch of the phylogeny or per unit time) or by a difference in mode (the relative ability of each clade to generate novel morphologies given similar rates of raw change). These two scenarios can be distinguished by projecting families of

phylogenies into multivariate morphospaces and reconstructing ancestral morphologies. The resulting phylomorphospaces can be used to infer the magnitude of morphological change along the branches of each possible phylogeny and the density of lineages within morphospace. In the case of the Anostomoidea, unequal morphological diversification resulted not from the morphologically diverse clade changing more on each of its phylogenetic branches, but from that clade distributing an equal amount of change more widely through morphospace and innovating continually throughout its history. While substantial morphological evolution occurred throughout the history of the less diverse clade, most of that clade's expansion in morphospace occurred in the most basal branches and more derived portions of that radiation typically oscillated within previously explored morphological limits. Comparing the observed phylomorphospaces with simulations revealed that it is very easy to generate two clades with the observed difference in mean morphometric branch lengths under a null Brownian model of evolution, but there is no more than a 5% probability of generating two clades that differ so greatly in the density of lineages. Thus, at least one of the two clades probably evolved under an alternate model of evolution, such as constrained change or adaptive radiation. The unequal morphological diversification of the Anostomoidea likely resulted from a difference in evolution's mode, not its tempo.

0003 Poster Session III, Sunday July 27, 2008

Adhesive Glands in *Gastrophryne carolinensis*

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The histology, histochemistry and ultrastructure of the adhesive breeding glands of male *Gastrophryne carolinensis* are described. Adhesive glands are multicellular exocrine glands in the dermis of the sternum and forearm that cause the male to adhere to the female during amplexus. The epithelial cells have distinct plasma membranes, and the product consists of electron-dense secretory granules that fill the cytoplasm and are released intact by an apocrine process. We support one previous study and contradict another report by finding that adhesive glands react positively for neutral carbohydrates and negatively for glycosaminoglycans and proteins. The ultrastructural results, the first on these organs, confirm that adhesive glands are derived from mucous glands and not serous glands.

0186 Poster Session III, Sunday July 27, 2008

Histology of the Paired-fin Adhesive Pads of Ostariophysan Fishes (Teleostei: Ostariophysi)

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The paired fins of benthic and rheophilic ostariophysan fishes frequently exhibit thickened pads of skin along the ventral surface of the anteriormost rays. These thickened regions of the epidermis, commonly referred to as adhesive pads, are often coated in a layer of unculi and are suggested to be involved in maintaining substrate contact in fast-flowing water. Paired-fin adhesive pads have been documented to date in members of the orders Gonorhynchiformes, Cypriniformes and Characiformes. The microsurface of paired-fin adhesive pads have been investigated extensively using SEM. Less frequently have the paired-fin adhesive pads of ostariophysan fishes been investigated using histological techniques. The histology of the paired fins of benthic rheophilic ostariophysan taxa from 14 families (representing four orders) was investigated. Histology confirms that the paired-fin adhesive pads in all taxa examined are formed by a thickening of the epidermis on the ventral surface of the anteriormost unbranched and branched rays. A collagenous cushion, deep to the epidermis and ventral to the lepidotrichia, was observed in members of the Balitoridae, Cyprinidae and Psilorhynchidae. Unculi were only observed on the ventral surface of the paired fins in members of the Balitoridae, Characidae, Cyprinidae and Psilorhynchidae. However, non-unculiferous keratinization of the ventral surface was observed in members of the Gyrinocheilidae and Catostomidae. Keratinization, associated with tubercle formation, was observed only in certain members of the Cyprinidae and Balitoridae. Paired-fin adhesive pads were not observed in the siluriform taxa examined. In addition, all taxa exhibited free neuromasts, mucocytes, and saccular secretory cells in the epidermis encompassing each lepidotrichia.

0016 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Reproductive Biology of *Agkistrodon piscivorus*

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Aspects of the reproductive biology of *Agkistrodon piscivorus* from the western portion of their range are described using histological techniques and reviewed and compared with historical data on *A. piscivorus*. The initiation of the reproductive season in these westerly snakes begins with mating in late summer/early fall, concurrent with a peak in renal sexual segment (RSS) hypertrophy in males, and the presence of sperm in the posterior oviduct of females. During this time the oviduct in

females synthesizes and stores abundant secretory material in the glandular uterus and the sperm storage region of the posterior infundibulum (SSTs). Sperm reaches the SSTs in females by late fall and remains present in this location through hibernation. Subsequent to hibernation, a similar pattern observed in the late summer/early fall occurs in the spring. This includes mating, as evidenced by sperm in the posterior oviduct and RSS hypertrophy in males. The uterine glands begin releasing the stored secretory material synthesized in the fall during the spring. By late May, mating has subsided, sperm in the posterior oviduct of females degrades (resulting in sperm presence only in the SSTs), and ovulation occurs. The uterine glands remain highly secretory and sperm persists in the SSTs, even though secretory granule synthesis has ceased, through gravidity. Post-partum females (fall to subsequent late summer/early fall) have little or no secretory activity occurring in the uterus or posterior infundibulum, however, sperm can remain in the SSTs until the summer of the next year. Spermatogenesis in male *A. piscivorus* from the western part their range occurs in late spring/early summer followed by another spike in spermatogenic activity in the late summer/early fall. Analysis of previous studies shows that some variation in the timing of male reproductive events may occur when moving west to east through the range of *A. piscivorus*. From our data on the cottonmouth, we propose that when looking at the reproductive biology of populations that inhabit a large range, multiple populations be used in the study to investigate geographic variation within a species. Data from Florida populations of *A. piscivorus* are desired.

0053 AES Management, Jarry/Joyce, Sunday July 27, 2008

Application of a Bayesian Hierarchical Meta-analysis in the Assessment of Pelagic Sharks: A Case Study Using the Night Shark, *Carcharhinus signatus*

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Night sharks, *Carcharhinus signatus*, are an oceanic species generally occurring in outer continental shelf waters in the western North Atlantic Ocean including the Caribbean Sea and Gulf of Mexico. Although information from some fisheries has shown a decline in catches of night sharks, it is unclear whether this decline is due to changes in fishing tactics, market conditions, or species identification. Despite the uncertainty in the decline, the night shark is currently listed as a species of concern due to alleged declines in abundance resulting from fishing effort, i.e. overutilization. A previous study concluded that the night shark did not qualify as a species of concern but the uncertainty in the trends in relative abundance precluded any determination of changes in stock status. Further, the "data-poor" situation precluded the application any typical stock assessment models. While some modeling-based frameworks (e.g. catch-free model) for estimating stock status in situations where catch data are poor have been utilized, the highly uncertain nature of the data for night shark also prevented application of these models. Previous standardized catch rates using a two-part generalized linear model gave conflicting

results, with one series showing a decline, two series showing an increase and one series showing constant abundance. To address this uncertainty, we used a hierarchical meta-analysis in a Bayesian framework to estimate changes in relative abundance from fishery dependent and independent catch rate series. Prior probability distributions of the estimated parameters were developed using knowledge of data source and collection method. The final model was fit using R and estimates of trends were based on Markov chain Monte Carlo posteriors. The meta-analytic estimate indicated little decline overall suggesting night sharks have not suffered significant declines in abundance.

0333 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Life in a Macrotidal World: Movements of the Dwarf Sawfish (*Pristis clavata*) in Northern Western Australia

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The short-term movements of adult dwarf sawfish (*Pristis clavata*) were studied using active acoustic telemetry in northern Western Australia. The semi-diurnal tidal variation in this region is extremely large, with a range over 10 m during spring tides. Individual sawfish were tracked for up to four days in shallow coastal waters using small boats. The tracks of five individuals showed very similar movement patterns. For approximately 100 minutes either side of high tide individuals rested in inundated mangrove forests. As the tide fell sawfish moved out of the mangroves and moved to remain in depths from 0-2 m. Individuals moved distances of 3-10 km during each tidal cycle before returning to the mangrove forest on the next high tide. High tide resting locations for individuals were often within 50 m from the previous tide. The macrotidal environment was concluded to be the dominant factor controlling the movement of dwarf sawfish in this region.

0479 Poster Session II, Saturday July 26, 2008

Factors Affecting Anuran Community Structure within Delmarva Bays: Implications for Conservation and Management

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Many factors across multiple scales affect anuran community structure; understanding these factors is crucial to creating effective management strategies. Land use adjacent to breeding ponds can drastically change anuran community structure. Recent results indicate that alterations in land use may also have indirect effects through modifications to pond pH. Compared to factors such as hydroperiod, pH has received less attention as a major determinant influencing amphibian use of breeding ponds. We selected 55 ponds across a forest buffer gradient (ranging in size from <1 to 3 hectares) using aerial photos and geospatial software. We are presently conducting calling surveys, larval surveys and egg mass counts at each pond. An information-theoretic approach to modeling the probability of calling males at wetlands as a function of hydroperiod and pH suggests hydroperiod plays a predominate role in determining calling, while pH plays a secondary role. *Pseudacris crucifer* and *Rana utricularia* were not modeled as they are heard calling at the majority of wetlands (> 96%). Hydroperiod had a positive effect on the probability of calling for *R. clamitans*, *R. catesbeiana*, and *R. virgatipes*, while other species were most common at wetlands with intermediate hydroperiods. *Pseudacris kalmi* and *R. virgatipes* are less likely to call at wetlands with higher pH, while other species display the opposite trend. Our results suggest pH does play a role in mediating pond-breeding amphibian community structure. Ongoing efforts are investigating links between adjacent land use, hydrology and pH, and incorporating larval surveys.

0496 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Habitat Utilization and Movement Patterns of Juvenile Porbeagle Sharks (*Lamna nasus*) in the Western North Atlantic

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The porbeagle (*Lamna nasus*) is a large, highly migratory endothermic shark broadly distributed in the higher latitudes of the Atlantic, South Pacific, and Indian Oceans. In the North Atlantic, the porbeagle has a long history of fisheries exploitation and recent assessments indicate that this stock is severely overfished. Although much is known of the life history of this species, there is little fisheries-independent information about habitat preferences and ecology. To examine migratory routes, potential nursery areas, swimming behavior, and environmental associations in the

western North Atlantic, we deployed pop-up satellite archival tags on 20 juvenile porbeagles in late November, 2006. The sharks, ten males and ten females ranging from 128-154 cm fork length, were tagged and released from a commercial longliner on the northwestern edge of Georges Bank, about 150 km east of Cape Cod, MA. The tags were programmed to release in March (n=7), July (n=7), and November (n=6) of 2007 and 17 (85%) successfully reported. Based on known and derived geositions, the porbeagles exhibited broad seasonally-dependent horizontal and vertical movements ranging from 77-870 km and from the surface to 1300m, respectively. All of the sharks remained in the western North Atlantic from the Gulf of St. Lawrence and the coast of Nova Scotia to Georges Bank and oceanic and shelf waters south to North Carolina. In general, the population appears to contract during the summer and fall with more expansive radiation in the winter and spring. Although sharks moved through temperatures ranging from 2-26°C, the bulk of their time (77%) was spent in water ranging from 8-16°C. In the spring and summer months, the sharks remained epipelagic in the upper 200m of the water column. In the late fall and winter months, some of the porbeagles (n=10) moved to mesopelagic depths (200-1000m). Temperature records indicate that these fish were likely associated with the Gulf Stream.

0215 Biodiversity & Agriculture II, Drummond, Saturday July 26, 2008

Effects of Conservation Practices on Fishes, Amphibians, and Reptiles within Agricultural Streams and Wetlands

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Conservation practices have been traditionally used to manage soil and water resources to improve agricultural production, and now include methods to reduce the environmental impacts of agriculture on streams and wetlands. These practices have been regularly implemented within agricultural watersheds in the United States without documentation of their impacts. The goal of the ARS Conservation Effects Assessment Project Watershed Assessment Study is to quantify the effect of conservation practices within 14 agricultural watersheds within United States. All watersheds are evaluating water chemistry and hydrological responses, and ecological responses are being examined in two midwestern watersheds and one southeastern watershed by the CEAP Ecology Working Group. However, we have conducted research on the effects of conservation practices on aquatic biota since the early 1990's. Our objective is to synthesize the results of our past and current research involving fish, amphibian, and reptiles within agricultural streams and wetlands. Research within channelized streams focused on fishes through a combination of field studies evaluating community responses and laboratory studies measuring acute toxicity of Pimephales promelas. Riparian wetland research consisted of field experiments that assessed fish, amphibian, and reptile population and community responses. Our key findings suggest that within agricultural

landscapes: 1) a combination of reach-scale habitat structures and watershed scale practices will be needed to positively influence fish communities within channelized streams; 2) conservation practices that only reduce loadings of agricultural chemicals within channelized headwater streams may have a limited short term influence on fish communities, but may reduce the prevalence of sublethal effects; 3) the creation of differently sized riparian wetlands adjacent to channelized streams will benefit riparian fish, amphibian, and reptile communities; and 4) conservation practices that alter the management of agricultural fields may provide greater benefits for fishes within riverine wetlands than edge-of-the-field conservation practices.

0447 Poster Session III, Sunday July 27, 2008

Intraspecific Phylogeography of *Graptemys ouachitensis*

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Geological changes throughout history have had a profound effect on the phylogeography of biota. Contemporary spatial relationships of species are a result of both active and passive changes in their geographic distribution. Although the phylogeographic patterns of ichthyofauna in large river habitats is becoming better understood, little is known about the evolutionary life history of reptiles. The Ouachita Map Turtle, *Graptemys ouachitensis*, is an aquatic, large river turtle species native to the Mississippi River Basin. There are two disjunct populations of this species in the Scioto River, Ohio and the Kanawha River, West Virginia. By sequencing mtDNA control region of *G. ouachitensis*, the phylogenetic patterns of this species were hypothesized. A minimum spanning network of 15 haplotypes from 14 populations uncovered three haplotype groups. All haplotype groups had low levels of sequence polymorphism within groups. This genetic differentiation between the haplotype groups is indicative of a vicariant event occurring within the population. One haplotype group has a localized distribution, while two haplotype groups are widespread throughout the species range. The lack of genetic differentiation within the haplotype groups as well as their widespread distribution across the species range could be evidence for a dispersal event following the Pleistocene glaciation.

0699 General Ichthyology II, Salons 6&7, Saturday July 26, 2008

The Northern-Most Cave Adapted Fish in the World: Discovery and Population Genetics

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The Pennsylvanian grotto sculpin (*Cottus*: Cottidae: Teleostei) was described in 2003 with specimens collected in a small cave in the Nippenose Valley, 15 km SW of Williamsport, PA. The specimens are not strikingly troglomorphic. They still have some pigment, eyes, and response to visual stimuli. The purpose of this study was to establish if the Pennsylvanian grotto sculpin is genetically distinct from its surface counterparts. Phylogenetic analysis of mitochondrial (16S rRNA) and nuclear (28S rRNA) haplotypes have surprisingly identified two distinct lineages within the same population of Pennsylvanian grotto sculpins. Within a single cave population, individuals have sequence divergence with a range of substitutions similar to those found among different species. However, despite the dramatically divergent DNA, individuals in the cave population reproduce with each other. The two cave lineages are related to either *Cottus bairdi* or to *C. cognatus*, both of which are found in nearby surface creeks. This suggests that the grotto sculpins are derived from a successful hybridization between two surface sculpin species, which were then able to survive in the cavernicole niche. In other sites in this area of Pennsylvania where hybridization occurs between *Cottus bairdi* and *C. cognatus*, hybrids do not successfully reproduce in surface populations, and their gene pools remain separate. The cave environment appears to allow for the hybrid offspring to survive. The cave lineages include haplotypes not found in either of the two surface species, which implies that the Pennsylvanian grotto sculpin has followed an independent evolutionary path from the surface species for an extended period of time. The restriction in gene flow allowed the cave sculpins to become troglobitic. These fish also hold the honor of being the northern-most cave adapted fish in the world.

0441 Poster Session I, Friday July 25, 2008

Mineralization of Meckel's Cartilage in the Shark, *Squalus acanthias*: Histological Observations and the Role of Mechanical Stress

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The chondrichthyan (sharks, skates, rays and chimaeras) skeleton is composed of hyaline cartilage surrounded by peripheral units of mineralization known as tesserae which provide strength while allowing for flexibility. Previous observations of *Squalus acanthias* skeletal tissue have shown differences in the development and localization of tesserae across a single cartilage element. We hypothesize that mechanical force and the resultant stresses imparted upon the cartilage may be one

factor that influences their formation. To test this hypothesis two groups of sharks were fed different diets for 12 - 13 weeks, to impart high versus low stress levels on the jaw cartilage during feeding. The first group was fed whole mackerel to stimulate active bite feeding, which requires greater use of the adductor mandibulae complex for an extended period of time. The second group was fed small pieces of chopped mackerel to promote suction feeding and invoke less adductor mandibulae use. Calcein, a fluorescent marker, was injected intramuscularly at the beginning of the study to trace newly mineralized cartilage. A stress-strain gauge affixed to the Meckel's cartilage near the insertion of the quadratomandibularis ventral (QMV) muscle was used to measure the magnitude of jaw cartilage stress imparted by muscles during feeding using. Electromyography provided simultaneous quantification of muscle activity. Demineralized and non-demineralized samples of Meckel's cartilage, individually stained with Alizarin Red S, Verhoeff's, Villanueva Osteochrome and for ALP/TRAP activity, were evaluated for the structure and distribution of tessellate mineralizations and evidence of cellular activity. Fluorescence microscopy revealed new mineralization in the cap and base of the body using calcein and Alizarin Red S for both treatment groups. Other features of jaw mineralization are presented for sharks subjected to the different feeding regimes. Collective histological observations support previous reports of different mechanisms of mineralization in the cap versus body zone of the tessera.

0629 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Relationships of the Stonefishes and Scorpionfishes (Teleostei: Scorpaenoidei)

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Recent molecular studies have suggested that the stonefishes do not form a clade with the traditional scorpionfishes and rockfishes (Scorpaenoidei). This hypothesis was examined using both anatomical and DNA sequence data. Preliminary results find strong support for the monophyly of the stonefishes and corroborate this clade's separation from the Scorpaenoidei. Morphological support for the monophyly and relationships of the stonefishes will be presented in the framework of the combined analysis.

0114 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

CO1 DNA Barcoding Amphibians: Successes and Failures

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A mitochondrial DNA barcode has been shown to be of great utility for species identification and discovery in an increasing number of diverse taxa, however caution has been urged with its application to one of the most taxonomically diverse vertebrate groups - the amphibians. We tested three of the perceived shortcomings of a CO1 DNA barcode's utility with a group of Holarctic amphibians: primer fit, sequence variability and overlapping intra and interspecific variability. We found that although the CO1 DNA barcode priming regions were variable, we were able to reliably amplify a CO1 fragment from degenerate primers and primers with G-C residues at the 3' end. Any overlap between intra and inter specific variation in our taxonomic sampling was due to introgressive hybridization (*Bufo*), complex genetics (*Ambystoma*) or incomplete taxonomy (*Triturus*). Rates of hybridisation and species discovery are not expected to be greater for amphibians than for other vertebrate groups, and thus problems with the utility of using a single mitochondrial gene for species identification will not be specific to amphibians. Therefore, we conclude that there is greater potential for a CO1 barcode's use with amphibians than has been reported to date. In the end, although there will undoubtedly be difficulties, this data set suggests that on the class level, we should not approach this group with an *a priori* expectation that they will be larger or more serious, than for any other taxonomic group of animals. Furthermore, these difficulties will expose questions for further scientific inquiry. It is our conclusion that it is far more advantageous that amphibians be included in a global effort to utilize a standardized gene region for species recognition than to exclude them because we wish for more evidence.

0756 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Areas of Endemism of New World Freshwater Fishes

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Concentrations of restricted-range species can be used to guide conservation efforts because they offer the opportunity to achieve high species conservation payoffs in a relatively small portion of the earth's surface. To date, this approach has been applied mainly to terrestrial biodiversity (i.e., Biodiversity Hotspots and High Biodiversity Wildernesses). As species mapping efforts advance, it will become possible to base priority areas on explicit range maps for large numbers of species. However, it is urgent to set freshwater priorities before such comprehensive datasets will be available. In order to identify initial priority areas for freshwater fishes, we geo-referenced the type localities for valid species based on stated type localities in Eschmeyer's Catalogue of Fishes, using the standards of the Biogeomancer Project.

When the type localities were too vague to map, we substituted a mappable locality near the center of the species range. For the purpose of mapping species concentrations at the continental scale, we reasoned that most freshwater fish ranges are so small relative to potential priority areas that using a single locality per species was as effective as mapping the whole range. We tested this assumption by comparing results based on whole species ranges of Mexican fishes with results based on one locality per species. We also made comparisons with previous analyses of species density in the USA. Both tests showed the method to be effective. We explored various thresh-holds for delineating concentrations of restricted-range species, and this revealed peaks of endemism in southeastern United States, the Mesa Central of Mexico, Meso-America, flanks of the northern Andes, Guyana Shield, several parts of the Amazon Basin, Cerrado-Pantanal, and coast of South America from the Atlantic forest to the Pampas. We are continuing the approach to cover freshwater fishes globally, and parallel studies of dragonflies, damselflies, and freshwater turtles are underway.

0573 Poster Session I, Friday July 25, 2008

HerpNet: A Global Virtual Museum of Geospatial Data for Herpetological Collections

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HerpNet began in 2003 with 36 North American institutions that shared a common goal of providing a single interface for searching geospatial data for all herpetological collections. Since then, participation has grown to 59 institutions representing 12 countries, with 48 institutions available online. Our major goals for this network were to: 1) advance the development of scalable, interoperable technologies for distributed databases; 2) train the next generation of scientists in biodiversity informatics; and 3) make these locality and specimen data available globally and publicly to allow repatriation to their country of origin. By August 2008, 80% of the unique localities for 3.7 million specimens will be georeferenced and available online for the original 36 institutions. An additional 276,035 georeferenced localities are available from eight non-North American collections. Georeferenced distributed data are the basis for much research in biodiversity and species distributional modeling. Museum data available on this scale are invaluable to studying historic distributions of species and specimen data from areas that are currently too politically sensitive to collect. Spatially accessible specimen records are useful for collection management and conservation. With more "eyes" on the data, data quality improves through time as HerpNet georeferencing provided the "first pass" and the procedures to quantify error. HerpNet also collaborated with AmphibiaWeb to allow dynamic mapping of museum specimen data and expert-opinion maps, and developed a cache to provide faster data access. Additionally, HerpNet staff hosted 10 georeferencing workshops in four countries; these

workshops provided a rare opportunity for museum curators and staff to meet to discuss use and challenges of geospatial data and to educate museum staff in data standards. Future implementations will seek funding to add more institutions, especially large, historically important collections, and to improve the data portal.

0673 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Geometric Morphometric Analysis of Head and Horn Morphology of the Coast Horned Lizard Species Complex, *Phrynosoma coronatum*

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The coast horned lizard (*Phrynosoma coronatum*) is distributed over 2,200 kilometers from the Cape Region of Baja California to northern California. A considerable degree of variation in scalation, cranial horn morphology, and coloration is found throughout its range. At least 20 attempts to partition this geographic variation into discrete taxonomic units have resulted in a turbulent taxonomic history. A recent morphological study used standard morphometric measurements to establish new species boundaries within the group. Geometric morphometric techniques offer a novel approach for morphological analysis and are particularly useful for quantifying differences in the shapes, sizes, and orientations of structures. The cranial horns of *Phrynosoma coronatum* are geographically variable and are a perfect candidate for a geometric morphometric analysis. We quantified variation in head and horn shapes from lizards collected throughout the range from northern California to southern Baja California to test alternative species boundaries based on morphology and genetic data. The geometric morphometric methods incorporated digitized scans of the dorsal surface of the head and horns. We digitally placed twenty positional landmarks on homologous locations on the head and horns, and used statistical methods (CVA and PCA) to compare differences among geographic groups. Thus far, we have scanned 628 adult male and female heads of specimens from 3 natural history collections. Preliminary analyses of adult horn and head morphology separate populations into two groups that are concordant with geography, and the break is located in southern Baja California, north of La Paz. There is no apparent separation statistically between California and Northern and Central Baja California groups. Components that represent horn and head shape were negatively correlated with latitude, with larger, more laterally curving occipital horns in southern lizards. This result is concordant with the previous morphological study, phylogenetic analyses of nuclear loci, and ecological niche modeling

0726 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

Sustainable Harvest of Sea Turtles: Myth and Reality

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Sea turtles are long-lived vertebrates that have high reproductive potential but low survivorship of hatchlings and juveniles. More than 40 years ago Archie Carr described the considerable commercial value of sea turtles in an article in National Geographic magazine. However, he quickly became skeptical of the value of both sea turtle farming and harvesting of sea turtles in the wild. He was convinced that the demands of the market would overwhelm the ability of sea turtles to reproduce and would drive natural populations to extinction. There are continued calls by some for market driven exploitation of sea turtles as a mechanism of conservation. Here we explore the relationship between the life history characteristics of sea turtles and the effects of harvesting adults, juveniles and eggs on their populations. Our analyses demonstrate that sea turtle populations cannot withstand more than a small harvest of eggs, juveniles or adults or they will be driven to extinction. For example, harvesting even 25% of eggs will lead to a long term decline in sea turtle populations. Adult mortalities above natural rates of 5 to 10% will also drive a sea turtle population to extinction. These models are similar to those for fresh water turtles and apply to all sea turtle species. Examples from the past and present support these mathematical models of population biology of sea turtles and indicate that it is not possible to sustain a commercial harvest of sea turtles.

**0442 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008;
STOYE GENETICS, DEVELOPMENT & MORPHOLOGY**

The Development of Kinethmoid Mediated Premaxillary Protrusion in the Zebrafish: What Can the Ontogeny of a Complex Trait Tell Us about Its Evolution?

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Cypriniform fishes effect premaxillary protrusion via a unique mechanism which includes the kinethmoid, a novel ossification within the rostral skeleton. Members of the Cypriniformes alone possess a kinethmoid which is situated behind the ascending processes of the premaxillae. This median bone is completely suspended by a complex bridge of ligaments uniting it to the premaxillae, neurocranium, maxillae, and palatines. Mouth opening and subsequent rotation of the maxillae (generated by contraction of jaw adductors) causes the kinethmoid to rotate and protrude the premaxillae. While the morphology and mechanics of such an innovative mechanism are inherently interesting to functional morphologists, the evolutionary origin of this novel trait makes it of special interest to evolutionary biologists. We investigated the development of this feeding mechanism in order to elucidate embryological processes on which selection could have acted to produce a

novel trait. Using techniques available to developmental biologists, we examined how a complex system comprised of multiple elements (from disparate embryological origins) develops to form one functional unit in the zebrafish. Firstly, there is a novel ossification, the kinethmoid, which first develops as a cartilaginous anlagen within the ligament uniting the paired maxillae. While the kinethmoid arises early in development, it is not until the juvenile stage that significant premaxillary protrusion is seen. This may be due to the fact that kinethmoid-mediated premaxillary protrusion requires a change to the adductor mandibulae muscles. The adductor mandibulae, the primary lower jaw closing muscle arises early in development as a single unit but later differentiates into divisions essential for protrusion. Finally, a complex bridge of ligaments suspending the kinethmoid and allowing protrusion must develop properly before protrusion can occur. These developmental data along with outgroup comparison have allowed us to develop evolutionary hypotheses concerning the origin, assimilation, and diversification of this novel feeding mechanism.

0234 Biodiversity & Agriculture I, Drummond, Friday July 25, 2008

Fish Assemblage and Water Chemistry Responses across a Gradient of Headwater Stream Enclosures

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In intensively farmed areas, headwater streams are often enclosed to increase the efficiency of farming and reduce soil erosion. Enclosures involve burying open first or second order streams and replacing them with drain tiles installed below the soil surface. This is also referred to as tiling over or burying streams. We wish to relate the degree of enclosedness of headwater streams in cultivated fields to the downstream ecosystem's structure and function in the Ausable River basin (ARB) in southwestern Ontario. Ten watercourses in the ARB with varying degrees of upstream enclosedness, but with similar natural variation, were selected for this study. Fish and benthic macroinvertebrate assemblages were characterized using standardized sampling protocols in July and November 2007 and May 2008. Water samples were collected monthly from July – November 2007 and March-July 2008 and analyzed for ammonia, nitrate and major ions (P^{3-} , Ca^{2+} , Mg^{2+} , K^+ , Na^+). Data from this field sampling enable us to test the hypothesis that enclosedness affects, among other ecosystem attributes, the diversity and composition of the downstream fish and benthic invertebrate community. Our findings will aid managers in Ontario in setting scientifically defensible regulations regarding stream enclosures and will significantly further our knowledge of the importance of headwater streams to downstream ecosystems.

**0123 General Ichthyology I, Drummond, Saturday July 26, 2008; STOYE
GENERAL ICHTHYOLOGY**

How Fins Contribute to Stability and Manoeuvrability in Fishes

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Most fish have two sets of paired fins and three median fins. Fish must balance torques around their centre of mass to control their body position and they appear to use their fins to do this. Recent kinematic and hydrodynamic studies on trout median fins show that dorsal and anal fins in trout appear to produce forces that balance rolling torques during swimming. Dorsal and anal fins oscillate with a large phase lag, yet the lateral jets produced by the fins have a small phase lag. This means dorsal fins release jets after they reach maximum excursion and anal fins before maximum excursion. Differences in incident flow experienced by each fin may contribute to different jet release timings between fins. Trout paired fins are located upstream of the median fins. The ventral location of paired fins means that the wake they produce could influence the flow surrounding the ventral anal fin. To date the kinematic or hydrodynamic function of the posterior paired pelvic fins has not been described. In this study I use particle imaging velocimetry and high-speed cameras to visualize the wake structures and kinematics of the pelvic fins in rainbow trout (*Oncorhynchus mykiss*). I use a horizontal light sheet to visualize the entire fish belly and describe how the pelvic fin wake interacts with the anal fin during swimming. Trout move their pelvic fins in a contralateral oscillation; one fin abducting while the other adducts. The contralateral oscillation of the pelvic fins produces distinct lateral jets that appear to influence and contribute to the anal fin wake structure, possibly enhancing anal fin hydrodynamic function.

0205 Fish Systematics III, Drummond, Saturday July 26, 2008

Pseudotropheus elegans*: A Junior Synonym of *Pseudotropheus livingstonii

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Boulenger described *Tilapia livingstonii* from the Shire River, Malaŵi in 1899. Subsequently this species was placed in the genus *Pseudotropheus* and later was moved to *Metriaclima*. Subsequent to the original description, Trewavas described *Pseudotropheus elegans* in 1935 and again this species was moved to *Metriaclima*. A detailed examination of the holotypes using computed tomography (CT) scan provided data to show that *P. elegans* is a junior synonym of *P. livingstonii*. Furthermore, this species does not possess the synapomorphies of *Metriaclima* (e.g. a moderately sloped ethmo-vomerine block and a swollen rostral tip). The ethmo-vomerine block of *Metriaclima zebra*, the type species of *Metriaclima* is positioned in the skull at a 48.7° angle, while that of *P. livingstonii* is positioned at a 64.5° angle.

0431 Herp Behavior, Salons A&B, Thursday July 24, 2008

Emydid Turtles Modulate Their Feeding Behavior in Response to Prey Type and Feeding Environment

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Plasticity of feeding behavior is an important component of phenotypic plasticity, allowing organisms to feed in multiple environments and on a variety of different prey items. Such plasticity can promote species dispersal into multiple environments or evolutionary diversification into new niches. Here, I present the results of two studies investigating plasticity of feeding behavior in emydid turtles. In the first study, *Chrysemys picta* and *Trachemys scripta* individuals were filmed feeding on 3 food types of varying physical properties. Aspects of feeding behavior were quantified, and variation in feeding behavior among species and food types was calculated. *T. scripta* individuals showed a greater ability than *C. picta* to modulate their feeding behavior in response to novel food items. We suggest that this greater flexibility may partially explain the greater success of *T. scripta* in invading new habitats. In the second study, aquatic and terrestrial feeding events were filmed for individuals of *C. picta*, *T. scripta*, *Graptemys pseudogeographica*, *Glyptemys insculpta*, *Deirochelys reticularia*, and *Malaclemys terrapin*. Of these species, only *G. insculpta* is known to regularly feed terrestrially in the wild. Aspects of the feeding kinematics of these species were quantified and aquatic and terrestrial bites were compared for each species. Although some species showed a greater difference between bites in the two environments, most species showed a consistent pattern of changes in bite kinematics between the two environments. Some of the patterns observed (e.g., less hyoid depression during terrestrial feedings) are consistent with those shown by *Terrapene carolina*, a turtle that regularly feeds in both environments. We suggest that the differing viscosities of water and air impose consistent changes on the feeding behavior of emydid turtles, and that these changes can be selected upon in those aquatic turtle species that adopt a terrestrial or semi-terrestrial lifestyle.

The Diet and Feeding Ecology of Sympatric Orectolobiform Sharks: An Example of Resource Partitioning

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Dietary studies are vital for determining a species' role within an ecosystem. It is recognised that elasmobranches play an integral role in the transfer of energy within marine ecosystems. However, studies of elasmobranch feeding ecology lag behind those on other vertebrates and knowledge remains limited, despite the global trend in declining elasmobranch numbers. Resource partitioning is an important mechanism that allows species to co-exist within an assemblage but there have been few investigations comparing the diets of sympatric elasmobranch species. The diet and feeding biology of three sympatric benthic shark species (*Chiloscyllium punctatum*, *Orectolobus maculatus*, and *Orectolobus ornatus*) were examined. Specimens were collected by commercial fishermen from the sub-tropical waters of Moreton Bay, off south eastern Queensland, Australia. The Index of Relative Importance (IRI) indicated that *C. punctatum* are generalist feeders, which prey on benthic invertebrates (polychaetes, 33.58%IRI; crustaceans, 33.80%IRI, predominantly carid shrimps and brachyuran crabs; cephalopod molluscs, 4.18%IRI) and demersal vertebrates (teleost fishes, 28.33%IRI). An ontogenetic shift was evident with teleosts more prominent in the diets of larger individuals. The wobbegong sharks (*O. ornatus* and *O. maculatus*) were predominantly piscivorous, with 96.98%IRI and 99.85%IRI for teleosts respectively. The diets of the wobbegongs were not significantly different at the prey taxonomic level of Order, but were significantly different ($P < 2.9\%$) at the Family level, with *O. maculatus* ingesting predominantly pelagic and soft substrate associated species and *O. ornatus* reef associated species. Teleosts ingested by *C. punctatum* and both wobbegong species were significantly different ($P < 0.1\%$), revealing that all three are targeting different teleost species. The dietary composition of the bamboo shark, *C. punctatum* complemented findings from acoustic tracking, which indicated that this species commonly feeds over inter-tidal mudflats adjacent to mangroves. It is proposed that spatial resource partitioning allows these benthic shark species to co-exist within Moreton Bay without inter-species competition.

0382 Poster Session III, Sunday July 27, 2008

Developing Predictive Models of Anuran Calling Activity: Optimization of Amphibian Monitoring Programs

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Recent declines in amphibian populations have been dramatic and alarming, and most declines have been documented in anuran populations. In response, programs have been established to monitor anuran populations, and many of these rely on calling surveys. Understanding how the environment influences calling variation can be used to optimize such surveys. In an effort to understand how environmental variation affects anuran-calling activity, we measured calling activity at an ephemeral wetland in the western Piedmont of North Carolina using an automated recording system. We determined which environmental variables significantly affected the calling activity of *Pseudacris crucifer*, *Pseudacris feriarum*, and *Rana sphenocephala*. Models developed using logistic regression showed that for *P. crucifer*, day of year, time, precipitation and water temperature positively influenced calling and air temperature negatively influenced calling; for *P. feriarum*, time, precipitation, air temperature and water temperature positively influenced calling, and day of year negatively influenced calling; for *R. sphenocephala*, day of year, time, precipitation and air temperature positively influenced calling, and higher water temperature negatively influenced calling. Using these results, we developed models predicting the best conditions under which to conduct anuran-calling surveys. The models were tested using previously collected data from calling surveys performed in the same region of North Carolina. Models accurately predicted calling activity approximately 70% of the time.

0361 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008;
STOYE ECOLOGY & ETHOLOGY

Light Habitat Influences Dewlap Conspicuousness of Male and Female Brown Anoles (*Norops sagrei*)

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Signal theory hypothesizes that visual signals should evolve conspicuousness sufficient to allow for detection in some light environments at the cost of conspicuousness in other light environments. We quantified the spectral variation of male and female dewlaps from a population of Brown Anoles, *Norops sagrei* that inhabited a semi-disturbed habitat in central Florida, using a UV-sensitive spectrometer. *Norops sagrei* display dewlaps that, to the human eye appear to have a yellow or white midline dewlap region flanked by a pinkish-red lateral region. We applied these spectral data to a visual model that integrated information about *Norops sagrei* visual physiology and coloration of background vegetation to estimate the conspicuousness of male and female dewlaps in four classic light habitats. The

chromatic aspects of dewlap reflectance of *Norops sagrei* were most conspicuous in light conditions typical of woodland shade, and were slightly less conspicuous in light conditions typical of large and small gaps. Green backgrounds generally rendered dewlap color more conspicuous than brown backgrounds. Sexes could be discriminated based on differences in their dewlap color and brightness, in woodland shade only. Of *Norops sagrei*'s four photoreceptor types, conspicuousness of the dewlap is primarily driven by the UV sensitive cone. The sexes, however, differ in the degree to which the medium and long wavelength cone stimulation explains conspicuousness in most light environments. We discuss how these results may influence social behavior of Brown Anoles.

0574 Poster Session I, Friday July 25, 2008

Phylogenetic Analysis of the Iguaninae

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The subfamily Iguaninae is a particularly interesting group because of its ancient Cenozoic origin, broad distribution across multiple geographical boundaries, and high degree of regional and island endemism. Prior molecular and morphological studies of this group have relied upon incomplete taxonomic sampling and limited data, resulting in unresolved or conflicting nodes within and between genera. Thus, the evolutionary history of the group and taxonomic status of several lineages remain unclear. In order to generate a robust phylogeny, we build upon prior studies with a more thorough sampling of the subfamily, taxonomically and geographically, as well as through the analysis of multiple independent data sets. Data presented are the result of sequencing between 71-55 individuals at 4 loci (nDNA: Cmos, NT3; mtDNA: ND4, CytB). These loci have varying rates of evolution and we are able to resolve most nodes throughout the tree with strong support (using MP, MLE, & Bayesian analyses). Results of phylogenetic analyses are compared to prior studies and examined in terms of biogeographic history and current taxonomy.

0510 Poster Session II, Saturday July 26, 2008

Testing the Sensory Exploitation Hypothesis in a Lizard, *Sceloporus minor*

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The sensory exploitation hypothesis states that male sexual signals evolve to stimulate a pre-existing female preference for such traits (Ryan and Rand 1993). This idea has received significant theoretical and empirical support in studies of mating preferences, but few studies have examined whether male aggressive signals could evolve similarly. In phrynosomatid lizards, male reproductive success is often predicted more strongly by male resource holding potential (RHP) than by female choice (e.g., Hews 1990). Consequently, members of this taxon might be expected to exhibit behavioral patterns consistent with male sensory exploitation, if variation in male intrasexual signals strongly predicts male fitness. *Sceloporus minor* is a Mexican phrynosomatid that exhibits striking variation both within and among populations in dorsal coloration. Sexual dimorphism of dorsal color is relatively weak in ancestral populations near the city of San Luis Potosí (SLP), each sex typically dull brown or orange. Conversely, in the derived population at Parque Nacional Los Mármoles (PNLM), only males exhibit bright blue dorsal color, often with overlying orange patches; females lack these additional color features. I predicted that if the sensory exploitation hypothesis best explains the observed pattern of between-population dorsal coloration in *S. minor*, then males at SLP painted to resemble the derived phenotype (blue) should receive less aggression than males painted to resemble the local phenotype (orange) or green (novel stimulus control). Resident males (n=24) were captured on their territories, marked, and released. Intruder males (n=24) were captured at separate sites, and painted dorsally with one of three paint treatments. All lizards were measured for morphometric and color variables that might influence contest outcome. Intruders were introduced to residents by tether, and allowed to interact for up to 20 min in videotaped trials; each resident and intruder lizard was used in only one trial. Preliminary analysis does not support the sensory exploitation hypothesis. These findings are discussed in the context of sexual selection theory.

0182 Poster Session III, Sunday July 27, 2008

Evaluating Patterns of Riparian Disturbance and their Influence on Aquatic Turtles in the Lower Flint River Basin, Georgia

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Agriculture has been a major part of the economy in southwest Georgia, but this large-scale land use has also had many negative effects on terrestrial and aquatic habitats. Although limited data exist, some known effects include sedimentation, chemical leaching, edge effects and most notably habitat conversion. Freshwater turtle communities are among many groups of wildlife that may be impacted by

agricultural disturbance to riparian habitats. Sedimentation and pollution from agriculture may negatively impact riverine turtles by reducing the abundance of invertebrate prey, and the clearing or thinning of forests near rivers may reduce the availability of logs needed for shelter and basking. The objective of this study will be to assess species richness and abundance of freshwater turtles in both unimpacted or restored and agriculturally-impacted tributaries of the Lower Flint River Basin (LFRB). Aerial photography and random site selection has been used to choose appropriate sites for sampling. Two methods of capture, aquatic hoop traps and effort-managed snorkel surveys, will be employed to sample all known species. During the summer of 2007, we made 349 captures of 301 individuals representing eight turtle species along 3.5 kilometers of Ichawaynochaway Creek. Preliminary results of seven sampled reaches have shown differences in capture abundances of yellow-bellied slider (*Trachemys scripta*) and Barbour's map turtle (*Graptemys barbouri*) when considering the amount of riparian disturbance. This research will add to knowledge of the influences of landscape scale disturbances on turtle community ecology and conservation.

0319 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Reproductive Behaviour, Mating and Male Competition in Manta Rays (*Manta birostris*) in the Indian Ocean

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Underwater observations and photographic capture of reproductive behaviours, including copulation and male/male competition for mates were obtained for continuous mating seasons (2005-2008) at North Male Atoll, in the Republic of the Maldives. Two types of male/female interactions have been documented. Males swimming in a linear pattern (mating "trains") consisting of 1 to 21 males following and chasing single, fast swimming females were well defined during October and November. A second association consists of males in smaller numbers (1 to 4), "shadowing" rather than chasing, slower swimming individual females. The former pattern appears to temporally follow the latter. Male group size appears to increase through time, reach a peak number and decline until only a few males remain and compete for access to a given female. During copulation the few remaining males attempt to dislodge the successful male from his attachment to the female by head ramming. Of the known resident females, 41 of 65 (63%) were pregnant in 2008 while only one was visibly pregnant in 2007. Some females involved in mating trains one season were pregnant the following year and shortly after giving birth, were observed bearing fresh pectoral fin mating scars. These data seem to suggest a biennial mating cycle as the norm and an annual reproductive cycle for some individuals.

0553 Poster Session I, Friday July 25, 2008

Clarification of the *Lycodes diapterus* Species Complex (Perciformes: Zoarcidae), with Comments on the Subgenus *Furcimanus*

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Lycodes diapterus, the type species of *Furcimanus* Jordan et Evermann, has been divided into as many as three subspecies (*L. diapterus diapterus*, *L. d. beringi*, and *L. d. nakamurae*). Although *L. d. nakamurae* has been broadly recognized as a distinct species by recent authors, the status of *L. d. beringi* is unresolved, and several authors have noted the need for a comprehensive morphological study of *L. diapterus*. Based on an examination of nearly 500 specimens collected from Kamchatka to California, we recognize *Lycodes beringi* as a valid species distinguished from *L. diapterus* by meristics and squamation. *Lycodes beringi* is distributed from southeastern Kamchatka through the Bering Sea, Commander and Aleutian Islands, Gulf of Alaska, and south along the North American west coast to Puget Sound, while *L. diapterus* ranges from the Pacific coast of Vancouver Island south along the U.S. west coast to southern California. In this report we document the morphological variation present in *L. diapterus* and *L. beringi*, provide distribution information for both forms, and clarify the status of the subgenus *Furcimanus*.

0631 Fish Systematics III, Drummond, Saturday July 26, 2008

A Morphometric Analysis of Guyanese *Arapaima* and Status of *Arapaima arapaima*

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Valenciennes (in Cuvier and Valenciennes 1847) described *Arapaima arapaima* based on descriptive information and an illustration from Schomburgk's (1841) monograph on fishes of British Guiana. This taxon has been considered a synonym of *Arapaima gigas* (Schinz, in Cuvier 1822) since 1868 when Günther published an opinion to that effect. A re-evaluation of the status of *A. arapaima* has been hindered by presumed absence of type materials as well as a lack of fresh *Arapaima* materials from the areas where Schomburgk collected. Review of materials in BMNH, London, and MNHN, Paris, led to the discovery of three specimens that could be considered syntypes of *A. arapaima* under international rules; but one of those is now lost and another is a skeleton in poor condition. Designation of the remaining entire specimen as Lectotype will provide a basis for evaluating status of *A. arapaima*. We have collected a complete size-range of *Arapaima* from the Essequibo River basin in Guyana over the past two years, and they provide a framework for evaluation of morphometric variation and allometry. We conclude that *A. arapaima* is a valid species whose distribution may extend from southwestern Guyana to central Brazil (i.e., Rio Negro and lower Rio Xingu).

0512 Poster Session III, Sunday July 27, 2008

Morphological And Call Divergence, And Contact Zone Dynamics Of Cryptic Lineages Of The Spring Peeper (*Pseudacris crucifer*)

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Phylogeography has played a major role in our current understanding of how historical processes shape contemporary species distribution. For many taxa, these data reveal striking range-wide genetic structure with well supported, geographically restricted clades that may both reflect historical refugial dynamics and the initiation of divergence. Despite over six decades of research however, a complete understanding of how such historical range fragmentation can contribute to the origins of new species diversity and an explicit link between phylogeography and the evolution of reproductive isolation remains elusive. In spring peepers (*Pseudacris crucifer*) mtDNA phylogeographic studies have revealed a dynamic history of isolation in Pleistocene refugia followed by post-glacial recolonization and many zones of secondary contact between deeply diverged lineages. Our analyses show that, within SW Ontario, where two such lineages are in secondary contact, males differ significantly in acoustic properties of their advertisement call (frequency and temporal attributes) and in morphology. This raises the possibility that females exhibit preference for their male calls of their natal lineage, a hypothesis we hope to assess this spring using phonotaxis experiments, with consequences for the evolution of reproductive isolation.

0650 Poster Session III, Sunday July 27, 2008; STORER ICHTHYOLOGY

The Evolution and Design of a Unique Feeding Mechanism: Asymmetry in Lake Tanganyika Scale Eating Cichlids

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Perissodus microlepis and *Perissodus straeleni* are cichlid fishes native to Lake Tanganyika in central Africa that forage through lepidophagy, or scale-feeding. Both species are laterally asymmetrical, their heads tending towards either the left or right side of the sagittal plane. The nature of this asymmetry, whether the result of one dramatically altered craniofacial structure or an integration of many differences between the left and the right side, remains unclear. Analyses focused on the bones of the head that constitute the feeding apparatus. Geometric morphometric shape analysis was performed as a means of phenotypic characterization. Landmarks were selected on the basis of being functionally significant pivot points and lever arms, and were used to test simple-lever and four-bar linkage models of the feeding system from which calculations of force and motion could be obtained. Initial results

indicate that scale eating cichlids show discrete, sided differences in jaw shape, and that these differences predict lateralization in the force and speed of jaw rotation. Nature is replete with examples of craniofacial asymmetries (i.e., narwals, owls, flatfish), and many human birth defects are characterized by asymmetric craniofacial malformations (hemifacial microsomia, Treacher-Collins syndrome, hemihypertrophy). Unfortunately, the development of lateral asymmetries in superficially paired structures is poorly understood, both genetically and evolutionarily. Studying the evolution of laterality in *Perissodus* and ultimately identifying the genetic factors that contribute to the asymmetric development of skeletal structures will shed light on the evolutionary and clinical consequences of vertebrate laterality.

0373 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

Developmental Mechanisms of Dentition Reduction in Cypriniform Fishes

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Reduction of the number of teeth and tooth-bearing locations is considered a general trend in the evolution of vertebrate dentition. This trend could be explained either by the frequent adaptive superiority of reduced dentition or by biases in the generation of variation in tooth number and location. We are attempting to distinguish between these possibilities through comparative developmental genetic studies focused on the zebrafish, *Danio rerio*. As in other members of the order Cypriniformes, teeth in *D. rerio* are restricted to the fifth ceratobranchials of the pharyngeal skeleton. In contrast to this extreme reduction of tooth-bearing locations, *D. rerio* retains what is thought to be the primitive number of teeth for the family Cyprinidae, despite a trend toward tooth number reduction in this taxon. Our previous comparisons of gene expression and function in *D. rerio* and the characiform *Astyanax mexicanus*, which retains oral and pharyngeal dentition, suggested loss of signalling through the Fibroblast growth factor (Fgf) pathway as a potential cause of oral tooth loss in cypriniforms. Specifically, application of a pharmacological inhibitor of Fgf signalling to *A. mexicanus* larvae resulted in loss of oral teeth and appearance of a gene expression profile in the oral region resembling that of *D. rerio*. To determine whether activation of Fgf signalling can restore oral tooth development in *D. rerio*, we used transgenic methods to ectopically express Fgf ligands. Such treatments resulted in the induction of supernumerary teeth in the pharyngeal, but not the oral region of *D. rerio*. This finding is consistent with a greater bias against expanding the number of tooth-bearing locations than increasing tooth number within a location.

0193 Northern Herps Symposium, Salons 6&7, Friday July 25, 2008

Frozen and Alive: Canadian Herps in Winter

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Natural freeze tolerance is key to winter survival for a selection of amphibians and reptiles and my laboratory has extensively studied the biochemical adaptations that support freezing survival using two Canadian species: wood frogs (*Rana sylvatica*) that winter on the forest floor and painted turtle hatchlings (*Chrysemys picta*) that spend their first winter in natal nests. For example, wood frogs can survive for weeks with 65-70% of total body water frozen in extracellular ice masses. Well-known components of freeze tolerance across phylogeny typically include the use of nucleating agents and high concentrations of carbohydrate cryoprotectants (e.g. glucose in frogs). However, advances in genomic and proteomic technologies have now allowed us to identify many genes/proteins (and their cellular functions) that have never before been associated with natural freezing survival. We now know that coordinated regulation of many aspects of metabolism is required to reorganize priorities for energy use in the frozen state, implement many metabolic or gene responses that deal with the stresses imposed by freezing (e.g. anoxia, tissue dehydration, physical damage by ice), and maintain long term cell viability in the frozen state. Recent work in my lab using cDNA array screening and Western blotting has documented the freeze responsive up-regulation of genes/proteins involved in multiple cell functions including ischemia protection, antioxidant defense, cell volume regulation, membrane transporters, signal transduction cascades (protein kinases and phosphatases, transcription factors), chaperone proteins, cell cycle versus apoptosis regulators, protease inhibitors and metabolic arrest mechanisms. Wood frogs also express three novel genes with unique freeze-responsive patterns of expression (organ, time, response to second messenger signals); their cryoprotective actions are as yet unknown but over-expression in insect cell lines strongly improves cell freezing survival in vitro. Freeze tolerance is not only an amazing example of biochemical adaptation but the molecular mechanisms that support natural freezing survival highlight key targets for the improvement of medical cryopreservation technology. Funded by NSERC Canada; for more information visit www.carleton.ca/~kbstorey.

0690 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Phylogenetic Relationships and Genetic Integrity of Native-Strain Walleye (*Sander sp. cf. vitreus*) from the Central Highlands

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Native populations of the walleye (*Sander vitreus*) persist in the Central Highlands despite the widespread destruction of their spawning sites and the introduction of exogenous fish from the Great Lakes. Although a few relictual spawning groups of Highlands walleye are known, neither their relationships with other walleye populations nor their genetic integrity have been rigorously investigated. We used a combination of mitochondrial and nuclear markers to assess the phylogenetic relationships of Highlands walleye in general, and the genetic integrity of putative native strain populations in particular. Phylogenetic analysis of mitochondrial cytochrome *b* and nuclear Rh2 sequences revealed that native-strain walleye in the Cumberland River (KY), Big South Fork (TN), New River, (VA), upper Ohio River (OH) and Black River (MO) represent an Evolutionarily Significant Unit (ESU) distinct from ESUs that natively occurred in drainages of the Great Lakes and Gulf Coast. Analysis of microsatellite variation revealed a historical relationship between spawning groups from the Appalachian and Ozark regions. The combined mtDNA and nuclear data set supports the hypothesis that native-strain walleye from the Central Highlands are phylogenetically distinct and represent an imperiled species. The distribution of the Highlands walleye is consistent with historical records for "*Stizostedion salmoneum*" and may warrant recognition pending a taxonomic revision of the genus.

0577 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Advances in Shark Repellent Research Using Highly Electropositive Metals

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Recent studies conducted by the National Oceanic and Atmospheric Administration - National Marine Fisheries Service (NOAA - Fisheries) suggest that electropositive metals hold promise as shark bycatch reduction devices. To understand the underlying electrochemical processes, voltammetry was performed with flowing seawater electrolyte and moveable fritted glass half-cells. Voltage and current were monitored as the distance was increased between half-cells. Voltammetric measurements indicate that shark skin is more electronegative than the electropositive lanthanide metals and mischmetals. We hypothesize that a galvanic cell, created by an electropositive metal in seawater, spontaneously produces trivalent cations in solution. These cations are attracted to the electronegative shark skin, resulting in a net positive charge on the shark skin, which is measured by the electrode. Further research is required to understand the mechanism by which the

accumulation of a positive charge is detected by the ampullae of Lorenzini. In practical fishery terms, because of the limited detection range of the ampullary organs, it is desirable to place electropositive metals as close to the hook as possible without interfering with capture. A simple hook modification has been developed which can be applied to multiple hook types. The modification utilizes thin ribbons of electropositive metal wrapped around a steel circle hook. Galvanometric analysis was utilized to confirm that the hook corrosion rate is not increased by the presence of the electropositive metal ribbon, thus ensuring that the structural integrity of the circle hook is not compromised during fishing.

0752 Poster Session I, Friday July 25, 2008

Applying an Individual-Based Modeling Approach to Address Potential Impacts of Habitat Loss in a Lemon Shark Nursery

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Mangroves provide critical habitat for many species, often during juvenile life stages. In Bimini, Bahamas, the mangrove-fringed lagoon between the two main islands comprises several important parturition sites and nursery areas for lemon sharks (*Negaprion brevirostris*). Within the North Sound nursery, juvenile lemon sharks are afforded abundant prey, as well as protection from larger predators. A significant volume of research exists concerning the life history, physiology, feeding and diet, bioenergetics, growth and behavioral ecology of lemon sharks in Bimini, as well as numerous studies on the ecosystem itself. The growing field of individual-based modeling has helped researchers begin to understand complex ecological patterns that develop from individuals' behaviors and interactions with each other and their environment. In an individual-based computer model, "agents" representing individuals are assigned rules that dictate their behaviors and influence interactions with other agents and the environment. This type of model can be a powerful heuristic tool to explain ecosystem complexity. After multiple iterations of the model, population- and ecosystem-level patterns may emerge from interactions of independently-acting agents. The goal is to develop the model such that emergent patterns reflect patterns of interest observed in the field. This study will utilize over twenty years of data to create an individual-based model that combines the behavior and bioenergetics of juvenile lemon sharks with that of the sharks' prey and predators as they interact within the North Sound ecosystem. The field-validated model will ultimately be used to address actual and potential ecological impacts of mangrove removal in the nursery area. In addition, the model will help elucidate the roles of this high-level predator in a mangrove-fringed lagoon ecosystem, as well as the potential consequences of a decline or loss of this predator. Supported by grants from NSF, Hoover Foundation, CPB Environmental Foundation and the Bimini Biological Field Station.

0347 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

The Potential Use of Pop-up Archival Transmitting (PAT) Tags to Examine Habitat Use and Migration Patterns of Spiny Dogfish (*Squalus acanthias*) in the Western Gulf of Maine

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Central to any successful fishery management plan is the availability of accurate, detailed and updated life history information on the species. Pop-up satellite archival tags (PAT) offer an innovative tool for examining the movement patterns, temperature, and depth preferences of many marine species. In the past, this technology has been too large or cumbersome for use in sharks less than 100cm in fork length. However, with the advent of the relatively small X-Tag by Microwave Telemetry, the value of using satellite technology on smaller shark species was tested on the spiny dogfish, *Squalus acanthias*, within the Gulf of Maine. Between October 31st and November 7th, 2007, a total of three X-Tags were attached to dogfish captured 6 miles off the coast of Southern Maine. Although two of the three tags prematurely released from the animal (expected "pop off" date was set at May 31st 2008), the data that was recovered (approximately 3 months worth) offered information that goes against many current paradigms for this species in the western Atlantic. This includes north-south movement ranges that are much wider and more active in scope than previously described for this shark. Moreover, deeper more constant depth profiles were also observed for this species. We anticipate the third tag will reveal similarly unique findings.

0694 Fish Morphology & Histology II, Salons 6&7, Saturday July 26, 2008

Ontogeny of the Fine-scale Morphology of the Tessellated Skeleton of Cartilaginous fishes

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The majority of the skeleton of elasmobranch fishes is characterized by a tessellated design in which uncalcified cartilage is overlain by a rind of mineralized and abutting hexagonal blocks (tesserae). This poses an interesting problem in that although the skeleton cannot exhibit significant remodeling, it must be able to grow in size while maintaining a continuous and integral calcified surface. We employ a diversity of imaging techniques and ontogenetic tissue series to investigate the development and ultra-scale morphology of the tessellated skeleton in a species of

stingray (*Urobatis halleri*). Tesserae formation and growth is characterized by distinct changes in cell morphology and orientation. The skeletons of yolk sac embryos are not yet tessellated and chondrocytes orient randomly relative to the perichondrium. In the histotroph stage, chondrocytes flatten at the tissue periphery and are engulfed by forming tesserae, creating cell-rich laminae in the mineralized blocks with communicating passageways between entombed cell lacunae. Alignment of peripheral chondrocytes relative to tesserae is pronounced only as tesserae are forming, then becomes more random with age. Chondrocytes and tesserae continue to grow in size through adulthood, with cell density and the number of chondrocyte twins (an indirect indicator of cell division) decreasing sharply following tesseral formation. Oxytetracycline injection indicates that tesserae grow from mineral accreted on all surfaces (perichondral, chondral and intertesseral) resulting in tesserae widening and deepening by up to 5 times in adults relative to the histotroph stage. Skeletal elements are therefore growing by matrix deposition in uncalcified regions and accommodating enlargement of tesserae. Although our results show some parallels with endochondral ossification (e.g., chondrocytes decreasing in size and density with age), cells do not hypertrophy and die as in tetrapods.

0273 Fish Ecology II, Salons A&B, Monday July 28, 2008

Deep-Pelagic Fishes And The Mid-Atlantic Ridge: Interactions And Vectoring Of Gelatinous Carbon To Higher Trophic Levels?

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The assemblage structure and vertical distribution of deep-pelagic fishes relative to a mid-ocean ridge system is described from an acoustic and discrete-depth trawling survey conducted as part of the international Census of Marine Life field project MAR-ECO. A survey along the Mid-Atlantic Ridge (MAR), covering the full depth range (0 to >3000 m) with a combination of gear types, was conducted to understand the role of the pelagic fauna in ecosystem dynamics. A total of 205 fish species were collected by midwater sampling. Depth was by far the primary assemblage composition determinant, with ridge section secondary. The dominant ichthyofaunal component was a widespread assemblage of fishes between 750-3000 m, from Iceland to the Azores. Some zonation was apparent in the northern and southern ends of this large depth stratum, with six smaller assemblages of fishes exhibiting limited distributions. Biomass per volume reached a water column maximum in the bathypelagic zone between 1500-2300 m. This stands in stark contrast to the general "open ocean" paradigm that biomass decreases exponentially from the surface downwards. As much of the summit of the MAR extends into this depth layer, a likely explanation for this midwater maximum is ridge association. Fish density within the benthic boundary layer (within 200 m of the ridge) was nearly double that of the water column and biomass was approximately 50% higher. Of the 'ridge-associating' species, two species known to consume gelata, *Bathylagus*

euryps and *Scopelogadus beanii*, contributed over half of the fish biomass of this layer. These data suggest that a pelagic fish-gelata trophic linkage may be a key element of benthic-pelagic coupling over mid-ocean ridges, thus supporting enhanced nekton biomass over ridges in the absence of terrigenous nutrient input. Ongoing research to better understand this trophic linkage will be presented.

0141 Poster Session III, Sunday July 27, 2008

Developmental Morphology of the Skeleton of the Barbel, *Barbus barbus* (Linnaeus, 1758) (Ostariophysi, Cyprinidae)

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The development of the skeleton of laboratory - reared cyprinid fish *Barbus barbus* from the six stages was observed. Larvae were first sampled at 7 days after hatching, and then every four days till 29 days after hatching. They were cleared and differentially stained for cartilage and bone using a modified version of Dingerkus and Uhler (1977). In the first stage the anterior tip of the notochord did not start to ossify yet and vertebral centra did not appear. In the neurocranium the otic capsules were developing. The taeniae marginales fused medially between the eyes to form the trabecula communis. Anteromedially the trabeculae crani fused to one another and chondrified laterally to form the ethmoid plate. In the splanchnocranium the cartilaginous and ventral elements of the mandibular and hyoid arch were present. All hyoid parts were fused to form a single cartilaginous piece. Most of the bony ossifications of the splanchnocranium were present in the third stage, 20 days after hatching. The fifth ceratobranchials developed later than first four, but ossified earlier. Two separate centres of development were found in the axial skeleton, Weberian apparatus and caudal fin. In the 16th day old larvae the anterior tip of the notochord started to ossify. The first vertebrae as well as the all structures of the Weberian apparatus were present. In the last stage analyzed, 29 days after hatching the skeleton of caudal fin was fully developed. Among the paired fins, as first developed the pectoral ones, while the pelvic fins were visible in the second stage, without any elements of the girdle. The dorsal fin developed first than the anal one. Lepidotrichia started to ossify 20 days after hatching. First ossification of the anal fin started late, in the sixth stage of development.

0140 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

Development of the Skeleton of the Spined Loach, *Cobitis taenia* (Pisces, Cobitidae)

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The development of the skeleton of the spined loach *Cobitis taenia* from hatching to 23 days was studied, from cleared and stained material. No elements of the skeleton were present during the first day. In the next day the major part of the skull base was formed. The trabecular bars were separated from each other. The posterior otic cartilage was distinguished. The cartilaginous dorsal and ventral elements of the mandibular and hyoid arch were present. The notochord had begun to flex during the second day after hatching. Beneath its posterior portion, a condensation of hypural 2 was visible. At this stage the pectoral fins were present as an endoskeletal disc and fin fold. Three days post-hatching the four branchial arches were developing. In the larvae of 4 days post-hatching the caudal fin continued to develop. Five days post-hatching in the fin fold around the body first elements of the dorsal and anal fin started to appear. In the 6th day post-hatching the ethmoid region started to differentiate. The decomposition of cartilage matrix in the pectoral fins has begun. Posterior to the anus the anal fin started to develop. Eight days post-hatching three otoliths in the otic capsulae were present. In the same age the pelvic fins started to develop. In the caudal fin the epural was first seen as a small cartilage above the posterior notochord. First three anterior vertebrae appeared 10 days post-hatching. At this stage the bone of pharyngeal arch started to stain with alizarin red. Thirteen days post-hatching partially ossified pharyngeal teeth were visible. During the next day the base of neurocranium as well as parts of the hyoid arch started to ossify. Twenty three days old larvae had fully developed all elements of the neuro- and splanchnocranium as well as the axial skeleton.

0383 Fish Morphology & Histology I, Salons 6&7, Thursday July 24, 2008; STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Functional Morphology of the Pectoral Fins in a Benthic Fish, *Myoxocephalus octodecimspinosus*, the Longhorn Sculpin

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Actinopterygian fishes are named for the bony, segmented rays that support their fins. It is the curvature and relative position of individual fin rays that control the shape and movement of the fins as a whole. Despite their importance, we know little about the diversity of fin ray form and function. The fin rays of benthic fishes support a potentially more diverse repertoire of fin-based behaviors than that of their open-water relatives. This is because some fins, like the pectoral fins, are often used for substrate contact as well as for swimming behaviors. I used a three-fold approach to investigate the relationship between individual pectoral fin ray curvature and

whole-fin function in a benthic fish species, *Myoxocephalus octodecimspinosus*, the longhorn sculpin. First, I characterized the three-dimensional pectoral fin kinematics using high-speed video. I then calculated the three-dimensional curvature of individual fin rays during two behaviors, substrate contact and swimming, that place different functional demands on the pectoral fins. This allowed me to relate the curvature of individual fin rays to the shape and function of the pectoral fin as a whole. Second, I compared the bending properties of the individual pectoral fin rays of the longhorn sculpin. The bending tests were performed on freshly dissected rays. The bending properties of the rays in this species are unlike those previously described for ray-finned fishes. Third, I described the microstructure of individual bony elements of each fin ray. I used microCT scanning to examine fin ray morphology in detail. Longhorn sculpin have a unique fin ray microstructure that likely contributes to their unusual bending properties.

0194 Herp Biogeography, Salons 4&5, Saturday July 26, 2008

Multi-locus Comparative Phylogeography of Two Australian Arid-zone Skink Complexes

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The spinifex deserts of Australia harbor an exceptional diversity of lizards, yet they lack the conspicuous geographic barriers often invoked to explain genetic structuring between and within species. Instead, habitat specificity has been implicated as a factor leading to the divergence of these arid-zone lizards, as lizard taxa differ in their degree of habitat specificity and in their relative abilities to disperse across unsuitable habitat. Our comparative phylogeographic study of two species with largely overlapping ranges and different habitat preferences, *Ctenotus pantherinus* and *Lerista bipes*, provides an opportunity to investigate the role of biogeographical history, habitat specificity, and dispersal ability in creating the genetic structure of extant populations. Both *C.pantherinus* and *L.bipes* are found throughout the spinifex deserts of Western Australia, but they differ in micro-habitat specificity, with the terrestrial *Ctenotus* living in association with spinifex grass clumps and the fossorial *Lerista* restricted to loose sand ridges. Analysis of DNA haplotype patterns reveals well supported, geographically structured mitochondrial DNA clades within *Ctenotus pantherinus*; corresponding analyses of nuclear loci show lower levels of geographic structuring. MtDNA haplotypes in *Lerista bipes* have a more complicated geographic pattern, possibly stemming from cryptic taxonomic diversity, higher levels of gene flow, or lineage sorting issues. Both ecological differences among species and contrasting information content of nuclear and mitochondrial markers helps explain the high phylogeographic diversity of these species complexes.

0551 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Do Rare Earth Metals Deter Spiny Dogfish? A Feasibility Study on the Use of Mischmetal to Reduce Dogfish Catches in Hook and Lobster Gear in Gulf Of Maine

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Spiny dogfish, *squalus acanthias*, are considered to be unacceptably abundant by many inshore fishermen (commercial and recreational) during the summer and fall in the Gulf of Maine. Finding a practical and economic dogfish deterrent for application in various fishing gears is of strong interest. An industry-science collaboration afforded six research trips during September 2007. Triangular slices of a cerium/lanthanide alloy ('Mischmetal') were incorporated into three baited gears (longlines, rod and reel gear and lobster traps) and the catches were compared for 'treatment' (Mischmetal present) versus 'control' (mischmetal absent). Field observations were inconclusive for the lobster gear since the traps caught no dogfish, regardless of treatment. Some reduction in dogfish catch was recorded for rod and reel (~2%) and longline (~9-25%), but these results were not statistically significant. One complicating factor was the high rate of Mischmetal dissolution, which led to the rapid disintegration of the Mischmetal slices in all gears. *In situ* video footage verified that dogfish feeding behaviour is persistent on bait, regardless of Mischmetal presence. A parallel laboratory study provided video-taped, behavioural observations on the effects of alloys versus a chemically inert stainless steel 'decoy', under varying levels of food satiation and dogfish density. The laboratory assessments found some evidence of aversive behaviour in dogfish approaching baits protected by Mischmetal, but only when the dogfish had been fed to satiation before undertaking the study; after any period of starvation, no aversion to Mischmetal was observed. Dogfish density had no effect on feeding in the laboratory and the *in situ* footage showed that bait pursuit by one dogfish would escalate to frenzied feeding by multiple dogfish, with or without Mischmetal. Overall, there is little evidence to suggest that Mischmetal has the potential to reduce dogfish catches in either commercial or recreational gear types in the Gulf of Maine.

0560 Fish Systematics II, Salons A&B, Friday July 25, 2008

Phylogenetic Relationships of the Cyprinid Subfamily Rasborinae (Order Cypriniformes) Inferred from Mitochondrial and Nuclear Sequence Data

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The subfamily Rasborinae is a diverse group of cyprinid fishes, found primarily across southern Asia, with members also occurring in Africa. This subfamily is notable for including the model organism, *Danio rerio*, as well as many species popular in the aquarium trade. Previous workers have recognized distinct lineages within the Rasborinae, but relationships within the subfamily as well as its monophyly remain uncertain. For this study, more than 100 taxa representing over 30 putative rasborin genera were sampled for sequence data. Representative species were drawn from previously recognized subgroups of rasborins; taxon sampling included both African and Asian species. Outgroup taxa ranged from species of other cyprinid subfamilies to species from more distantly related ostariophysan groups. Our analyses are based on two mitochondrial genes (COI, *cyt b*) and two nuclear genes (RAG1, rhodopsin) evaluated using parsimony, maximum likelihood, and Bayesian methods. Although the results of our analyses do not support a monophyletic Rasborinae as currently constituted, there is support for a clade that includes *Rasbora* and most of the other putative rasborins (Rasborinae *sensu stricto*). The status of the rasborins as well as their relationships to other cyprinid groups will be discussed. This study is part of the Cypriniformes Tree of Life Initiative.

0248 Fish Systematics IV, Salons A&B, Monday July 28, 2008

Systematics of the Genus *Anisotremus* Gill, 1861 (Haemulidae: Perciformes)

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The family Haemulidae is present in the Atlantic, East Indian and Pacific oceans. They are mainly marine fishes with a few brackish species and rarely present in fresh water. Despite being widely distributed in both American coasts and appear frequently in local fisheries, few papers about their phylogenetic relations have been published to date, mostly limited to species descriptions and some biological and ecological information. Nowadays, the phylogenetic relations and the biogeographic history of *Anisotremus* are poorly known. The genus *Anisotremus* includes ten species, which were considered in this work as the ingroup. 52 bony characters were

examined; polarization was made by the outgroup method, which includes selected species of the genera *Genyatremus*, *Haemulon*, *Pomadasys*, and *Orthopristis*. All the characters were treated as unordered. A branch and bound search was performed with the ACCTRAN character state optimization, in addition to procedures of resampling for each of the nodes in the cladogram. The strict consensus tree, product of two parsimonious solutions, has a length of 119 steps and consistency and retention indexes of 0.521 and 0.689, respectively. According to the evidence, *Anisotremus sensu stricto* is not a monophyletic group. The inclusion of *Genyatremus luteus* in *Anisotremus* or the use of another generic arrangement for the branch including *G. luteus* and the two basal species, *Anisotremus dovii* and *A. pacifici*, could be to the solution to this systematic and taxonomic conflict. The main synapomorphies defining those clades are related to the oral and pharyngeal regions. The genus *Orthopristis* seems to be the sister group of *Anisotremus*, which would be in agreement with Mago (1961). The validity of the transisthmian species pair *A. taeniatus*-*A. virginicus* is confirmed.

0751 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Kill 'Em All: The Amazing Reptilian Immune System

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Many herpetologists would attest anecdotally to the fact that reptiles have extraordinary immune systems. For example, we often observe that our field or laboratory reptile subjects have wounds that heal very quickly and with little apparent negative effect on the animals, and we remark that our study reptiles recover very quickly from surgeries and other manipulations that could cause a high degree of mortality in mammalian or avian subjects. However, very little is known about just how the immune systems of reptiles impart such protection from pathogens, and few studies have examined relationships between reptilian immune function and aspects of their disease ecology, parasitism, or potential medical applications. Studies have shown that the complement system of spiny lizards (genus *Sceloporus*) is able to kill the spirochetes that cause human Lyme disease (*Borrelia burgdorferi*) in the ticks that infest them. A recent study on American alligators demonstrated that blood proteins have the ability to protect against a myriad of pathogens, and can even kill the human immunodeficiency virus *in vitro*. Research in my laboratory shows that blood from squamate reptiles also demonstrates a high propensity to kill bacterial pathogens *in vitro*, and that reptilian immune function has a complex relationship with circulating hormones, reproductive state, and various other physiological parameters. In addition, the rapid wound-healing of squamate reptiles can be used as an easily quantifiable marker of innate immune function. Because of the ease of study and surprising strength of the immune systems, investigations of reptilian immune function hold the promise of providing a wealth of information in both basic and applied sciences.

0121 Poster Session II, Saturday July 26, 2008

Annual Body Temperature Profiles of Free-Ranging Male Northern Pacific Rattlesnakes (*Crotalus o. oreganus*)

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Since most physiological and behavioral processes of reptiles are temperature-dependent, collecting accurate and plentiful data on body temperatures (T_b) of free-ranging reptiles allows us to better understand the role of thermal biology in other organismal processes. Thermochron iButtons can be surgically implanted into the body cavities of many reptiles, and can remotely collect T_b at programmed intervals. I implanted 10 male Northern Pacific rattlesnakes (*Crotalus o. oreganus*) with radiotransmitters and with iButtons programmed to log T_b every two hours. After 1.5 years, the iButtons were removed and downloaded. Lowest mean daily T_b was in January, and highest was in August, consistent with environmental temperatures. In general, T_b was usually higher when snakes were surface active than when they were in refugia. However, snakes spent most of August in refugia and still had very high T_b; surface activity may have been limited by high temperatures during that month that penetrated into refugia. Mean daily variance and standard deviation of T_b were very low in winter months (October-February), reflecting the inactivity of overwintering snakes. These values were highest during spring months (March-June) and September, reflecting the increased surface activity of the snakes. Values were mid-range in July and August, when snakes were relatively inactive but high daytime surface temperatures likely penetrated to the snakes' refugia. Remote, automated T_b data collection using technology such as iButtons is a powerful tool for providing unbiased data on the thermal biology of free-ranging reptiles. These data could potentially be used to remotely estimate surface activity, calculate energy budgets, examine effects of microhabitat on thermal biology, and many other applications.

0485 Poster Session II, Saturday July 26, 2008

Stomach Content Analysis of *Kuhlia xenura* in Kolekole Stream, Hawai'i

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Fishes in the family Kuhliidae are found in subtropical and tropical fresh, estuarine and marine waters of the Indo-Pacific. *Kuhlia* are important culturally and as a food fish in the Hawaiian Islands, which makes their management a significant scientific concern. Recent studies have split the originally named species *Kuhlia sandvicensis* into two distinct species: *K. sandvicensis* and *K. xenura* (which appears to be endemic to Hawai'i). It is known that *K. xenura* can migrate between freshwater and fully marine habitats, experiencing 0 to 36 ppt. Their migration pattern makes them an important vessel for nutrient and energy flow between the two habitats. This

stomach content analysis study is a component of an ongoing series of projects to analyze the biology of the recently split *Kuhlia* species in Hawai'i. Fish were collected during day and night hours from freshwater and estuarine habitats of Kolekole Stream on the Island of Hawai'i. Diet content analysis has found both larval and adult food items of terrestrial, freshwater and marine origins, including Actinopterygian fishes, Dipterans, Neuropterans, Hymenopterans, Isopods, Arachnids, Copepods, Decapod crustaceans, Oligochaetes, and Turbellarians. In addition, freshwater algae (primarily filamentous greens and diatoms) were found in most but not all fish. Preliminary data analysis suggests that the top four food items found are *Macrobrachium lar* larvae, adult dipterans, dipteran chironomid larvae, and ants. A trend is observed between night and day samples, where all night samples included an abundance of *Macrobrachium* larvae not seen in day samples. Chironomid larvae were also more abundant in night samples. Ongoing analysis will include comparisons of stomach volume and food type in terms of the relative importance of each item. Enhanced understanding of the diet of these endemic, euryhaline fish will likely promote an awareness of ecological connectivity between marine and freshwater ecosystems in Hawai'i.

0107 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

Effect of climate change on thermal regimes inside natural nests of a lizard species with temperature-dependent sex determination

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Species in which ambient temperatures directly determine offspring sex may be at particular risk as global climates change. However, whether or not climate change affects sex ratio depends upon the effectiveness of buffering mechanisms that link ambient regimes to actual nest temperatures - for example, females may simply lay nests earlier in the season, or in more shaded areas, such that incubation thermal regimes are unchanged despite massive ambient fluctuation. Based on 10 years of monitoring nests in the field at an alpine site in south-eastern Australia, we show that lizards (*Bassiana duperreyi*, Scincidae) have adjusted their seasonal timing of oviposition as well as nest depth in response to rising ambient temperatures, but have been unable to compensate entirely for climate change. That inability stems from the fact that the seasonal march of soil temperatures - and thus, the degree to which thermal regimes at the time of laying predict subsequent conditions during incubation - also have shifted with climate change. As a result, mean incubation temperatures in natural nests now have crossed the thermal threshold at which incubation temperature directly affects offspring sex in this population.

0495 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Global Phylogeography of the Great (*Sphyrna mokarran*) and Smooth (*Sphyrna zygaena*) Hammerhead Sharks

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The great (*Sphyrna mokarran*) and smooth hammerhead (*S. zygaena*) sharks are globally distributed species of significant conservation concern because they have high bycatch rates and high value fins. The great hammerhead has been assessed as endangered and the smooth hammerhead as Lower Risk / Near Threatened by the IUCN Redlist. There is no information on the population structure of either species to inform management and conservation efforts. We report on an ongoing assessment of the global population structure of both species using nuclear microsatellite markers and complete mitochondrial control region (mtCR) sequences (approximately 1098 nucleotides) from 78 great and 85 smooth hammerheads. Great hammerhead samples analyzed thus far included 59 North Atlantic and 6 Indo-Pacific individuals. Smooth hammerhead samples analyzed included 14 Atlantic, 23 North Pacific, 28 Southeast Pacific and 19 Indo-Pacific individuals. Analyses of the great hammerhead mtCR revealed strong geographical subdivision into two distinct evolutionary lineages with little exchange of haplotypes between the lineages (F_{ST} 0.704, $P < 0.005$) and little to no detectable genetic structure within either lineage. Smooth hammerhead mtCR revealed strong geographical subdivision into four separate populations with no evidence of gene flow between the populations (F_{ST} = 0.802, $P < 0.00000$) and little to no detectable genetic structure within the populations. Analyses of microsatellite loci from both species are currently underway. Despite the modest regional distribution of samples analyzed thus far, the data suggest that genetic population subdivision in these species may be extensive, making it likely that proper management will require a multi-regional approach.

0080 Fish Systematics III, Drummond, Saturday July 26, 2008

Phylogeny and evolution of the shrimp/goby mutualism in the Pacific

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A paradigmatic example of marine symbiosis is that of shrimp gobies and their shrimp. In this mutualism, snapping shrimp (genus *Alpheus*) dig a burrow that they inhabit with a partner goby. The shrimp is nearly blind, and the goby acts as a sentinel, communicating in a tactile language of tail flicks detected by the shrimp's elongated antennae. An estimated 110 goby species in 10 genera participate in this mutualism in the Pacific, along with approximately 20 species of alpheid shrimp. This imbalance in diversity indicates either that there are many cryptic and/or undescribed shrimp species, or that speciation between gobies and shrimp has not

proceeded in concert. We describe novel field techniques for capturing mutualistic gobies and shrimp, hypothesize phylogeny for both partners based on DNA sequence data, and compare the phylogenies to determine whether or not a pattern of cospeciation exists. We found that of the mutualists we sampled (29 goby species in seven genera and eleven shrimp taxa), some undescribed diversity among shrimp was indicated, but not enough to equal the number of goby species partnered with them. No cospeciation pattern was detected between the shrimps and gobies, instead we identified many generalist taxa of both gobies and shrimp. The distribution of different pairings seems most likely to be determined by ecology, not by evolutionary relationships.

**0514 Fish Ecology I, Drummond, Thursday July 24, 2008; STOYE
ECOLOGY & ETHOLOGY**

**Mosquitofish as Biotic Resistance to Invasion: Predation on Two
Nonindigenous Poeciliids**

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Predation by native species may limit the invasibility of communities. Mosquitofish *Gambusia* spp. are common, small-bodied poeciliids native in many freshwater systems in the USA. Previous work has shown that predation by mosquitofish on small-bodied fishes to be a strong factor in shaping community structure both with naturally co-occurring fishes and where mosquitofish have been introduced. Furthermore, recent research demonstrates that mosquitofish are not strictly gape-limited and can effectively prey on fishes of similar size. Florida has many established nonindigenous fishes, yet few are small-bodied. We experimentally investigated what role mosquitofish predation may have in limiting invasions of small-bodied nonindigenous fishes. In a series of three mesocosm experiments using two common ornamental poeciliids (swordtail *Xiphophorus hellerii* and variable platyfish *X. variatus*) we tested 1) the effect of predator density on adult survival following introduction, 2) the effect of predator density on a stage-structured population, and 3) effect of habitat structural complexity on predation efficiency of mosquitofish. Mosquitofish successfully killed adults of both species even though these individuals were significantly larger than the mosquitofish. Density effects of mosquitofish were not significant in platyfish survival, where survival remained high across treatments, but was a significant factor with swordtails, which had lower survival with increasing mosquitofish densities. Mosquitofish presence was shown to have a strong negative effect on survival of juveniles of both species. Interestingly, mosquitofish predation efficiency on swordtails was shown to actually increase with increasing stem density, although results were not significant with platyfish. Our results suggest that predation on juveniles by mosquitofish is likely a strong factor in limiting invasion success of these species. Direct mortality on adults also may be a factor with swordtails. In both species there was an observed shift in habitat use in the presence of mosquitofish and this may be an important indirect effect, perhaps facilitating other predators.

0357 Fish Systematics I, Salons A&B, Friday July 25, 2008

Taxonomy of the Catfish Genus *Amphilius* (Teleostei: Amphiliidae) in Kenya and Eastern Tanzania

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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 endemism. The species with large distributions are thought to be species complexes with many populations worthy of taxonomic recognition. Skelton (1984) revised the east African species of *Amphilius* and recognized *A. uranoscopus* as a widely distributed species. However, this species is extremely variable in pigmentation and other morphological characteristics. We examined all available specimens, including recently collected material from eastern Tanzania and Kenya, to determine the identity of several nominal species currently in the synonymy of *A. uranoscopus* and to discover undescribed diversity in the complex. We conclude that current taxonomy is inadequate to describe the diversity in Kenya and eastern Tanzania and provide evidence for recognition of several new species as well as some currently in the synonymy of *A. uranoscopus*.

0255 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008

Ontogenetic variation in effect of ration size on growth of *Scyliorhinus retifer*

Jacqueline E. Thrasher, John F. Morrissey

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Chain catsharks, *Scyliorhinus retifer*, are continental shelf- and slope-dwelling elasmobranchs of eastern North and Central America. This species has been relatively unstudied and it is important to understand some of the basic elements of their natural history to comprehend the larger roles they play, such as their ecological impact as predators within an ecosystem. The main purpose of this study is to determine how daily maintenance ration will affect growth and gross conversion efficiency during ontogeny. Previous studies have examined how different daily ration levels affect growth and gross conversion efficiency of teleost fishes; however, few studies have dealt with this issue in cartilaginous fishes, and no studies have examined the ontogenetic variation in this relationship for any shark species. This study examines a cold-water species with a considerably slower metabolism compared to similar studies on other cartilaginous fishes. We used four feeding regimes in juveniles and adults to examine the relationship between food intake and growth. We hypothesize that the percentage of food intake that will be used for growth will be highest in juveniles and lowest in adults. We also hypothesize that

gross conversion efficiency will peak at an optimum ration that will lead to a decrease in increasing rations beyond this optimum point.

0663 General Ichthyology II, Salons 6&7, Saturday July 26, 2008

Phylogenetic Signals from the Guts of Stomachless Piscivores (Belonidae: Beloniformes)

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Needlefish have a global temperate and tropical distribution occurring in oceanic, coastal, estuarine and fresh waters. They are primarily piscivorous yet lack a stomach, the principal digestive organ in piscivorous fishes. Intestinal pH ranges from 6.0 to 7.3. Oral teeth are caniniform, only holding but not cutting captured fish prey. They have adaptations in both jaw and pharynx that allow them to swallow relatively large fish whole. Little mechanical digestion occurs as a function of passage through the pharyngeal mill apart from possible scale loss and integumental scoring caused by the anteriorly directed posterior teeth of the fifth ceratobranchial dentition. Ingested fish tend to be held in the posterior portion of the intestine just anterior to the rectal valve where it appears that intestinal enzymes alone break them down. These data are compared with comparative data from other members of the order to assess competing phylogenetic hypotheses concerning the Beloniformes.

0004 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT SYSTEMATICS/EVOLUTION

Exploring the Faunal Connection between the Ozark Plateau and the Appalachian Mountains: A Phylogeographic Study of the Long-tailed Salamanders (Plethodontidae: Splerpinae: *Eurycea*)

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The Ozark Plateau is a major geographic feature in eastern North America that harbors a wide diversity of endemic plants and animals. The colonization of these highlands is believed to have occurred from numerous independent invasions from adjacent areas, including the Appalachian Mountains and the Coastal Plain. Although in recent years there have been several detailed phylogeographic studies of eastern North American, few examine species groups that are distributed across the Ozarks and adjacent areas to test the origins of fauna in this physiographic region. Long-tailed salamanders of the genus *Eurycea* are widespread throughout both physiographic areas and are found in relatively high abundance providing an ideal model system to investigate the faunal connections that exist between these regions. This group contains four nominate taxa: the long-tailed salamander, *E. longicauda longicauda*, from the Appalachians, the dark-sided salamander, *E. l. melanopleura*,

endemic to the Ozark Plateau, the three-lined salamander, *E. guttolineata*, widespread in the Coastal Plain and the cave salamander, *E. lucifuga*, that is distributed across both the Appalachians and the Ozarks. Using mitochondrial and nuclear DNA sequence data, I closely examined the phylogeographic relationships among the long-tailed salamanders. I specifically tested the timing and patterns of dispersal and colonization into the Ozark Plateau and/or Appalachian Mountains. The nuclear and mitochondrial sequence data obtained provides taxonomic and systematic resolution for the current subspecies *E. l. melanopleura*. Additionally, the existence of hybridization and intergradation between *E. l. longicauda*, *E. l. melanopleura* and *E. lucifuga* previously suggested based on morphological assessments was examined.

0537 Poster Session III, Sunday July 27, 2008

Upland Movements of Juvenile Eastern Tiger Salamanders (*Ambystoma tigrinum tigrinum*) on Long Island

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The long-term survival of the New York State endangered eastern tiger salamander is of special concern due to rapid development of its last remaining habitats on Long Island. Understanding the characteristics of ponds and vernal pools utilized by amphibians like the tiger salamander, as well as the upland habitats used throughout the year, is essential to the conservation and proper management of these species. A radio-telemetric study is currently underway at Brookhaven National Laboratory on Long Island, New York. Data were collected from 2004 to 2007 at three pond locations. Fifty-nine juveniles have thus far been captured and implanted with transmitters. Single night movements ranged 4 to 269m. The average distance from the edge of the wetland was 82.5m, while the average total distance travelled was 109.8m. Animals were tracked for an average of 66 days. Implanted animals have been lost due to predation, loss of transmitter signal, or are still being tracked. Based on our findings, we feel that the current 30m buffer zone for wetlands and aquatic breeding habitats and the corridors to maintain connections with adjacent areas beyond 150m are insufficient to allow for dispersal of juvenile tiger salamanders.

0556 Poster Session III, Sunday July 27, 2008

The North American Reporting Center for Amphibian Malformations and Online Amphibian Information Portal

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Amphibians face many important conservation challenges globally; the dissemination of important 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) launched the NBII Amphibian Site and North American Reporting Center for Amphibian Malformations. Together, these online resources constitute a valuable information repository that supports the collaborative efforts of herpetologists as they seek out 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 can provide researchers early warning and just cause for continued monitoring. By engaging the public in citizen science, NBII-SAIN and SREL are raising awareness about amphibian conservation issues. In addition to searchable data 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, and amphibian monitoring programs. 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.

0504 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Interspecific Effects of Upland Forest Clearing on Amphibian Migrations: Implications for Habitat and Population Connectivity

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Forest clearing has been shown to reduce survival and promote evacuation of resident amphibians. Therefore, forest clearings may act as barriers to migrating amphibians and limit the connectivity of breeding ponds to adjacent uplands or limit the interconnectivity of local population patches. To examine the effects of canopy removal on amphibian breeding migrations we created 4 replicate experimental arrays in forest habitat on the Savannah River Site, Aiken, SC, USA. Each array had 4 forest harvesting treatments applied to upland habitat immediately adjacent to amphibian breeding ponds: (1) an unharvested forest (>30 yr old); (2) a partially thinned forest; (3) a clearcut with coarse woody debris retained; and (4) a clearcut with coarse woody debris removed. We intercepted amphibians as they migrated to and from wetlands through these habitats using drift fences with pitfall traps. We found limited evidence for treatment effects on the number of individuals immigrating to wetlands through the upland habitats except in open-canopy breeding *Bufo terrestris* and *Rana* spp. which were captured in significantly greater numbers immigrating to wetlands through clearcuts. We also identified a trend, albeit non-significant, for *Ambystoma opacum* to immigrate to wetlands through unharvested forest. We captured significantly greater numbers of salamanders (*A. opacum* and *A. talpoideum*) emigrating out of the wetlands through unharvested or partially thinned forests than through clearcuts. Comparing salamanders with frogs, we found that a significantly greater proportion of salamanders used forested habitat for migrations rather than clearcuts. Our results reflect the important differences that exist in the ecology and vagility of amphibian species. Further, they suggest that landscape-level effects of forest clearing, such as reductions in gene flow or local and metapopulation persistence, may be greater for pond-breeding salamanders than for pond-breeding frogs in the Coastal Plain region.

0257 Poster Session II, Saturday July 26, 2008

Effect of Predation on Body Shape and Life History of Females of *Gambusia* (Teleostei: Poeciliidae)

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Predation can have a streamlining effect on body shape of fishes, which may reduce reproductive allocation by reducing abdominal space available for reproduction. Inversely, theoretical and empirical evidence show that increased reproductive allocation is optimal in environments with increased adult mortality rates. Here we have a possible conflict: predation risk can simultaneously decrease reproductive allocation by selecting for higher escape speeds which can in turn cause a reduction in abdominal space, but also select for an increase in reproductive allocation according to life-history theory. There are few studies that address this potential conflict. We are analyzing the relationship between predation, abdominal space, and reproductive allocation in species of *Gambusia* using a comparative approach. Specifically we are testing the hypothesis that predation and abdomen size interact in a complex way to determine reproductive allocation of females of *Gambusia*. Specimens have been gathered from museum and our own collections. Life history data have been obtained from dissections. Body shape data has been obtained from lateral- and ventral side photographs. Currently we have data from 22 species, comprised by 68 collections. Each of these species was classified according to the predation or water current regime they live in. Our preliminary analyses showed a large variation in life history traits and body shape within the genus. Our hypothesis will be tested using confirmatory Structural Equation Modelling. We will continue pursuing our main objective, to make an assessment of the effect of predation and current, on morphology, life history, performance, and feeding characters for the species of the genus *Gambusia*.

0632 Poster Session I, Friday July 25, 2008

Using Fuzzy Model to Age Estimation of Freshwater Stingrays Species from Rio Negro Basin, Brazil

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Accurate assessment of elasmobranch age is necessary to obtain estimates of growth, mortality and longevity rates. The purpose of this study was through Fuzzy method developed a model for noninvasively determining the age of two species of freshwater stingrays from Rio Negro Basin: *Potamotrygon motoro* e *P. cf. hystrix*. One of assumption of the model is that the first maturation occurs in the point of inflection of length and weight curve obtained in the model crisp. The Fuzzy model incorporates the variations that in fact happen in the experimental data. The

feasibility of estimating the age by a computer model based on a Fuzzy system was previously reported to teleost fish. The result obtained through Fuzzy model to *Potamotrygon cf hystrix* provide a significant fit to observed data for capture and release studies. Nevertheless *the first maturation age of Potamotrygon motoro* is overestimated using this method, and a model adjustment it is necessary.

0590 Poster Session II, Saturday July 26, 2008

Using GIS and Ecological Niche Modelling to Investigate the Environmental Factors Regulating Amphibian Distributions in Missouri

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A significant challenge in understanding patterns of biodiversity is determining the degree to which the distributions of organisms are regulated by either broad-scale environmental factors (e.g., climate) or local interactions (e.g., competition, microhabitat availability). We are investigating the effects of broad and local-scale abiotic factors on the distributions of ten pond-breeding amphibians in eastern Missouri. Maximum entropy (Maxent) ecological niche models have been developed for each species using temperature and precipitation data, as well as georeferenced locality data. We are testing the predictive ability of these species distribution models using field survey data from amphibian breeding ponds in eastern Missouri. Field surveyors utilize calling adult anuran surveys, egg mass surveys, and larvae surveys to detect amphibians. We are also comparing the accuracy of the niche model predictions to local-scale variables (e.g., pond hydroperiod and canopy cover) that have been demonstrated to be important in regulating amphibian community structure. Initial results indicate that, for most species, the niche models did not predict species presence as well as the local environmental variables. However, Maxent predictions for *Rana sylvatica* exhibited better than random ability to predict species occupancy in areas where individuals were present. In addition, jackknife tests indicated that maximum temperature of the warmest month was the most important climatic variable contributing to the accuracy of the *R. sylvatica* prediction. As *R. sylvatica* is at the southern edge of its geographical range in the study area, this may suggest that broad-scale climate variables are more important in regulating the distribution of species at the edge of their ranges, while local environmental factors may control species distributions near the center of their ranges.

0181 Reptile Ecology, Salons 6&7, Friday July 25, 2008

Eastern Fence Lizards Clean the Agent of Lyme borreliosis from Blacklegged Ticks

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Western blacklegged ticks (*Ixodes pacificus*) are cleaned of Lyme disease-causing spirochetes, *Borrelia burgdorferi*, after feeding on western fence lizards (*Sceloporus occidentalis*). This has been proposed as a partial explanation for the relative scarcity of Lyme borreliosis in the western U.S., where *S. occidentalis* commonly serves as a host for larval and nymphal ticks. We investigated the role that the sister taxon, the eastern fence lizard (*S. undulatus*) may play in *B. burgdorferi* persistence in the Northeast, where most Lyme borreliosis cases occur. Our objective was to test the hypothesis that *S. undulatus*, like its western congener, actively clears *B. burgdorferi* infection from infected ticks. We collected lizards in southern New Jersey, where *I. scapularis* and *B. burgdorferi* are common. In the field, we found little naturally-occurring parasitism of *I. scapularis* on *S. undulatus*, during a time of year when nymphal *I. scapularis* were actively host-seeking in the Northeast. In the lab, we first fed *B. burgdorferi*-infected nymphal ticks on *S. undulatus* and then checked the molted ticks for infection. We found that *S. undulatus* cleaned *I. scapularis* of the Lyme pathogen. We subsequently fed uninfected larval ticks on challenged lizards to assay for transmission of *B. burgdorferi*, and while transmission to larvae was not completely blocked, it was extremely low. Our data strongly suggest that *S. undulatus* is not a highly competent reservoir for *B. burgdorferi*, at least not for the *B. burgdorferi* strain (Vallhalla, Westchester County, N.Y.) we used. However, *S. undulatus* may be more permissive to other *B. burgdorferi* strains. It appears that *S. undulatus* do not serve the same role in reducing Lyme borreliosis risk as do western fence lizards, because eastern fence lizards are far less important as hosts for *I. scapularis*.

0720 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Population Viability Modelling of the Gopher Tortoise (*Gopherus polyphemus*) and its Implications for Managing Tortoise Populations

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The gopher tortoise is still widespread across the southeastern U.S., although the species is believed to be in serious decline. Biologists and land managers face the dilemma of having to make decisions about how best to manage the remaining populations. When attempting to select among in-situ and ex-situ management options, there are no good decision tools for evaluating or predicting whether the existing population is viable in the long term. We developed demographic models for both native and translocated gopher tortoise populations and used those models to predict outcomes for a variety of population conditions and management scenarios. Baseline models for naturally occurring populations were constructed in VORTEX from demographic values currently available in the literature. All basic model scenarios resulted in declining populations, though populations of 100 animals were unlikely to experience extinction over 100 years and populations of 250 animals were modelled as persisting for 200 years. In all cases, it was clear that juvenile survivorship rates need to be much higher than reported to achieve stability. Populations not likely to be viable will require management intervention, including habitat and/or population manipulations. In-situ protection and management are preferable where possible, and the models suggest that improving habitat can improve long-term population viability. When habitat management alone is unlikely to ensure population viability, manipulations of the population itself, including translocation, may be necessary.

0710 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Impacts of Invasive Brown Anoles (*Anolis sagrei*) on the Arthropod Fauna of Cabbage Palms (*Sabal palmetto*) in Florida

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Invasive species often displace ecologically similar native species, but the effects of such displacements on other food web elements are not well-studied. In Florida, dense populations of an invasive lizard, the brown anole (*Anolis sagrei*), can displace populations of the native and ecologically similar green anole (*Anolis carolinensis*) in open or disturbed habitats. Cabbage palms (*Sabal palmetto*) are commonly abundant in such habitats and are frequently occupied by green and brown anoles. I investigated the potential for brown anole invasions to impact the arthropod fauna of cabbage palms by censusing palm canopy arthropods and conducting timed anole counts on a series of 33 similar islands that varied with respect to brown anole

presence and abundance. Using regression analyses, I asked whether brown anole abundance was a significant predictor of arthropod richness or abundance per palm, both overall and for specific taxonomic and functional groups. Brown anole abundance was negatively related to both total arthropod richness and abundance, and regression models indicated that highly invaded islands would be expected to have approximately 35% fewer arthropod species and 40% fewer individuals per palm than identical uninvaded islands. The abundance of brown anoles was also negatively related to the abundances of salticid and other cursorial spiders, ants, crickets, and beetles. Somewhat surprisingly, brown anole abundance was not significantly related to web spider abundance, nor did it predict the abundances of cockroaches or hemipterans. Since brown anoles have been shown to displace green anole populations on the islands used in this study, these results suggest that green and brown anoles do not have equivalent effects within island food webs, at least for arthropod communities on cabbage palms.

**0534 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY**

**Molecular Genetic Variation in Subspecies of the Circumtropical
Needlefish *Platybelone argalus***

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Marine needlefishes (Beloniformes: Belonidae) are common fishes found worldwide in the tropics and subtropics. The circumtropical species *Platybelone argalus* is restricted to oceanic environments found well offshore of coastal continental waters, frequently inhabiting waters around oceanic islands. Based on morphological variation there are currently eight geographic subspecies of *P.argalus* described and summarized in previous studies. Possibly, there are subspecies that have been geographically separated to the extent that there has been no gene flow between populations for a sufficient time period to have diverged genetically. The objective of our study is to determine the taxonomic status of subspecies of *P.argalus*. Using molecular genetic techniques, such as DNA sequencing, we will assess genetic variation between the populations based on DNA sequences of cytochrome b gene and D-loop region. Preliminary results from mtDNA cytochrome b and D-loop sequences indicate genetic variation between Atlantic and Pacific populations.

0251 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Phylogeography of the orangebelly darter, *Etheostoma radiosum*

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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.

0164 Poster Session III, Sunday July 27, 2008

Validation of Daily Increment Formation on Otoliths and Birth Date Calculation for Young-of-the-Year Black Sea Bass (*Centropristis striata*)

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Black Sea Bass (*Centropristis striata*) are an important recreational and commercial fish species in coastal Massachusetts. A better understanding of their life history characteristics, including the accurate determination of their local spawning patterns is essential to the effective management of the fishery. The primary objective of this study is to determine birth dates using daily otolith increments of young of the year (YOY) fish. The formation of daily increments in the otoliths was first validated in the laboratory with a tetracycline immersion experiment. Tetracycline immersed YOY sea bass were maintained for 30 days in a recirculating aquarium system and their otoliths examined to determine the number of rings formed in the experimental time period. For birth-date analysis, sea bass were collected from 5 coastal and 8 offshore sites within Buzzards Bay and Nantucket Sound in the late summer and early fall of 2006 and 2007. Sagittal otoliths were removed, and prepared for analysis by sectioning, polishing, and treating with trypsin. Daily rings were observed

through a compound microscope (4X and 10X) and computer enhanced daily rings counted. Birthdates from each sample are being used to identify spawning patterns for the local population of sea bass. Because the coastal and offshore sites were from two separate areas in coastal Massachusetts waters, (Buzzards Bay and Nantucket Sound) the possibility of differing birth dates and spawning patterns will be explored. This study will allow for the spatial and temporal comparisons of YOY sea bass while in residence in their juvenile habitats.

0480 Poster Session II, Saturday July 26, 2008

Amazonian Poison Frogs Depositing Tadpoles with Andean Competitors: an Ancient Ecological Trap?

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Reproductive habitat selection in anurans is an important determinant of an individual's fitness. Although previous studies have shown that anurans select reproductive habitat on the basis of many cues, relatively few have addressed competition risk as a potential cue. We investigated whether a widespread Amazonian frog, *Ameerega trivittata*, selects habitat for tadpole deposition on the basis of intra- or interspecific competition risk. Competition experiments from a previous study allowed us to determine the effects of competition *a priori* and therefore assess whether habitat selection in response to competitors was adaptive. Our results show that montane populations of *A. trivittata* adaptively select tadpole habitat in response to conspecific competitors. Conversely, their habitat selection in response to a heterospecific competitor (*A. bassleri*) is maladaptive and appears to function as natural ecological trap. We suggest that this ecological trap is maintained by high levels of gene flow from lowland populations that are naïve to the competitor, and that the montane population of *A. trivittata* avoids extinction through its connectivity to lowland populations.

0516 AES Reproduction, Kafka/Lamartine, Saturday July 26, 2008

Androgen Receptors In The Bonnethead Shark (*Sphyrna tiburo*): A Means To Understanding The Functional Role Of Steroids In The Male Reproductive Tract

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Androgens and the androgen receptor (AR) play important roles in virilization, spermatogenesis, and sexual behavior in vertebrates. An understanding of the distribution and levels of expression of the ARs on the cellular and tissue level demonstrates the pattern of responsiveness to the androgenic hormones in a given organism. In this study, the ARs of the reproductive tract of the male bonnethead

shark, *Sphyrna tiburo*, were detected on a cellular level using *in situ* hybridization (ISH) and immunocytochemistry (ICC) while levels of AR expression were measured using relative quantitative PCR. ISH results localized the AR RNA in the interstitial cells, Sertoli cells, and developing sperm of the testes, and mature spermatozoa within the seminal vesicles and the epididymides. The ICC methods used to detect the AR protein using a rabbit polyclonal antibody, PG-21, produced comparable results in the shark testes but did not yield positive results in the seminal vesicles or the epididymides. However, the Leydig gland, whose secretions contribute to the seminal fluid, demonstrated consistent AR immunoreactivity. The use of relative PCR revealed that these organs have variable levels of AR gene expression that significantly differ with the stage of the shark's seasonal reproductive cycle. Additionally, the presence of steroidogenic enzymes, such as 17 β -hydroxysteroid dehydrogenase, was detected cellularly as a measure of androgen synthesis using ICC. Serum steroid hormone levels are often presumptively correlated with reproductive events whereas knowledge of the cognate receptors provides insight into the cells and processes that are regulated by the hormones. By characterizing AR distribution in the reproductive tract and the steroidogenic enzymes in the testes of male *S. tiburo*, this study provides the basis for future research on the direct and indirect effects of androgenic hormones in this species. These results, along with comparisons of AR distribution in other elasmobranch species, will be discussed.

0491 Poster Session I, Friday July 25, 2008

Re-examination of Growth Rates of Female Bonnethead (*Sphyrna tiburo*) from Two Different Populations from the Eastern Gulf of Mexico Based on Tag-Recapture Data

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Juvenile and adult *Sphyrna tiburo* were tagged with external nylon-barbed tags and released along Florida's Gulf coast beginning in November of 1991. Length and time-at-liberty data from 105 usable recaptures were used to examine growth rates of female sharks from the eastern Gulf of Mexico. The time at liberty ranged from 2 to 2,029 days while the measured growth increments ranged from -5.4 to 29.8 cm. A maximum likelihood approach was employed for the analysis of the growth increment data derived from this tagging and recapture study. This approach allowed for the estimation of von Bertalanffy parameters as well as measurement error, growth variability, and uses mixture theory to provide an objective way of dealing with outliers. A bootstrapping method was utilized to estimate confidence limits of the parameters. Analyses were performed combining all usable samples from all areas and by separating them in two different populations based on previous studies that concluded that there is latitudinal variation in growth rates for this species. These results will be discussed and compared with previous published results from age-at-length data for female bonnetheads inhabiting similar regions of Florida.

0586 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Captive Records of Manta Rays in Okinawa Churaumi Aquarium

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From thirty years, from 1978 to 2008, we have kept a total of 19 Manta Rays (*Manta birostris*) in captivity at the Okinawa Expo Aquarium and its immediately adjacent successor, the Okinawa Churaumi Aquarium. We are the first Aquarium in the world to keep manta rays successfully, and as of January 20, 2008, we hold the world record for the longest time in captivity of a single individual, 15 yrs. 8 months. A female manta pup, the first-ever conceived and born in captivity, was born here on June 17, 2007. For 24 years, until 2001, 14 of these rays were kept either in the 1,100 m³ tank or the open-sea pen associated with the Expo Aquarium. In 2001, when the new 7,500 m³ tank was ready at Churaumi, four of these rays were transferred directly to it, where they have been kept until now. The large Churaumi tank was built to serve as both a display and experimental tank, with the twin goals of exhibiting Whale Shark and Manta Ray feeding behaviors, and studying their reproduction in captivity. We have been fortunate to make observations on mating and birthing behavior of captive adult Manta Rays, and to collect reproductive data, such as size and age at reproductive maturity, gestation time, litter size, size and weight of newborn, most of which is information new to science. Our observations and data, including data on survival times in captivity, are reported and discussed in this report. Among the four species in the Family Myliobatidae kept in our Aquarium (including *Manta birostris*, *Mobula japonica*, *M. diabolus*, *M. tarapacana*), Mantas have shown the best adaptability to captive settings. Because of our demonstrated ability to keep and observe animals successfully over long periods of time, we believe keeping wild animals in captivity can lead to making valuable contributions to understanding their biology.

0764 General Herpetology II, Jarry/Joyce, Monday July 28, 2008

The EMBL/TIGR/JCVI Reptile Database

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The EMBL Reptile database was founded in 1996 and has been the largest and most prominent reptile database on the web since then. In 2007 the database moved from European Molecular Biology Laboratory (EMBL) to The Institute of Genomic Research (TIGR) and then to the J Craig Venter Institute (JCVI) in Rockville, Maryland. Currently it contains more than 8,800 reptile species with data on synonyms, distribution, types, and more than 25,000 references. From the outset the database has been focusing on species-level taxonomy but also provides information on phylogeny and other biological subjects. The current release (May 2008) has also links to photos (on the web) for 3,463 species (~39%) of which more than 2,500 photos of more than 1,500 species are on our own server. Every year the database

adds on the order of ~100 species with a record increase in 2007 of more than 150 species. Several years ago we started to collect original descriptions of reptile species. Several hundred descriptions published before 1900 have been made available on our website (see URL below). In a related project, major historical works have been digitized and are available on CD-ROM, including Duméril and Bibron's "Érpetologie Générale" (10 volumes), Boulenger's catalogs (6 volumes), and complete runs of the Annals and Magazine of Natural History (383 articles pre-1900), Proceedings of the Academy of Natural Sciences of Philadelphia (129 articles pre-1900), Zoologischer Anzeiger (127 articles, 1880-1905), and the Proceedings of the Zoological Society of London (in progress). The database is freely available on the web although CD-ROM and download versions are available for a small fee (or free for contributors who donate photos, literature, or data). Demos of the database will be given in Montreal. The database is available at <http://www.reptile-database.org>.

0380 General Ichthyology I, Drummond, Saturday July 26, 2008

High Diversity in Goatfishes (Mullidae) of the Western Indian Ocean: Two New Species of the Genus *Upeneus*

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The Western Indian Ocean fish fauna is particularly rich in species requiring detailed taxonomic, systematic, and ecological studies. Here we report the finding of two new species of goatfishes of the genus *Upeneus* (Mullidae) based on recently collected material from coastal waters of East Africa, Madagascar and the Seychelles. A part of the collection was made during a cruise with the RV *F. Nansen* off South Africa and Mozambique in 2007. The two new species can be clearly distinguished from other closely related species by a combination of morphometric, meristic, and color characters. *Upeneus* sp.nov.1 differs from the co-occurring *U. guttatus* in numbers of dorsal fin spines (8 versus 7), pectoral fin rays, gill rakers, as well as in coloration. It differs from *U. japonicus* of the Pacific in dorsal fin spine number (8 versus 7), body coloration, and morphometric characters. *Upeneus* sp.nov.2 differs from the Pacific *U. mouthami* in number of lateral line scales, number of gill rakers, head shape, and paired fin lengths. Currently 16 valid *Upeneus* species (two-thirds of the total species of *Upeneus*) are known from the Western Indian Ocean. Further plans include studies of intra- and interspecific morphological and genetic variation among the *Upeneus* and a review of this genus for an account of the family to be included in a book on littoral fishes of the Western Indian Ocean.

0742 Herp Genetics, Salons A&B, Sunday July 27, 2008

Multiple Datasets Lead to a Novel Conclusion: The Case for Male-mediated Gene Flow in the *Phrynocephalus przewalskii* Complex of Toad-headed Lizards

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The central Asian deserts are broken up by large rivers and mountain ranges that provide an assortment of selection regimes and physical barriers. The toad-headed lizards in the *Phrynocephalus przewalskii* complex thrive throughout this dynamic landscape. Thus, one might expect to see an assortment of species and contact zones where hybridization occurs. Indeed, morphological and mitochondrial DNA datasets supported this hypothesis. Our research attempted to unravel the evolutionary relationships of this 'species complex'. We focused on the eastern portion of this complex's range where three distinct species were believed to exist. Using 7 microsatellite loci over 9 populations from 4 mitochondrial clades we discovered an unexpected result. It appears that members of the *P. przewalskii* complex are a single, panmictic population with gene flow dominated by male movements. Green sea turtles are another animal that demonstrates strong, male mediated gene flow. Male mediated gene flow has significant implications for systematics. Results based strictly on mtDNA will never accurately reflect the evolutionary history of species with male biased gene flow. These results emphasize the importance of incorporating data from both the nuclear and mitochondrial genomes in any systematic analysis.

0358 Fish Development/Reproduction, Salons 6&7, Sunday July 27, 2008

A Test for Genetic Associations between Male Nuptial Coloration and Female Mating Preference or Male Aggression Bias in a Polymorphic Cichlid Fish

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Both inter- and intrasexual selection has been implicated in the origin and maintenance of species flocks of cichlid fishes inhabiting lakes Malawi and Victoria. Simultaneous disruptive selection by female mating preference and male-male competition can in theory lead to speciation without geographical isolation if both act on the same male trait. Female mating preference can generate discontinuities in gene flow between morphs, whilst male-male competition can generate negative frequency-dependent selection stabilizing polymorphism of the male trait. The probability of speciation without geographical isolation is greatly enhanced when female mating preference and/or male aggression bias are genetically associated with the trait they operate on. Genetic associations between mating preference, aggression bias, and male nuptial coloration have never been tested for. In this study we focused on these associations in the haplochromine cichlid genus *Pundamilia* from Lake Victoria. We crossed *Pundamilia* females from a phenotypically variable population with males of the same population taken from alternative extreme ends of the phenotype distribution (blue or red). We then quantified mating preferences of the female offspring, and the aggression biases and coloration of the male offspring. We found no evidence of an association between mating preferences of female offspring and coloration of the sires. Male offspring of a red sire were significantly redder than males of a blue sire, which indicates that intrapopulation variation in male nuptial coloration is heritable. Males of the red sire directed more aggression to red males than to blue males, but males of the blue sire did not show any bias. There was a positive association between male aggression bias and its own body coloration among all lab-bred males. This association, which may be due to physical or linkage disequilibrium, could facilitate maintenance of the color polymorphism.

0118 Poster Session II, Saturday July 26, 2008

Vascular Dynamics in the Snake Spectacle

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The vasculature of the reptilian spectacle presents a unique visual problem to those species that possess it. Physiologically necessary on the one hand, optically detrimental on the other, a curious balance between physiological and visual needs must have been struck to achieve optimal fitness. Research by Ludicke (1940, 1969, 1973) attempting to correlate the distribution of vessels with visual need was not entirely conclusive (eg. areas serving the binocular field or the fovea do not have a lower density of vessels). We thus hypothesized that the dynamics of spectacle blood flow could be engaged to minimize the deleterious visual effects. In our lab, spectacle blood flow of 3 coachwhip snakes (*Masticophis flagellum*) was observed using a slit-lamp equipped with an infrared light source and video monitoring system. Subjects were observed while at rest and while moving targets were presented. At rest, flow followed a cyclical ON-OFF pattern that was very regular within sessions but variable between them ($p < 0.0000$) - as examples, the cycle could consist of 30 seconds of flow for 600 seconds of no flow, or 60 seconds of flow for 120 seconds of no flow. Thermoregulation, residual handling stress, and fed state may all be responsible for this variation. When visually presented with moving targets, the frequency of ON flow events was significantly reduced for the duration of the stimuli ($p < 0.028$). During the shedding cycle, spectacle flow was always ON, regardless of visual stimuli. It is unclear whether we are observing a phenomenon specifically to assist with vision, or if this is a general sympathetic response to the visual stimuli (ie. "fight or flight") that draws cutaneous blood away from the surface. Regardless, the end result remains the same: in times of visual need, spectacle vessels constrict, resulting in a potential improvement to vision.

0414 Herp Conservation, Salons 4&5, Sunday July 27, 2008

Road Salt Runoff: The Relative Contribution of Direct and Indirect Effects on Aquatic Food Webs

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Recently, ecologists are discovering that anthropogenic sources of stress (e.g., pollutants) may not have direct lethal effects on species, but might alter the strength and direction of trophic interactions when stress is examined in the context of the entire ecological community. Road deicers have recently been identified as a rising chemical pollutant to freshwaters in the United States resulting in salinization. We examined the impacts of salt stress on lentic food web dynamics in two microcosm experiments. In May - July 2007, we assessed gray treefrog (*Hyla versicolor*) tadpole survival, growth and periphyton feeding rates under a sodium chloride (NaCl) gradient (60-945 mg/L Cl⁻). Gray treefrog egg masses were obtained from the Patuxent Wildlife Research Center, tadpoles added to microcosms at the free-feeding stage, and periphyton sampled every 10 days. From December 2007 - January 2008 we also examined the effects of NaCl on phytoplankton and zooplankton using the same NaCl gradient described above. Microcosm ponds were sampled over 4 weeks for phytoplankton biomass and zooplankton abundance. We found that NaCl stress had no direct impact on tadpole survival or growth and no direct effect on periphyton growth. Salt loading had positive effects on phytoplankton whereby chlorophyll-a concentration was greatest in microcosms containing moderate and high NaCl concentrations. The high NaCl treatment reduced zooplankton survival. Plausible explanations include indirect effects on zooplankton due to a shift in the phytoplankton community (i.e., shifts in their primary food source) or direct lethality to zooplankton. Overall, our results suggest that low levels of environmental toxicants that are elevated in the built environment can lead to complex patterns in pond food webs. Differential susceptibility among trophic levels to salt stress in our system might very well lead to altered trophic interactions, even the relative strength of bottom-up versus top-down control.

0176 Poster Session II, Saturday July 26, 2008

Influence of Habitat Heterogeneity and Climate Variables in Brazilian Anuran Communities

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Amphibians are particularly influenced by spatial heterogeneity and high levels of precipitation, because these factors offer a great variety of breeding microhabitats. Here, we analyzed which environmental descriptors of breeding ponds are related to the species composition, and which climate variables influence the species richness among anuran faunas. We performed a Mantel correlation test among the matrix of species composition (Jaccard coefficient) and each one of the matrix (Euclidian distance) of five environmental descriptors (edge types, hydroperiod, size of water bodies, vegetal cover and vegetal structure in the edge) of 37 water bodies from four localities in southeastern Brazil. We also compiled published data from 37 localities in Brazil and extracted climate data (annual mean precipitation and annual mean temperature) from available database of worldclim (<http://www.worldclim.org/current.htm>), using DIVA-GIS mapping software. Linear multiple regression was applied among species richness and climate data of each locality. Three environmental descriptors (edge types, vegetal structure in the edge, and hydroperiod) were correlated to species composition of 37 water bodies. Thus, length of water availability (hydroperiod: $r = 0.16$ and $p = 0.00$), humidity (edge types with humid or flooded soil: $r = 0.38$ and $p = 0.00$), and structure of plants (edge with herbaceous, shrubby and arboreal plants: $r = 0.29$ and $p = 0.00$) showed to be the primary factors affecting the composition of anuran species in breeding ponds. Climate data was related to species richness in the studied localities ($F_{(4,32)} = 4.31$, $p = 0.02$), but only rainfall was related to species richness ($\beta = 0.34$ and $p = 0.03$), while temperature was not related ($\beta = -0.26$ and $p = 0.10$). The present study corroborates that high levels of precipitation, mainly in forested areas, represent a linkage to occurrence of high number of anuran species.

0461 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008;
GRUBER

Factors Influencing the Abundance of Sympatric Ray Species over a Shallow Sandflat in Shark Bay, Western Australia

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Shallow habitats of tropical regions often support diverse ray communities, but few studies have investigated how they may partition habitats or resources. Between 2006 and 2008 we examined spatiotemporal variation in ray species composition and abundance over a shallow sandflat in Shark Bay, Australia using belt transects. At least nine species of rays were observed over the flats. More species and individuals were observed when water temperatures were high. The most common species were the giant shovelnose ray (*Rhinobatos typus*), reticulate whipray (*Himantura uarnak*), cowtail ray (*Pastinachus sephen*), and blackspotted whipray (*H. toshi*). Factors influencing species abundance varied. Blackspotted whipray abundance increased with increasing temperatures but was equal among microhabitats and across tidal heights. Abundances of giant shovelnose rays, reticulate whiprays, and cowtail rays, however, were affected by water temperature, microhabitat, and tidal height. These rays were most common in a narrow band close to shore and increased in abundance only within this microhabitat as temperature increased. These three species also increased in abundance at lower tidal heights when temperatures were high. Feeding pit densities were highest closest to shore, despite preliminary evidence that prey densities are no higher in this microhabitat than other microhabitats and contrary to predictions of behavioral thermoregulation, rays tended to rest in the warmest water available. The patterns exhibited by giant shovelnose rays, reticulate whiprays, and cowtail rays could be driven by predation risk from great hammerhead and tiger sharks, which are common at higher temperatures, but cannot access shallow habitats at low tidal heights.

0047 Herp Behavior, Salons A&B, Thursday July 24, 2008

Effects of *Batrachochytrium dendrobatidis* Infections on Larval Foraging Performance

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There is increasing evidence of pathogen induced modifications in host behaviour, including alterations in foraging behaviour or foraging efficiency. Changes in behaviour may compromise host fitness indirectly by reducing growth and development. Chytridiomycosis is an emerging infectious disease of amphibians caused by the pathogenic fungus *Batrachochytrium dendrobatidis* (*Bd*) and has played a role in the worldwide decline of amphibians. In larval anurans, *Bd* infections may result in reduced growth and developmental rates. Two hypotheses exist for this phenomenon: *Bd* infected larvae are lethargic and spend less time foraging compared

to non-infected larvae or *Bd* infections cause the loss of keratinized structures in the oral apparatus, thereby reducing the foraging capabilities of infected larvae. To test for differences in foraging activity and efficiency, we conducted experiments examining the effects of *Bd* on larval foraging time and efficiency of larval Grey Treefrogs (*Hyla versicolor*) and Fowler's Toads (*Bufo fowleri*). If *Bd* infections reduce larval activity, we predicted that infected larvae will spend less time foraging compared to non-infected larvae. However, if *Bd* induced oral deformities inhibit normal foraging efficiency, we predicted that infected larvae will forage for the same amount of time as non-infected larvae, but will have less food in their alimentary track compared to non-infected larvae. To test these hypotheses, we conducted two experiments that ran concurrent with each other. In the first experiment, we used a repeated measures design and tested for differences in foraging activity of *Bd* infected and non-infected larvae. In a second experiment, we tested for differences in the short-term ingestion rates of similarly staged larvae by examining the amount of food in their alimentary track after a 3 hour foraging period. Preliminary data from larval *H. versicolor* suggest that *Bd* infected larvae spend less time foraging compared to non-infected larvae. However, in the foraging efficiency trials, there were no differences in the amount of food ingested between infected and non-infected larvae. These data suggest that reduced larval growth rates observed in previous experiments with this species may not be from *Bd* induced changes in foraging ability. Further data will be presented with both *H. versicolor* and *B. fowleri* larvae.

0034 AES Devil Ray Symposium, Jarry/Joyce, Thursday July 24, 2008

Captive Biology of the Pygmy Devil Ray (*Mobula munkiana*) at the Monterey Bay Aquarium

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Relatively little is known about the captive biology and husbandry care of the devil rays (family Mobulidae). In 2005 the Monterey Bay Aquarium embarked on a collection trip to the Sea of Cortez, Baja California Sur, Mexico. One pygmy devil ray (*Mobula munkiana*) was held for one year and seven months at the Tuna Research and Conservation Center. During this time we learned animal handling and feeding techniques for this species and gathered some initial information on captive biology. A pilot respirometry study was conducted to measure routine metabolic rate; preliminary results indicate a mean MO_2 of 136.2 ± 5.0 (S.E.) mg O_2 /kg/hr at 21 °C. We hope to continue more respirometry and bioenergetics studies in the future, as well as continuing to develop husbandry techniques for these active rays

0229 Poster Session III, Sunday July 27, 2008

Effects of Forest Clearcutting and Buffer Width on Demography of Vernal Pool Amphibians

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Conservation of vernal-pool-breeding amphibians is inhibited by inadequate understanding of the amphibians' upland habitat requirements. Upland forested buffer zones around vernal pools have been proposed as a management strategy for these amphibians. However, the effectiveness of buffer zones as mitigation for habitat disturbance has yet to be substantially validated. Specifically, few studies have examined the effects of clearcutting and buffer width on demography of amphibians breeding in vernal pools. We used clearcutting to experimentally manipulate upland buffer widths at 11 vernal pools. Over the next four breeding seasons, we used drift fences and pitfalls traps to capture, identify and count all amphibians entering and exiting the pools. We marked each exiting spotted salamander (*Ambystoma maculatum*), blue-spotted salamander (*Ambystoma laterale*), and wood frog (*Lithobates sylvaticus*) for recapture, and documented sex, age class, mass, and snout-vent length. We are using these data to assess the impacts of buffer width on such population parameters as sex ratio, size structure, fecundity, and population size variability. We will use results from this study to improve forestry best management practices.

0467 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Barcoding Reef Fish Larvae: Dispersal and Connectivity Studies and Identification of Rare Species

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The utility of barcoding for studies of the early life history of reef fishes has only begun to be explored. Despite the importance of questions of connectivity between reefs and distant islands, little is known about the long-distance dispersal of reef fish larvae. Comprehensive open-ocean samples of larvae are uncommon and identifications are difficult, especially to species. Resolving species is, however, necessary, since most interesting questions of connectivity are at the species level. Barcoding provides an excellent method to identify larvae to species and thus often can help reveal the origin of the dispersing cohort. I applied this technique to a large sample of larvae I collected from the open ocean along the equator about 1,000 km from the coast of Ecuador and 400 km from the Galapagos Islands. Species-level identifications revealed some surprising results: the cohort included a razorfish species supposedly endemic to Baja California (2000 km from the collection site), as well as a suite of reef fishes and continental fresh-water species indicative of an origin in Central America. These findings greatly expand our model of the dispersal abilities of reef fish larvae. In addition, barcoding also helps to identify the larvae of

rare species, which are typically undescribed and usually remain undetected among conspecifics. I present an example of this with the identification of larvae of the rare and threatened giant cubera snapper from my collections in Caribbean Panama.

0127 Poster Session II, Saturday July 26, 2008

Ichthyofaunal Survey of the Rivers of the Eastern Arc Mountains in Tanzania

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Between 8 September and 4 October 2007, we conducted a preliminary survey of fish species in several rivers draining the Eastern Arc Mountains of coastal Tanzania, including the Uмба, Sigi, Pangani, Ruvu, Wami and Ruaha/Rufiji River basins. The Eastern Arc Mountains are renowned for a high level of endemism among plants and terrestrial animals and are considered one of the world's top conservation "hot spots." Despite early exploration of this area during both British and German colonial periods, the ichthyofauna of this important region is still poorly known. A total of 29 field sites were sampled, with an emphasis on fast flowing streams arising in the Usambara, Uluguru and Udzungwa Mountains, individual ranges within the Eastern Arc Mountains. We employed a variety of methods to collect fishes including seines, cast nets, dip nets and an electroshocker. Approximately 75 species of fishes, from 17 families, were collected. Rheophilic catfishes like *Chiloglanis* (Mochokidae) and *Amphilius* (Amphiliidae), as well as species of *Labeo*, *Garra* and *Barbus* (Cyprinidae) are particularly well represented in these collections. Preliminary assessments of the material indicate the presence of several new species, including but not limited to the families Amphiliidae, Mochokidae, Cichlidae, and Mormyridae. The limited sampling of this vast area and its conservation significance strongly suggest that further collecting efforts are necessary to accurately and thoroughly document the fishes of this region. Specimens and associated tissue samples are deposited at the Cornell University Museum of Vertebrates and Florida Museum of Natural History.

0163 Fish Physiology, Salons 6&7, Sunday July 27, 2008

Jaw Protrusion Enhances Suction Feeding Performance in Fishes

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The ability to protrude the jaws during prey capture is a hallmark of teleost fishes, widely recognized as one of the most significant innovations in their diverse and mechanically complex skull. An elaborated jaw protrusion mechanism has independently evolved multiple times and is a conspicuous feature in several of the most spectacular fish radiations, ultimately being found in approximately half of living species. Variation in jaw protrusion distance and speed is thought to have facilitated the remarkable trophic diversity of these groups, although its mechanical consequences for feeding performance remain unclear. Here we show, using a hydrodynamic perspective that rapid jaw protrusion enhances by up to 50% the force exerted on prey items during suction feeding, thus improving prey capture ability. This counterintuitive mechanism represents the first general advantage recognized for suction feeding fishes that protrude their jaws. Furthermore, using a phylogeny of centrarchid fishes, we report an intimate evolutionary association between the capacity to generate high-velocity suction flows and rapid jaw protrusion during suction feeding, indicating that these two innovations evolved synergistically to enhance suction feeding ability. The force requirements for capturing aquatic prey appear to have been a strong selective factor for the evolution of jaw protrusion in modern fishes.

0152 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008

A new species of angelshark, *Squatina* sp. nov., from the western North Pacific (Chondrichthyes: Squatiniformes, Squatinidae)

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A recent taxonomic study (Walsh and Ebert, 2007, *Zootaxa*, 1551: 31-47) redescribed and confirmed the occurrence and validity of four squatinid species (*Squatina formosa*, *S. japonica*, *S. nebulosa*, and *S. tergozellatoides*) in the western North Pacific (WNP). These squatinids can be distinguished from each other by several distinctive characters including: the relationship of the pelvic fin tips to the first dorsal fin origin, pelvic girdle width, upper lip arch shape, and the presence or absence of mid-back thorns and ocelli on the pectoral fins. Examination of a squatinid species caught off the Philippine Islands, previously identified as *S. formosa*, was found to reveal several distinct characters inconsistent with other WNP squatinids. These distinctions include differences in the head width, pelvic insertion and pelvic base length, and unique caudal and upper lip arch shapes. We contend that these differences warrant designation of a new species of WNP squatinid. A revised

dichotomous key for the region is presented that now includes all five known WNP squatinid species.

0734 Fish Conservation, Drummond, Sunday July 27, 2008

Age-0 Fish Assemblages of the Apalachicola River and Floodplain, Florida, in Relation to Altered Hydrology and Movement Patterns of Reproductive Adults

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The Apalachicola River is the largest river by discharge in Florida and has one of the most extensive forested floodplains of Gulf Coastal rivers. Decades of regulated hydrology, long-term droughts, and increased water consumption have significantly affected aquatic habitats and fish communities in the floodplain and the river. Allocation of water resources to restore and protect aquatic habitats and management of associated fish populations are major issues within this stressed system. Of particular concern are low-flow conditions and habitat availability during critical life-history phases of floodplain-dependent fishes. Studies were conducted from 2002-2007 to characterize fish communities within the floodplain, with emphasis on examining assemblage structure and temporal appearance of the age-0 year class. Sampling strategy varied each year from 2002-2004 to address spatiotemporal heterogeneity. Efforts in 2006-2007 were directed to: (1) further refine estimates of peak spawning periods, (2) compare river and floodplain catches as related to an artificial oxbow restoration project, and (3) search for correlates of age-0 fish abundance of selected target species with movement activities of reproductive adults as determined by acoustic telemetry. For the entire study period a total of about 64,000 age-0 fish were collected from over 1,500 light-trap sets. At least 50 taxa were recorded from floodplain habitats representing about 55% of all freshwater and diadromous species in the Florida portion of the drainage. Families represented by greatest abundance were cyprinids, centrarchids, catostomids, and percids. Habitat heterogeneity and variation in distribution of species belonging to different habitat or trophic guilds accounted in part for differences in relative abundances of individual taxa among waterbodies and macrohabitats. Recruitment extended from early spring to late summer with peaks from March to May. A simple binomial likelihood model for estimating the probability of adult fish using the mainstem and/or floodplain tributaries suggested a relationship between flow regime and probability of fish using a given habitat.

0099 Poster Session III, Sunday July 27, 2008

Habitat Use and Movement Patterns of Eastern Hognose Snakes (*Heterodon platirhinos*) in Southcentral New Hampshire

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The protection of rare, threatened, or endangered species largely depends on suitable natural history information to develop appropriate conservation plans. We present the results of a two-year radiotelemetry study of eastern hognose snakes (*Heterodon platirhinos*), listed as threatened by the state of New Hampshire. We radiotracked 8 adult eastern hognose snakes (seven females, one male) on New Boston Air Force Station (NBAFS), a 1,144 ha site in southcentral New Hampshire that contains a variety of landcover types. We found that snake home range sizes, calculated using minimum convex polygons (MCP) and 50% fixed kernel estimates, varied considerably among individuals (MCP: 7.2 - 116.0 ha; fixed kernel: 1.4 - 11.3 ha). To determine snake selection of particular habitat types or other geographical and topographical features of NBAFS, compositional analyses of discrete variables and repeated-measures analyses of variance of continuous variables were performed to compare the characteristics of snake locations to random locations on the station. Overall, snakes selected open habitats (old fields, clearcuts, and parkland) and avoided forested and wetland habitats. Snakes selected sandy and gravel-sand mixed soils more often than soils with exposed rocks or stones. Snakes also selected locations with lower slopes and with shorter distances to streams. These results are consistent with observations of eastern hognose snake resource use in other parts of the species' range. We suggest that the maintenance of open early successional habitats as a component of forested landscapes will be critical for the persistence of eastern hognose snake populations in the northeast USA.

0081 Poster Session II, Saturday July 26, 2008

Variation in Amount of Forest Habitat Influences Orientation of Juvenile Amphibians Emigrating from Breeding Ponds

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Juvenile dispersal is important for the persistence of amphibian populations. Previous studies have observed non-random orientation in juvenile amphibians emigrating from breeding ponds; however, the environmental cues associated with these movements are not well understood. We examined the emigration behavior of recently metamorphosed juveniles of three pond-breeding amphibian species from three woodland ponds. We found that juvenile small-mouthed salamanders (*Ambystoma texanum*), American toads (*Bufo americanus*), and wood frogs (*Rana sylvatica*) exhibited non-random orientation upon exiting the breeding ponds. Furthermore, we found a positive relationship between captures of juvenile small-mouthed salamanders and wood frogs and width of the surrounding forest habitat,

indicating that these species are selecting areas with broader forested habitat upon exiting the breeding ponds. Our results indicate that migrating juvenile amphibians may rely on direct environmental cues as the orientation of small-mouthed salamanders and wood frogs was influenced by width of the surrounding forested habitat. These observations support previous studies suggesting that maintaining forest habitat, along at least a portion of breeding ponds, is important for the persistence of amphibian populations.

0613 Reptile Ecology, Salons 6&7, Friday July 25, 2008; STOYE ECOLOGY & ETHOLOGY

Spatial Ecology of Male Northern Water Snakes, *Nerodia sipedon sipedon*, in the Beaver Archipelago

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Sexual dimorphism is common across the animal kingdom and can sometimes cause a differential in attention paid to a particular sex by researchers. In the case of northern water snakes (*Nerodia sipedon sipedon*) this is manifested by an inordinate proportion of studies focusing female snakes, as they are larger and more obvious. Traditionally males have been considered only during the breeding season. This study examined the differences between the sexes by focusing on unknown behavioral characteristics of males (post breeding season). PIT tagging and radio telemetry were used to facilitate the collection of data on BMI and factors related to habitat selection. Results suggested that BMI increases over the course of the year, as expected. In terms of micro-habitat selection, males seem to have individual preferences that do not correlate with any other factors. Likewise there were significant differences detected between individual males for mean body temperature. These results emphasize the need for further study of more cryptic male sex and especially for the use of a larger sample of individuals in order to tease apart the determining factors for microhabitat and mean body temperature selection.

0101 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Multi-Trophic Level Effects of Terrestrial Salamanders in Forest-Floor Food Webs

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Terrestrial salamanders are hypothesized to play an important role within the detrital food web of the forest-floor through top-down regulation of invertebrates and ecosystem processes. However, salamanders reside within a complex food web in which the strength and direction of predator effects are influenced by species composition, bottom-up forces (detritus supply), and abiotic factors. Also, predators can have multiple effects in addition to predation, including trait-mediated effects, regulation of apparent and actual competition among prey species, indirect effects on non-prey species, and direct subsidies to lower trophic levels through waste products. I will summarize results of long-term field and short-term laboratory experiments through which my students and I have documented such complexities in the ecological role of the red-backed salamander (*Plethodon cinereus*). A 5-year field experiment investigating the impact of *P. cinereus* demonstrated that salamanders can have significant effects on diversity and density of invertebrates. However, salamander effects varied among invertebrate taxa and over time. The strongest effects of salamanders are positive indirect effects that increased density of some invertebrate taxa. Interaction strengths between salamanders and invertebrates varied in strength and sign with a gradient of litter resources, with strong positive interactions at low litter supply and negative interactions at high litter supply. Covariance of litter supply and interaction strength was non-linear for several taxa for which neutral to positive interactions were observed at intermediate litter levels. Microcosm experiments indicated that positive effects of salamanders were exerted through regulation of apparent or actual competition and/or subsidies in the form of salamander wastes or skin secretions. A field experiment comparing effects of removals of salamanders and arthropod predators to un-manipulated controls indicated that trait-mediated effects also play an important role. The implications of these results with regard to food web theory and effects on ecosystem processes will be explored.

0339 AES Conservation, Kafka/Lamartine, Sunday July 27, 2008

Counting Elasmobranchs

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Recent widespread evidence documenting large-scale shifts in elasmobranch populations has changed the perspective of research methodology from observational studies to a more predictive framework based on meta-analysis of fisheries data and population modelling. However, this shift has not effectively addressed the fundamental problem with censusing elasmobranch populations which is that long-lived and potentially rare and declining species continue to be decimated, and in some cases they are removed for the sole purposes of censusing. Given that many shark species have declined to dangerously low levels of abundance at alarming rates, there is an need to implement non-destructive methods of censusing these highly vulnerable species. I synthesize methods used to count marine fishes, with an emphasis on elasmobranchs, and make the argument that volunteer scuba divers can provide valuable data that should be used in the assessment of global elasmobranch populations. I first review the most commonly used methods for censusing elasmobranch populations. Then I cover non-extractive methods- how they work, and their ability to include elasmobranchs. Subsequently, I present results of a model that simulated fish and divers in the three most commonly used underwater visual census (UVC) methods, roving-diver technique, belt-transect technique, and stationary-point count. Here, I discuss the accuracy of these UVC methods for estimating fish density at different fish speeds and investigate the best method for censusing fish at low densities. Finally, I review the utility of Citizen Science and present the North American Breeding Bird Survey (BBS) as an example of a successful application of volunteer surveys. Using the BBS as an analogy, I propose that marine scientists employ volunteer scuba divers to report elasmobranch sightings in a way that can be valuable for monitoring and conservation.

0153 HL Graduate Research Award, Salons A&B, Sunday July 27, 2008; HL

The Interaction between Mean and Variance of Nest Temperature Affects Primary Sex Ratios in an Agamid Lizard

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Temperature-dependent sex determination (TSD) may enhance parental fitness because it enables male and female offspring to be produced at their respective optimal incubation temperatures. Indeed, recent work suggests that male and female offspring of many agamid lizards may differ in their optimal timing of hatching, and that TSD in these species may have evolved to generate adaptive seasonal shifts in offspring sex ratios. To explore this hypothesis, I studied how changes in the mean and variance of nest temperature over the season may influence seasonal shifts in offspring sex ratios in an Australian agamid lizard with TSD (*Amphibolurus*

muricatus). By radio-tracking gravid females, I located 44 nests spanning the entire reproductive season (Oct-Feb). Nest temperatures and the resultant sex ratios were recorded from each nest. Although both mean and variance in nest temperatures changed seasonally, a concomitant shift in clutch sex ratio was not statistically significant. This non-significant relationship between nest temperature and predicted primary sex ratios in the field may have been obscured by egg mortality and/or confounding maternal effects. A subsequent laboratory-based egg incubation experiment that mimicked natural nest temperatures (and minimized egg mortality and confounding maternal effects) demonstrated that both mean and variance in nest temperature induces variation in offspring sex ratios. Moreover, a significant interactive effect of thermal mean and variance on primary sex ratios illustrates that complex interactions among different environmental parameters during embryonic development affect offspring phenotypes in ways that could impact fitness.

0399 Fish Phylogeography, Kafka/Lamartine, Monday July 28, 2008

Fish Faunal Regions of the Southern United States: Isolation by Distance as a Structuring Mechanism

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The southern United States supports one of the richest temperate freshwater fish faunas on Earth. Fishes of the region also show high levels of drainage endemism, suggesting isolation as an important mechanism structuring the fauna spatially. I examined geo-spatial structure of this large, rich fauna using a database of 685 fish taxa with each taxon allocated across 51 drainage units. I used the total native fauna and faunal subsets (darters, minnows, catfishes, and suckers) to define fish faunal regions and to examine the association of isolation by distance and fish assemblage structure among drainage units. I used distance matrices and cluster analyses to compare geo-spatial structuring among faunal subsets and drainage networks. I used non-metric multidimensional scaling analysis as an independent test of the adequacy of cluster-derived faunal regions. The analysis revealed eight, highly distinctive faunal regions (Atlantic North; Atlantic South; Florida Peninsula and Panhandle; Mississippi River (including Interior Highland tributaries) plus the Ohio River, and Red River mainstems; Western Gulf Slope; Tennessee and Cumberland Rivers and Ohio River tributaries; and Missouri River and tributaries plus the Illinois-Neosho River). The phenetic relationships of the fauna of drainage units (all native and subsets) were significantly and strongly congruent with geographical linkages of drainages (isolation by distance). Overall, the results indicate highly, distinct, strongly geo-spatially structured inter-drainage and inter-regional native fish faunas.

0545 Reptile Ecology, Salons 6&7, Friday July 25, 2008; STOYE ECOLOGY & ETHOLOGY

Ecological Effects of Food Supplementation in Fer-de-Lance (*Bothrops asper*).

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A growing body of work has shown that food limitation can have wide-ranging effects on predators. In reptiles, energetic resources can directly influence life-history parameters including growth, reproduction, and survivorship; less well-documented is the relationship between food availability and spatial ecology under field conditions. Ambush-hunting snakes such as pitvipers may be particularly well-suited to such studies as they are typically infrequent feeders with relatively low space usage, and whose activities are often correlated with prey availability. I investigated the effects of food supplementation on a population of fer-de-lance (*Bothrops asper*) in Costa Rica. Free-ranging snakes were assigned to either a "control" (n=6) or "fed" group (n=5) and monitored via radiotelemetry for up to one year. Fed snakes were offered a pre-killed rat in the field once every two weeks, to simulate increased but not unnaturally high prey availability. I compared spatial patterns between treatment groups in terms of home range (minimum convex polygons, 95% kernel density), movement rate, and both macro- and microhabitat usage. Differences in body condition (mass-length ratio), survivorship, and non-spatial behaviors (percentage of evenings spent ambushing, shelter usage) are also reported.

0424 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Macroecological Patterns at the Mesoscale: Distribution, Abundance, and Body Size of Amphibians and Reptiles on Forest Islands in Northeastern Bolivia

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Here we explore three common macroecological patterns on naturally-occurring forest islands in a forest-savannah transition zone in northeastern Bolivia: the distribution-abundance relationship, the abundance-body size relationship, and the distribution-body size relationship. We utilized partial correlation analysis to investigate associations between pairs of variables independent of the effects of the third variable, and we partitioned our total data set taxonomically to explore variation in relationships among variables. For both amphibians and reptiles, there were strong, positive correlations between distribution and abundance: abundant species were widespread in the environment. Large-bodied amphibians were widely distributed among forest islands, but this was not the case for reptiles. We attribute the positive association between distribution and body size seen in amphibians to

dispersal limitation of small-bodied species. There was an inverse relationship between abundance and body size for amphibians; small bodied species are more abundant than large-bodied species, but this was not the case for reptiles. We explore the implications of the differences in the abundance-body size relationship between amphibians and reptiles in light of competing ideas about how resources are partitioned among species in local communities.

0578 Herp Physiology/Bar Codes, Salons 4&5, Thursday July 24, 2008

Thermal Physiology and Field Observations Support Microhabitat Diversification and Spatial Resource Partitioning Among *Plestiodon fasciatus*, *P. laticeps*, and *P. inexpectatus*

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Three species of five-lined skinks (*Plestiodon fasciatus*, *P. laticeps*, and *P. inexpectatus*) occur in syntopy across much of the Southeastern United States. These closely-related species, at one or more levels of development, all exhibit a like phenotype and a high amount of prey resource overlap as documented by published gut content data. Under competitive exclusion hypotheses, these species should therefore not locally co-occur. This study confirms, through analysis of habitat type and canopy cover at the point of capture, that *P. inexpectatus* and *P. fasciatus* do not typically inhabit the same forest habitat. In fact, where their ranges overlap, *P. fasciatus* inhabits closed-canopy hardwood forests, while *P. inexpectatus* inhabits open forested habitats such as Longleaf Pine Savannah and coastal scrub forests. Outside of the range of *P. inexpectatus*, *P. fasciatus* inhabits a wider variety of habitats. *P. laticeps* is routinely found in sympatry with either species. Due to their large adult size, *P. laticeps* may be able to utilize larger prey, thereby partitioning available resources. Physiological data - oxygen consumption and its temperature response (Q_{10}) - supports the hypothesis that these species differ with respect to their metabolic response to temperature. *P. fasciatus* exhibits a high Q_{10} at the interval that exceeds the mean daily summer temperature of sampled closed canopy forests (~25°C). *P. inexpectatus* exhibits a dramatic decrease in metabolic rate on the interval that falls below the mean daily summer temperatures of sampled Longleaf Pine Savannah habitat. The VO_2 of *P. laticeps* is the least temperature sensitive. Collectively, these findings indicate that an evolutionarily conserved physiological niche among species/populations may play an important role in spatial resource partitioning and maintenance of biodiversity between two of these three closely-related species.

**0323 Fish Physiology, Salons 6&7, Sunday July 27, 2008; STOYE
PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY**

**An Adaptive Physiological Response to Thermal Habitat Alteration by the
Globally Invasive Species, *Gambusia affinis***

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The Invasive Species Specialist Group of the World Conservation Union (IUCN) has included the western mosquitofish, *Gambusia affinis*, as one of the world's 100 worst invasive species. Initially introduced in many areas as a means to control the mosquito populations, *G. affinis* is currently the most widely distributed freshwater fish in the world, inhabiting every continent except Antarctica. The ability to tolerate or adapt to diverse environmental conditions is commonly considered a trait of invasive species. A broad thermal tolerance, in particular, allows potentially invasive species to disperse across a larger latitudinal gradient. The results of this study establish upper and lower critical thermal limits for three populations of *G. affinis* across seasons at two acclimation temperatures, including a population exposed to artificially elevated temperatures produced by a steam-electric power station. Thermal temperature polygons were established to describe this species' eurythermicity, and to assess the capacity of this invasive species to adapt to anthropogenic alterations of its thermal habitat, which has broad implications for invasive species exposed to ongoing, global climate change.

**0455 AES Student Papers I, Kafka/Lamartine, Thursday July 24, 2008;
GRUBER**

**The Intrinsic Elasmobranch Gill Design Potentially Limits Gas Exchange
and the Aerobic Performance of the Shortfin Mako, *Isurus oxyrinchus*, a
Lamnoid Shark**

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The lamnid sharks (family Lamnidae) demonstrate a remarkable evolutionary convergence with tunas (family Scombridae) for high-performance swimming. Analysis of gill structure and function in the shortfin mako, *Isurus oxyrinchus*, a lamnid shark, reveals similarities to tunas in the presence of specializations to maintain gill rigidity during ram ventilation and to permit the O₂ transfer required for fast, sustainable swimming. However, mako and tuna gill specializations have structurally different bases due to intrinsic differences in the gill design of elasmobranchs and teleosts. The elasmobranch gill has a more tortuous water pathway, and *in vivo* measurements of mako gill resistance suggest that this design limits total gill surface area in comparison to some teleosts. Thus, while mako gill areas are larger than non-lamnoid shark species, they are significantly less than those

of tunas. The larger size of elasmobranch erythrocytes also increases mako respiratory lamellar thickness and gas diffusion distances in comparison to tunas. These intrinsic characters limit gas exchange and may prevent lamnid sharks from reaching the scope of sustainable aerobic performance achieved by tunas.

0043 Fish Systematics III, Drummond, Saturday July 26, 2008

***Crystallaria cincotta*, a New Species of Darter (Teleostei: Percidae) from the Elk River of the Ohio River drainage, West Virginia**

Stuart Welsh¹, Robert Wood²

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A new species of percid, *Crystallaria cincotta* (Diamond Darter) was described recently from the Cumberland, Elk, Green, and Muskingum river drainages of the Ohio River basin, USA. It differs from populations of *Crystallaria asprella* (Crystal Darter) of the Gulf Coast, lower Mississippi River, middle Mississippi River, upper Mississippi River, and Wabash River drainages by having a reduced number of cheek scale rows restricted to the post-orbital region, a falcate margin on the pelvic fins, a preorbital blotch distinctly separate from the anterior orbital rim, and a wide mouth gape. The Diamond Darter population of the Elk River is also divergent genetically from Crystal Darters of the Gulf Coast, lower Mississippi River, and upper Mississippi River drainages. Since 1980, sampling efforts have produced a total of 12 Diamond Darters from the lower 36 km section of the Elk River, West Virginia. The relatively small number of Diamond Darters collected from the lower Elk River likely indicates species rarity, but may also reflect sampling gear avoidance. Based on museum specimens and sampling efforts, the distribution of the Diamond Darter has decreased dramatically since the late 1800s with population extirpations in Kentucky, Ohio, and Tennessee.

0029 Poster Session III, Sunday July 27, 2008

Development of a Handbook on Gopher Tortoise (*Gopherus polyphemus*) Health Evaluation Procedures

Lori Wendland¹, Harold Balbach², Mary Brown¹, Joan Berish³, Ramon Littell¹, Melissa Clark¹

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The gopher tortoise is a widespread species, but one at risk. Recently, greater interest in the survival of the species has led to a series of programs and proposals for a region-wide program of cooperative management. Relocating the animals when their habitat is threatened by human disturbance is a common management practice on both public and private lands. However, numerous diseases and health conditions affecting the species have the potential to influence the success of these relocations. A process to better incorporate health and disease related information into management decision-making was identified as an important missing element. The newly developed manual contains decision trees, charts and other such aids, including a special section identifying warning flags of potentially serious health problems. The manual thus facilitates decision-making regarding the health status of gopher tortoises by land managers, military and otherwise, when developing management plans involving relocation or augmentation of tortoise populations on their lands. The primary emphasis is on basic physical examinations of gopher tortoises because the manual was specifically designed for use by land management personnel. Additional information and resources are provided for instances when more comprehensive health assessments are needed. This manual is part of a larger project initiated within the US Army environmental research program to address specific gaps in information regarding gopher tortoise population ecology and health.

0677 Poster Session I, Friday July 25, 2008

Migration of a High Trophic Level Predator, the Salmon Shark, Between Distant Ecoregions

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Knowledge of how animals move through the environment, and the characteristics of habitats they select, are essential to understanding the ecological functions they are fulfilling in each habitat, which in turn is necessary to predict responses to environmental change. High trophic level organisms are known to exert structural influences through the food web, so understanding the range, migration and

foraging strategy of abundant predators is necessary to understand ecosystem function. As a result of the difficulty of studying pelagic marine animals, our knowledge of their life history and ecology has developed slowly. Recent advances in monitoring technologies have enabled researchers to remotely follow individual animals over seasonal and multi-year timescales, revealing long-distance migrations in a variety of marine taxa. In this study, satellite telemetry is used to monitor the behaviour of salmon sharks, and remote sensing to characterize their environment, thereby obtaining both animal behaviour and habitat data. Salmon sharks undertook long-range migrations wherein behavioural indices were correlated with regional habitat characteristics. Quantitative movement analyses to determine speed, path straightness and first passage time revealed focal area behaviours in northern and southern regions, with transiting behaviours at mid-latitudes. Individuals migrating to a highly productive southern region stayed longer than those moving to a low productivity region. The combination of multi-year time-series of animal behaviour with synoptic environmental data allows us to understand how the habitats that animals select differ from one another, the key factors influencing habitat selection, and the likely responses to change.

0679 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Migration and Habitat Use of Blue Sharks in the Eastern North Pacific Ocean

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The blue shark is the most abundant pelagic shark in the world and is likely to be an important predator in open ocean ecosystems. Blue sharks have been captured in enormous numbers in high seas fisheries over many decades, sustained only by the wide distribution and high fecundity of the blue shark, but major reductions in abundance have occurred in some ocean basins and the IUCN lists the species as 'Lower Risk Near Threatened'. Knowledge of the biology of this species is important to help us understand how pelagic communities function, and why some elasmobranch species are more vulnerable to overexploitation and extinction than others. We studied the spatial ecology of blue sharks via satellite telemetry by tagging sharks in two locations within the California Current System of North America. Sharks made extensive use of the rich upwelling system off Baja California, California and Oregon, and also made long distance movements into oligotrophic regions of the subtropical gyre and the eastern tropical Pacific. Blue sharks did not appear to undertake movements in a coordinate manner as they dispersed from the tagging locations. Blue sharks inhabited cool upwelled waters, warm tropical waters to near 30°C, and waters beneath the thermocline to 7°C. The sharks undertook extensive diving to depths in excess of 700 m. Diving was frequently greatest during daytime, but sharks undertook dives at all times of the day. Knowledge of the movements and habitat usage of this abundant pelagic shark will improve our

understanding of pelagic ecosystems and inform the development of high seas fishery management schemes.

0568 Poster Session II, Saturday July 26, 2008

Evolution of Neurotoxins in Rattlesnakes: DNA and Peptide comparisons

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A number of rattlesnakes possess PLA₂ β-neurotoxins in their venoms, which contributes to high toxicity and low LD₅₀ values. These toxins exist in heterodimeric form as complexed A (acidic) and B (basic) subunits, and include crotoxin, Mojave toxin, and sistruxin, among others. Published DNA and amino acid sequences for these three toxins were compared to determine patterns of evolution related to individual subunits, species phylogeny and relationships to related taxa. Based on mRNA constructs and cDNA sequences, A (chaperone) subunits are conserved relative to B (neurotoxic) subunit DNA sequences. The reverse was observed for peptide sequences of these toxins. Previous hypotheses of gene duplication and parallels to species differentiation are supported.

0667 Fish Systematics I, Salons A&B, Friday July 25, 2008

Phylogenetics and Bioinformatics of Fishes and Herps: Web Tools for Taxonomy and Evolution in the Encyclopedia of Life

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Rapid access to information is arguably the defining revolution of our times. This is true of all fields in biology, as the growth of accessible information on species, geography, genetics, evolution and ecology transcends our ability to process and analyze it. Large-scale, web-based bioinformatics projects provide opportunities for biologists to aggregate multiple kinds of information about organisms, and will create new ways of conceiving of exciting biological questions, analyzing data, and rapidly communicating about biodiversity. The Encyclopedia of Life is one of many bioinformatics projects that may offer opportunities for the ASIH audience to rapidly integrate multiple sources of data for synthesizing information on taxonomy, specimen collections, biogeography and phylogenetics. The EOL will develop web content for all described species on Earth, including fossil taxa, and by collaborating with FishBase, Catalog of Fishes, Catalog of Life, and the Tree of Life Web Project (among others) we now have over 50,000 species pages, most of them depending on FishBase content. Web tools for contributing to and editing the EOL are nearly ready, and will enable ASIH members to make EOL pages according to our vision. In addition, a dynamic phylogenetic tree browser is a top priority of the Biodiversity Synthesis Center (BioSynC), a branch of the EOL in Chicago. We propose to begin construction of a supertree for Fishes (contributed to by many) that will provide a

browser for EOL fish content, as a model for other groups of organisms (like Herps) as more content becomes available on the site. BioSynC welcomes proposals for synthesis meetings on topics in lower vertebrate taxonomy, biogeography and evolution as a means of jump-starting web-based tools that will accelerate the pace of our science. We also are interested in discussing the process of linking to information about Fishes and Herps, from collection databases and genetics, to images, video, and other data sets that will help web-based projects evolve into the kinds of useful, interactive tools that we can all see on the horizon.

0738 Herp Stressors/Snake Conservation, Salons 6&7, Monday July28, 2008

Quantitative Genetics Meets the Evolutionarily Significant Unit: The Case of the Endangered San Francisco Garter Snake, *Thamnophis sirtalis tetrataenia*

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Molecular genetic studies of neutral markers have suggested that an endangered subspecies of garter snake, *Thamnophis sirtalis tetrataenia*, is not a distinct entity. However, *T.s. tetrataenia* is readily diagnosable at the phenotypic level by color pattern. The most parsimonious explanation for the discrepancy between neutral genotypic markers and phenotypic markers is that *T.s. tetrataenia* has diverged phenotypically from other populations of *T. sirtalis* through rapid adaptive evolution. We propose that quantitative genetic theory can be used to assess the evolutionary significance of the of *T.s. tetrataenia* phenotype. Specifically, we ask whether the shift from an ancestral blotched morph to a derived striped morph could have occurred through a simple change in population trait means, or whether a more fundamental genetic reorganization occurred. We quantify blotch width at scale rows four and six using a dataset obtained from a large scale breeding study of *T. sirtalis* color patterns and present estimates of heritability and genetic correlation for the two traits. Our results reveal that sufficient heritable variation exists for dorsolateral blotches to evolve into a variety of novel shapes. However, a positive genetic correlation between the blotch widths at scale row four and six render a rapid evolutionary shift towards a striped form relatively unlikely. We conclude that analysis of genetic architectures can be a useful tool for evaluating the evolutionary significance of diagnostic traits.

0739 Poster Session I, Friday July 25, 2008

A mtDNA Phylogeny of the Subfamily Amphistichinae Sheds Light on Anal Fin Color Polymorphism in the Silver Surfperch, *Hyperprosopon ellipticum*

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Polymorphisms within populations can provide insights into microevolutionary processes. However, before polymorphisms can be truly considered as such, the assumption must be met that all individuals belong to one panmictic population, rather than multiple sympatric species. A case in point is the silver surfperch, *Hyperprosopon ellipticum*. Individuals collected from the same time and locality express a striking polymorphism for anal fin color (orange vs. black vs. colorless). Previous work has established that the trait is not sexually dimorphic. We used mtDNA sequence data to obtain a phylogeny for the genus *Hyperprosopon* (3 species) and its sister genus, *Amphistichus* (3 species), which together comprise the subfamily Amphistichinae. We also obtained sequence data for each color morph within *H. ellipticum*. We discuss our results in light of ecological factors that may contribute to the observed polymorphism.

0359 Amphibians in Ecosystems Symposium, Salons 6&7, Sunday July 27, 2008

Effects of Amphibian Population Declines on the Structure and Function of Neotropical Streams

Matt Whiles¹, Karen Lips¹, Sue Kilham², Cathy Pringle³, Piet Verburg³, Roberto Brenes¹, Scott Connelly³, Checo Colon-Gaud¹, Meshagae Hunte-Brown², Chad Montgomery⁴, Scot Peterson¹

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Amphibians can be important consumers in both aquatic and terrestrial habitats and likely represent an important link between the two, particularly in the tropics where amphibian diversity and abundance are high. In the last two decades, amphibian populations have declined dramatically around the world, with catastrophic declines occurring even in protected upland regions of the tropics. Studies of amphibian declines generally focus on identifying causes and documenting patterns, but we know little of the ecological consequences of these losses. Through the Tropical Amphibian Declines in Streams (TADS) project, we have been examining the ecological roles of amphibians in Central American headwater streams and quantifying the consequences of their declines. Our studies indicate that stream-dwelling tadpoles in these systems perform a variety of ecological functions, ranging from grazing to detritus processing, and that their loss influences algal communities

and primary production, quality of particulate organic material (seston) exported from the streams, populations of other consumers such as stream invertebrates and riparian snakes, and reach-scale food web structure and nutrient cycling. In general, amphibian declines result in increased algal biomass, changes in grazing invertebrate communities, decreased internal recycling of nutrients and seston quality, and reduced abundances of some riparian snake species. Hence, along with the inherent tragedy of these losses, tangible ecological changes in stream and riparian ecosystems are occurring. Understanding the ecological consequences of amphibian declines provides insight into the consequences of declining biodiversity and is central to the conservation and management of remaining amphibian populations.

0499 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Do Snakes Have Predetermined Germ Cells?

Mary White, Brian Crother

Southeastern Louisiana University, Hammond LA, United States

Among vertebrates there are two major mechanisms for determining primordial germ cells, the founder cells of the germ lineage. In birds, frogs, and some fish, PGCs are determined by molecules localized in a specific germ plasm of oocytes and/or early embryos. Salamanders and mammals do not have germ plasm early in development. Instead, in these animals germ cells must be induced much later during embryogenesis by mechanisms similar to the induction of other mesodermal tissues. Although the mechanism for germ cell determination is not known for squamates, it has been suggested that snakes and some groups of lizards predetermine germ cells, while other groups of lizards have induced germ cells. We will review morphological evidence and present molecular evidence for the mechanism of germ cell determination used by snakes.

0628 Poster Session III, Sunday July 27, 2008

A Re-examination of Relationships Among the Palm Pit Vipers (Bothriechis)

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The genus *Bothriechis* consists of seven to nine currently-recognized species of Palm Pit Vipers from South and Central America. Relationships among species of the genus *Bothriechis* have been hypothesized using morphology, allozymes, and mitochondrial DNA. Although phylogenies derived using morphology and allozymes are largely congruent, mitochondrial DNA suggests a different set of relationships. For example, morphology and allozymes point to a sister relationship between *B. lateralis* and *B. bicolor*, while mitochondrial DNA suggests that *B. lateralis* and *B. nigroviridis* are sisters; this has been explained as the result of possible

introgression because the species are syntopic (Note that these studies did not include *B. thalassinus* which was described more recently). The combined morphology/allozyme data set hypothesized a sister relationship between *B. aurifer* and *B. rowleyi*, while mitochondrial discovered a *B. marchi/ B. rowleyi* clade, *B. aurifer* as sister to *B. bicolor*. It has been hypothesized that the mtDNA is misleading this case. To test this, we have re-examined relationships among member of the genus *Bothriechis* using a nuclear DNA data set. Results will be discussed in context of nuclear and mitochondrial phylogenies.

0112 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

The Bycatch Fishery for Mobulid Rays in Eastern Indonesia

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Although mobulids are taken in a variety of fisheries throughout much of their range, details of these fisheries are poorly documented. In Indonesia, mobulid rays are landed as bycatch by artisanal gillnet fishers targeting skipjack tuna. Between April 2001 and March 2006, more than 20 surveys of Indonesian fish landing sites were carried out to determine the species, size and sex compositions of the chondrichthyan catches. This study contributes to the limited knowledge on biological aspects and fisheries information for the Mobulidae. The data were derived from 409 mobulids that were examined during the fish landing site surveys. At one particular landing site, it was estimated that 1575 mobulid rays (equivalent to ~320 tonnes) are landed annually. The most abundant of the five species was *Mobula japanica* (~50%), followed by *Mobula tarapacana* (~24%), *Manta birostris* (~14%), *Mobula thurstoni* (9%) and *Mobula cf kuhlii* (2%). The four most abundant species were represented by a wide size range of each species and, in the case of *Mobula japanica*, by embryos, neonates and fully-mature individuals. The disc width at maturity (DW_{50}) of males, derived from the proportion of males at each size class with fully-calcified claspers, ranged from 1538 mm for *M. thurstoni* to 3752 mm for *M. birostris*. In recent years, there has been an increasing demand for various body parts of mobulids. Branchial filter plates, which are used for traditional Chinese medicines, are the most valuable, fetching as much as 30 \$US a kilo (dry weight). The skins are dried and deep fried and the flesh salted and dried and these are used for human consumption, while cartilage is dried for export as a filler for shark-fin soup. The very low fecundity of the large and probably long-lived mobulid rays make the stocks of their species particularly susceptible to further increases in fishing.

**0484 AES Student Papers III, Kafka/Lamartine, Friday July 25, 2008;
GRUBER**

Correlated Evolution of Selachian Tooth Morphology, Diet, and Ecology

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Due to the cartilaginous nature of the skeleton, the fossil record for sharks is overwhelming composed of teeth. Hypotheses regarding diet, feeding habit, and evolution are therefore usually inferred from a combination of qualitative dentition characteristics and the possible prey items that are contemporaneous in the fossil record. To date, a rigorous evolutionary analysis of the above characters has not been undertaken. The goal of this study is to assess the correlated evolution of tooth morphology, diet, and ecology in extant selachian families using independent contrast analysis. Each family was represented by one to four species, dependant on the degree of tooth morphology variation in the family, with filter-feeding species excluded. For each species, a series of morphometric measurements were taken on teeth on the right side of the upper and lower jaws of up to five individuals. These measurements were used to calculate quantitative tooth morphology characters, including cusp aspect ratio, notch angle, cusp inclination indices, and percent of tooth base overlap. Data about ecology and diet were taken from the literature. The above characters were mapped onto an existing phylogeny. Independent contrast analysis was then used to search for correlated evolution of these characters, with branch lengths set to unity. Preliminary results indicate no phylogenetic pattern for teeth of the upper jaw. These teeth tend to be highly variable in morphology intraspecifically, even within families such as Lamnidae and Carcharhinidae. However for teeth in the lower jaw, families with cusps that are less broad tend to have teeth that are also angled more distally relative to the jaw symphysis and deeper notches. There appears to be no pattern for degree of tooth base overlap in either the upper or lower jaws; this instead appears to be correlated with prey handling behaviour.

0454 Amphibian Conservation, Salons 4&5, Saturday July 26, 2008

Decline and Conservation of Amphibians in Central America

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The status of amphibians in Central America was reviewed as part of a volume in the Amphibian Biology series. We describe the Central American environment, describe patterns of amphibian species richness and patterns of endemism in the context of ecological associations and biogeographic patterns. We use the Global Amphibian Assessment (GAA) dataset to explore the conservation status of amphibians in the region. We review conservation threats in light of a meta-analysis of conservation of

Central American amphibians; 43 papers out of 401 valid studies of amphibians in Central America from 1967 to 2007 dealt with conservation. Our analysis revealed gaps in spatial coverage for the region and a paucity of studies focused on particular processes. Most research in Central America has focused on losses associated with the spread of chytridiomycosis. We also review conservation actions in place and conclude with statements concerning future research in Central America.

**0321 Conservation in Canada, Salons 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR**

The Effect of Wood Frog Tadpole Presence on Boreal Chorus Frog Growth and Metamorphosis

Arthur Whiting, Cynthia Paszkowski

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Recruitment to metamorphosis in temporary ponds depends on rapid growth and development of aquatic larvae. Reduction in larval growth and/or development may reduce recruitment affecting local population persistence. We investigated the effect of wood frog tadpole presence on the growth and recruitment to metamorphosis of boreal chorus frogs in the Aspen Parkland of Alberta. Both species are abundant and co-occur at 95% of sites surveyed within Elk Island National Park. Growth rates of chorus frog tadpoles in the field decreased with increasing wood frog density. Manipulations within mesocosms explored the effect of wood frog presence and nutrient addition on the growth and metamorphosis of boreal chorus frog larvae. Results were consistent with field observations - boreal chorus frog tadpoles grew faster and larger in the absence of wood frogs and at higher nutrient concentrations. Laboratory experiments examined the non-interactive effects of wood frog tadpoles on boreal chorus frog tadpole growth and metamorphosis. Presence of wood frogs in dark mesh cages and removal of wood frog feces showed no effect on growth of chorus frog tadpoles. Slower growth and smaller chorus frog metamorphs were found in the presence of wood frog when their feces were moved from the mesh cages into the chorus frog tank. A third experiment is to be conducted to determine the influence of wood frog feces without wood frog presence on the growth of boreal chorus frog tadpoles. The laboratory results suggest that growth inhibition is not the result of food based competition or physical interference within mesocosm or field locations, but rather some metabolic inhibitor present in the feces of wood frog tadpoles.

0322 Poster Session II, Saturday July 26, 2008; CARCNET/RÉCCAR

The Role of Tadpoles in Temporary Pond Food Webs within the Aspen Parkland of Alberta

Arthur Whiting, Cynthia Paszkowski

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Little is known about the role of larval amphibians in aquatic food webs. Stable isotope analysis provides a means to examine the trophic roles of amphibian larvae and explore potential resource overlap with other web members. We were interested in the potential resource overlap between wood frog and boreal chorus frog tadpoles and its effect on tadpole growth within temporary ponds in the Aspen Parkland of Alberta. Few studies have performed stable isotope analysis on amphibian tissues to examine the role of larvae and adults within food webs of temporary ponds. We sampled from six ponds within Elk Island National Park and five ponds in the surrounding agricultural areas. The isotopic signals of tadpoles suggested that resource overlap occurred in some locations, but was not related to differences in growth of chorus frogs across ponds. Both species tended to be at the same low trophic position, but food source varied with pond. In addition to food web structure, we collected larval samples from eggs through to metamorphosis and from adults. Isotopic signals through ontogeny show differences between terrestrial diets and aquatic resources.

0111 Herp Behavior, Salons A&B, Thursday July 24, 2008

Can She-male Flat Lizards (*Platysaurus broadleyi*) use Multiple Signals to Deceive Male Rivals?

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A central theme in animal communication is understanding what constrains signalling and keeps a signal honest. An equally fruitful approach is to examine cases of dishonest signalling. Female mimicry, when certain males take on the appearance of females, is most commonly a male alternate reproductive tactic that is condition-dependent, but which can be frequency-dependent. A number of adaptive explanations for female mimicry have been proposed that include avoiding the costs of aggression, gaining the upper hand in combat, sneaking copulations with females on the territories of other males, and gaining physiological and survival benefits. Previous studies of female mimicry have focused on a single mode of communication, although most animals communicate using multiple signals. Male Augrabies flat lizards adopt alternate reproductive tactics in which one group of males (she-males) mimic females. We tested whether she-males are able to mimic females using both visual and chemical cues. We tested chemical recognition in the field by removing scent and relabelling females and she-males with either male or female scent. At a distance, typical males (he-males) could not distinguish she-males

from females using visual cues. During close encounters, he-males correctly determined the gender of she-males using chemical cues. She-males are therefore able to deceive he-males using visual, but not chemical, cues. To effectively deceive he-males, she-males avoid close contact with he-males during which chemical cues would reveal their deceit. This strategy is likely adaptive because he-males are aggressive and territorial and by mimicking females, she-males are able to move about freely and gain access to females on the territories of resident males.

0701 Poster Session III, Sunday July 27, 2008

AmphibiaWeb; A Dynamic Online Resource Aiding Amphibian Conservation

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AmphibiaWeb provides on-line information on amphibian conservation, declines, and natural history, including an ever-growing database containing an up-to-date list of all amphibian species recognized worldwide, by family, striking a balance between the most current taxonomic research and standards accepted by the herpetological community at large; more than 11,000 photos of amphibians from around the world via CalPhotos; and over 1,700 species accounts, including many for new species. We now provide cutting-edge dynamic mapping for amphibian species by overlaying vouchered, georeferenced museum specimen data (via HerpNET) onto Global Amphibian Assessment's expert opinion maps. Among other new features, we also provide a separate, publicly available compendium of newly named amphibian species from the scientific literature. Additionally, AmphibiaWeb is serving as a testing ground for new ways to map phylogenetic information by integrating amphibian phylogenetic data from AmphibiaTree with georeferenced specimen data from HerpNET.

0386 Poster Session II, Saturday July 26, 2008

Composition, Distribution, and Diversity of Pelagic Fishes around Oceanic Islands

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Oceanic islands of volcanic origin have a narrow shelf and a steep slope that enhance the spatial overlap among coastal and oceanic fauna. During six pelagic surveys in the Canary archipelago, Eastern Central Atlantic, over 65 000 fishes belonging to 211 species were collected at depths between 8 and 1035 m. The mesopelagic families of the bristlemouths (Gonostomatidae) and the lanternfishes (Myctophidae) accounted for about 50 % of all specimens. Four different assemblages associated with mesopelagic, epipelagic-oceanic or neritic-coastal habitats could be identified using multivariate classification and ordination methods. Two of these assemblages were shelf-associated differing in the proportion of meso- and epipelagic species. These data indicate intense horizontal migrations of mesopelagic fishes (mainly Myctophidae) into the neritic realm and increased spatial interactions between neritic and oceanic habitats. No marked differences among oceanographically similar areas of the entire archipelago were found. A considerable heterogeneity in species distribution was found off SE Fuerteventura in an area with high hydrographic variability and abrupt topography. We conclude that both topography and hydrography are important factors influencing the distribution and abundance of pelagic fishes in this oceanic archipelago.

0675 AES Student Papers II, Kafka/Lamartine, Friday July 25, 2008

Not All Nursery Areas Are Created Equal: The Importance of Small Scale Nursery Habitat for Delaware Bay Sandbar Sharks

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Due to declines in sandbar shark populations, efforts are underway to better understand habitat use in nursery areas for rebuilding depleted stocks. Large numbers of young-of-the-year (YOY) and age 1+ juvenile sandbar sharks reside in Delaware Bay from early summer through early fall. We utilized an automated telemetry array (Vemco VR-2) to monitor sandbar shark habitat utilization patterns during their residency in Delaware Bay. We hypothesized that our principal receiver array was near or within primary nursery habitat based on previous studies. Additional receivers were attached to navigational buoys within Delaware Bay. We monitored the movement patterns of 59 sandbar sharks that were surgically implanted with coded acoustic transmitters during the summers of 2005 and 2006. In total over 46,000 detections of telemetered sandbar sharks were recorded. The vast

majority (92%) of total detections occurred within the hypothesized nearshore primary nursery habitat compared to receivers located in deeper waters and at the entrance to Delaware Bay. Site fidelity for returning sandbar sharks was high (42%) in years following the implantation of transmitters. Of the returning individuals (n=25), a high proportion (80%) were comprised of age 1+ juvenile sandbar sharks. The low rate of returning YOY sandbar sharks to Delaware Bay suggests either a high mortality rate during the first year of life or low fidelity to Delaware Bay in the second summer. The high degree of site fidelity and abundance of near shore detections illustrate the importance of such a small portion of Delaware Bay to juvenile sandbar shark stocks. Data from this research may improve the protection and understanding of sandbar shark habitat while residing in Delaware Bay.

0700 Herp Stressors/Snake Conservation, Salons 6&7, Monday July 28, 2008; STOYE CONSERVATION

Evaluating the Effects of Multiple Stressors in Agricultural Streams Using In Situ Tadpole Enclosures

Bethany Williams

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There has been a recent push in aquatic ecotoxicology for studies to demonstrate more realistic exposure conditions and more explicit connections with the natural contexts in which exposures to contaminants typically occur. This desire for increased realism has led to an increase in in situ enclosure experiments, which may be especially suitable for agricultural streams and other systems experiencing multiple natural and anthropogenic stressors. Studies with caged amphibian larvae have a fairly long history in lentic systems, but have been much more limited in streams. I tested two tadpole enclosure designs for stream systems—a submerged hemicylindrical steel mesh cage, and a floating plastic enclosure after my own design. Enclosures were deployed for one month at five agriculturally impacted stream sites in northern Missouri. Plains leopard frog (*Rana blairi*) tadpoles showed survival up to 100% in floating enclosures and higher survival in floating than submerged enclosures across all sites, despite the fact that both enclosure designs occupied nearly the same portion of the water column in these shallow streams. Tadpole length, mass, and developmental stage differed among sites, but not always predictably across the gradient of agricultural land use. Interactions between site and enclosure type were also strong. These results indicate that floating plastic enclosures may be a valuable means of evaluating the effects of complex contaminant exposures on amphibian larvae in a near-natural context.

0040 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Reproductive Success And Sexual Selection In Wild Tiger Salamanders (*Ambystoma tigrinum*)

Rod Williams, J. Andrew DeWoody

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Variation in reproductive success is most pronounced in species where mate competition and mate choice are likely, sexual dimorphisms exist, and in populations containing strongly biased operational sex ratios. This situation occurs in many Ambystomatid salamanders, and thus they have served well as evolutionary models for the study of sexual selection. We used molecular genetic markers to study sexual selection in a breeding congregation of adult tiger salamanders (*Ambystoma tigrinum*) from northwestern Indiana. Using hypervariable microsatellite loci, we genotyped 155 mature adults and 1341 larvae from 90 egg masses. Parentage analyses revealed 108 crosses among 31 dams and 60 sires. Both sexes engaged in multiple successful matings, which was three times 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 reproductive success was enhanced by increased mating success and that the intensity of sexual selection was roughly equal between sexes. The adult morphological attributes we measured (snout-vent length, tail height, tail length, and mass) were not correlated with mating or reproductive success in either sex. The apparent lack of sexual selection on morphological characteristics may be a result of sperm storage, sperm competition among males, alternative mating tactics utilized by smaller males, and/or random induction of spermatophores by females.

0641 SSAR Seibert Competition, Salons 4&5, Friday July 25, 2008; SEIBERT ECOLOGY

Effects of Prey Type on Prey Handling, Digestive Metabolism, and Post-prandial Locomotor Performance in the Banded Watersnake, *Nerodia fasciata*

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Despite the importance of prey availability to predator populations, assessments of prey availability seldom consider differences in quality among prey types. To aid our understanding of factors that influence the distribution and abundance of the banded watersnake (*Nerodia fasciata*), we compared quality of prey characteristic of ephemeral and permanent wetlands: paedomorphic salamanders (*Ambystoma talpoideum*) and sunfish (*Lepomis marginatus*), respectively. Specifically, we compared nutritional composition and morphology of the prey taxa and used a series of repeated-measures experiments to examine handling (number of prey consumed, maximum prey size, and handling time), digestive metabolism (specific dynamic

action, SDA), and post-prandial locomotor performance (reduction in maximum crawling speed) of snakes fed *Ambystoma* and *Lepomis*. Although the two prey types were similar in nutritional composition, snakes consumed larger *Ambystoma* than *Lepomis* (maximum meal sizes 105% vs. 50% of snake body mass), consumed more individual *Ambystoma* than *Lepomis* of similar size per feeding event, and exhibited longer handling times for *Lepomis* than *Ambystoma* within prey size treatments. Overall, SDA profiles were similar for snakes digesting the two prey types, with no significant effect of prey type on total volume of O₂ consumed above standard metabolic rate, peak rate of O₂ consumption, digestive scope, or SDA coefficient and only subtle differences between the prey types in the shapes of the SDA curves (time to 50% and 75% decrease from peak O₂ consumption). However, prey types differed in their impact on post-prandial locomotor performance; snakes fed *Lepomis* suffered a 45% reduction in maximum crawling speed 1 h post-feeding, compared to a 23% reduction for *Ambystoma*. Our results indicate that prey taxa may differ substantially in quality, even when their nutritional compositions are similar. Differences in quality of available prey may have substantial ecological consequences and may contribute to variation in density and demography among snake populations.

0341 General Ichthyology II, Salons 6&7, Saturday July 26, 2008

Sexual Size Dimorphism and Body Size Allometry in a European Pipefish Species

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Mating success and fecundity are positively correlated with body size in both sexes of male-pregnant *Syngnathus* pipefish. As male pipefish brood eggs on their tail and female egg production occurs in her ovaries located in her trunk, fecundity selection is predicted to act differently on male and female size. Female body size is also under sexual selection, as large females are preferred by males. We investigated sexual size dimorphism and body size allometry in the broad-nosed pipefish *Syngnathus typhle*, based on the hypothesis that fecundity and sexual selective pressures act differently in males and females. Measurements of overall body size and body proportions were taken from seven populations of *S. typhle* sampled across a wide geographical range. Males and females differ significantly in trunk length, tail length and total body size. Patterns of female growth in the trunk and the tail vary significantly among populations, while male tail grows more rapidly than does his trunk in all populations. This results in sexual size dimorphism that is specific for a body region: for a given body size, females have a longer trunk than do males, while males have a longer tail. Female biased dimorphism in overall body size was found in three populations. Morphological variation in the broad-nosed pipefish supports the hypothesis that fecundity selection on male tail length is responsible for a region-specific sexual size dimorphism and different patterns of growth in male and female *S. typhle*. Female biased dimorphism in overall body size is likely a product of sexual selection.

0311 Poster Session II, Saturday July 26, 2008

Interactions between Fishes and Invasive Jellyfish in the Upper San Francisco Estuary, USA

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Jellyfish populations are increasing around the world in response to anthropogenic alterations of the oceanic environment. Jellyfish invasions are often harmful to planktivorous fishes, because they can successfully compete for planktonic prey and will feed upon fish eggs and larvae. In the upper San Francisco Estuary, there are three abundant invasive jellyfish (*Maeotias marginata*, *Blackfordia virginica*, and *Moerisia sp.*). We present a conceptual model of the potential impact of jellyfish competition and predation on four declining planktivorous fish populations (Delta smelt, YOY striped bass, threadfin shad, and longfin smelt) and describe studies on jellyfish abundance and distribution, prey selectivity, and dietary overlap with fishes. Invasive jellyfish are potentially contributing to the decline and/or recovery failure of planktivorous fishes in the upper San Francisco Estuary.

0580 Poster Session III, Sunday July 27, 2008

Brown Tree Snake Invasion Risk Assessment for the Continental United States

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Brown tree snakes (*Boiga irregularis*) are a mildly venomous, rear-fanged constrictor which is native to Australia, Papua New Guinea, and other Melanesian Islands. 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 invasive species 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. This is why it is important to identify the areas within the continental United States which are at the highest risk for brown tree snake invasion. A similarity assessment was done between areas within the BTS home range and areas within the continental United States using distance analysis. Using aspects of climatic tolerance for BTS, we were able to identify areas at the highest risk for BTS invasion. Another assessment was also done between Guam and areas in the continental United States to examine the differences between invasion from Guam and invasion from the BTS home range. In both assessments, areas with the most similar temperature and precipitation to that of the compared area (either the home range or Guam) are identified as highest risk. The high-risk areas which are identified in this assessment will be important targets for increased public education, training and awareness. The North America Brown Tree Snake Control Team

(NABTSCT) will use this assessment for mapping high-risk locations on the NABTSCT website for public access, leading to increased awareness.

0024 Herp Stressors/Snake Conservation, Salons 6&7, Monday July 28, 2008

Investigating Rural Kenyan Teachers' Attitudes Toward Snakes: New Perspectives for Teaching

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A 3-month quasi-experimental mixed-methods study was conducted mid-September through mid-December 2005 to investigate rural southeast Kenyan teachers' attitudes toward snakes. 60 teachers from 6 villages near Mt. Kasigau were surveyed and interviewed about their attitudes toward snakes to obtain baseline data before and after a herpetofauna institute. 25 teachers representing 5 of the 6 villages attended a 6-hour seminar on reptiles and amphibians. From these 25 teachers, 8 teachers from 3 villages were afforded additional educational opportunities about snakes, and 2 teachers from this group of 8 were teamed with 2 herpetologists as mentors. Findings suggest that teachers' attitudes toward snakes, within a culture where all snakes are feared and killed onsite, can change toward a more favorable orientation when faced with a scientific perspective of snakes, learn taxonomic/ecological information about snakes, and observe positive modeling of snake handling.

0500 Herp Systematics, Drummond, Friday July 25, 2008

A Preliminary Phylogeny of the Genus *Acanthosaura* Gray 1931, Inferred from Mitochondrial and Nuclear DNA

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The Southeast Asian agamid lizard genus *Acanthosaura* Gray, 1931 currently contains six recognized species (*A. armata*, *A. capra*, *A. coronata*, *A. crucigera*, *A. lepidogaster*, and *A. nataliae*). It ranges throughout Myanmar, Thailand, Cambodia, Laos, China, and Malaysia (including its off shore islands, Pulau Tioman, Pulau Aur, Pulau Perhintian, Pulau Perhintian Kecil and Pulau Langkawi). An analysis of the mitochondrial and nuclear DNA coupled with maximum parsimony (MP) and maximum likelihood (ML) analyses were used to test the hypotheses (1) *Acanthosaura* cf. *crucigera* from the Cardamom Mountains forms a distinct group separate from *Acanthosaura crucigera* from its type locality in Thailand (2) *A. armata*, *A. crucigera*, and *A. lepidogaster* are composed of multiple cryptic species (3) *Acanthosaura* cf. *armata* from Pulau Aur and Pulau Tioman form the sister group to other *A. armata*, (4) *Acanthosaura* cf. *crucigera* from Pulau Langkawi is more closely related to Cambodian *A. cf. crucigera* than to *A. crucigera* from Thailand, following other biogeographic patterns. This will be the first time nuclear DNA and all recognized species will be included in a phylogenetic context.

0584 Poster Session III, Sunday July 27, 2008; STORER ICHTHYOLOGY

The Phylogenetic Distribution of Siluriform Venom Glands

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Though many species of catfishes have long been known to produce venoms associated with the dorsal and pectoral-fin spines, the distribution of this trait throughout the Order Siluriformes has yet to be determined. The histological examination of fin spines taken from museum specimens, including representatives from 32 of the 34 currently recognized (extant) catfish families (including over 100 genera) has revealed the presence of venom glands in species from at least 20 families. For several of these families, this represents the first time that venomous representatives have been demonstrated. The results of this study indicate that approximately 1500-1700 species of catfishes should be presumed venomous. Mapping of the presence of venom glands onto recently generated siluriform phylogenies indicates at least two independent developments of venom glands in catfishes. Multiple losses of venom glands are found throughout the Order, in lineages in which the fin spines have been lost or extensively modified. Though the presence of venom glands was consistent in most families examined, cases were found in which two genera from the same family differed in the presence vs. absence of venom glands. Robust species level phylogenies of siluriform families and genera are needed to more clearly trace the evolutionary history of venom glands (and their secretions) in these groups, and may also offer insight into the ecological factors that have favored this intrafamilial incongruence.

0760 Poster Session II, Saturday July 26, 2008

Body Temperature Selection and Thermoregulatory Efficiency of the Giant Garter Snake

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The Giant Garter Snake (*Thamnophis gigas*) is a threatened species precinctive to the Central Valley of California. Despite a large body of literature on the thermal ecology of garter snakes, relatively few studies have examined body temperature selection and thermoregulatory efficiency of these snakes where they occur in benign thermal environments. The thermal ecology of the Giant Garter Snake is of particular interest because it is the largest of the garter snakes, is highly aquatic, and is restricted to a Mediterranean climate. We examined multiple hypotheses regarding temporal, sexual, and behavioral differences in the selection of body temperatures and thermoregulatory precision of the Giant Garter Snake using temperature-sensitive radio telemetry and an information-theoretic analytical approach. Similar to other garter snakes, individual Giant Garter Snakes selected body temperatures near 30°C. Male and female Giant Garter Snakes did not exhibit differences in body temperature

selection or thermoregulatory efficiency most of the year, including the midsummer gestation period. Resting individuals thermoregulated more precisely than individuals active on land or in water. Despite potential energetic costs, individuals emerged from hibernacula to bask on warm, sunny days in winter. The relatively benign Mediterranean climate, coupled with the Giant Garter Snake's occurrence in a complex and variable thermal environment, contribute to the apparent reduced importance of thermoregulatory behavior for the Giant Garter Snake relative to its congeners.

0293 Poster Session I, Friday July 25, 2008

Phylogenetic Relationships of Labeonini (Teleostei: Cyprinidae) Inferred from Four Nuclear and Three Mitochondrial Loci

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The Labeonini (sensu Rainboth, 1991) is a tribe of the subfamily Cyprininae, the largest subfamily of Cyprinidae. Species of this tribe are widely distributed in the freshwaters of tropical Africa and Asia. Currently, around 31 genera and 400 species are included in this tribe. Most species are adapted to inhabit fast-flowing water and exhibit unique modifications of their oromandibular morphology. The monophyly of this tribe has been tested and generally accepted by previous morphological and molecular studies. The major objective of this study was to reconstruct the phylogenetic relationships of the tribe Labeonini, test its monophyly and explore its subdivisions, their intrarelationships and their biogeography. Nucleotide sequences of four nuclear and three mitochondrial loci were collected from 21 Labeonini genera, 47 species throughout its distribution range. Maximum parsimony, maximum likelihood and Bayesian analyses were conducted using combined dataset. The monophyly of Labeonini was well supported. Three clades could be recovered within the tribe. These clades are not consistent with the groupings of previous workers and with current taxon resampling, do not exhibit any logical geographic pattern.

0291 Fish Conservation, Drummond, Sunday July 27, 2008

Predicting Invasions of Gars (Actinopterygii: Lepisosteidae) in Mainland China Using Native Range Data and Ecological Niche Modeling

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Gars (Lepisosteidae) are top predators in freshwater systems. Their native distributions range from southeastern Canada and eastern North America south to Costa Rica and the Caribbean. No fossil or extant gars have ever been described from China. In 1990s, however, gars were imported into Mainland China as pet fish. In recent years, more and more gars have been found in natural waters across the country. We have compiled records in China, and found gar reported more frequently in coastal provinces and with a general trend inland. Up to four gar species may have been found: longnose gar *Lepisosteus osseus*, shortnose gar *L. platostomus*, spotted gar *L. oculatus*, and alligator gar *Atractosteus spatula*. Native range data and ecological niche modeling were used to predict the invasive potential of each species and also Florida gar *L. platyrhincus* in Mainland China: all except the Florida gar have the potential to be able to spread broadly in southern, eastern and central China. Alligator gar may also be able to spread to northern and eastern China, while Longnose gar may be able to invade the northeast. Florida gar may only restrict to small areas of southern China. The consequences of potential establishment of gars could be profound for Chinese aquatic diversity: gars may feed mainly on small cyprinids, loaches, and some catfishes in China, and they may also compete with native piscivorous fishes. Gars also have the potential to spread from China into Southeast Asia.

0196 Poster Session I, Friday July 25, 2008

Evolution of the Spinous Dorsal- and Anal-fin Rays of Cyprinine Fishes (Ostariophysi: Cyprinidae: Cyprininae)

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Several members of the Cyprininae possess a thickened, spine-like leading fin ray in the dorsal and anal fins. These 'spines' are formed by the ontogenetic fusion of individual lepidotrichia segments and thus differ from the true spines of acanthomorph fishes, which are never segmented. Though the presence or absence of spinous rays are important characters in taxonomic keys of cyprinine fishes, little is known about their evolutionary origins. We investigated the evolution of the spinous rays of cyprinine fishes using a molecular phylogeny of the subfamily. Four characters relating to the spinous rays were investigated using ancestral character state reconstruction: (1) presence/absence (p/a) of the spinous dorsal-fin ray; (2) p/a of spinous dorsal-fin ray serrations; (3) p/a of the spinous anal-fin ray; (4) p/a of the spinous anal-fin ray serrations. We predicted *a priori* that the spinous rays of

cyprinine fishes were each the result of a single evolutionary event. Due to ambiguous optimization on our molecular phylogeny, it is not possible to definitively state the number of independent acquisitions of the spinous dorsal-fin ray of cyprinine fishes and it appears that there have been numerous losses of this structure. The evolution of the spinous anal-fin ray of cyprinine fishes is much clearer and is the result of two independent evolutionary events (once on the branch leading to *Cyprinus* + *Carassius* and once on the branch leading to *Puntioplites*). Previous authors had hypothesised a close relationship between *Cyprinus*, *Carassius* and *Puntioplites* based on the presence of the spinous anal-fin ray in these taxa. We hypothesize that, based on differences in morphology (presence vs. absence of spinous anal-fin ray serrations) and our molecular phylogeny, the spinous anal-fin rays of *Puntioplites* and *Cyprinus* + *Carassius* are not homologous.

0526 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

A Neural Basis for a Shark's Motor Repertoire? Quantifying the Complexity of the Cerebellum using Magnetic Resonance Imaging (MRI)

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The cerebellum appeared at the onset of the chondrichthyan radiation and is known to be essential for executing fast, accurate, and efficient movement, yet there is still much controversy surrounding its absolute function, which remains unresolved. Comparative data on cerebellar anatomy from cartilaginous fishes with disparate behavioral repertoires can provide critical information on cerebellar function and development, and ultimately vertebrate evolutionary trajectories. Recent work has shown patterns of brain organization in sharks that are correlated with ecological parameters. Cerebellum size has strong allometric correlations, but there exists significant interspecific variation in corpus folding. We have previously developed a visual grading method, ranging from 1-5, which provided a classification scheme for cerebellar foliation. When applied to a range of species (n=81), the highest foliation levels (4-5) were found in agile predators that lived in 3D environments, such as *Isurus oxyrinchus*, *Alopias vulpinus*, and *Sphyrna mokarran*. However, visual classification is limited as it does not parameterize structural variations, and thus does not provide a quantitative method for characterization and comparison of foliation; these methods can often miss subtle but important differences between species that may have high evolutionary significance. Here we provide such a quantitative method using Magnetic Resonance Imaging (MRI) in conjunction with shape analysis methods. The degree of foliation was quantified using three different measures of geometric variation following image segmentation: (1) local tissue curvature (2) cortical flattening, and (3) spherical harmonic decomposition. These methods were preliminarily applied to 5 shark species with varying levels of foliation (based on the visual classification scheme). These methods greatly extend the visual foliation index by providing quantitative methods for interpreting and analyzing the architecture and surface structure of chondrichthyan brains. Through

these, we plan to explore the extent to which adaptive, developmental, and phylogenetic processes are driving neural evolution.

0200 Poster Session II, Saturday July 26, 2008

**Osmoregulation in the Diamond-backed Watersnake (*Nerodia rhombifer*):
Salt Stress is Stressful**

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Changes within the physical environment of freshwater systems have begun to affect the natural distribution of native species. Increases in water salinity, due to agricultural inputs, have forced some freshwater organisms out of previously inhabited areas. In addition, riverine species may reach a local range limit if the river drains into salt water. On the physiological side, previous work speaks of salt stress without examining if the stress hormones (e.g., cortisol, corticosterone) increase after exposure. As an ecophysiological model, we used a species that frequently inhabits lotic systems with an estuarine zone (*N. rhombifer*). The extent of *N. rhombifer*'s salinity tolerance is unknown, as is whether this exposure causes the animal to experience inordinate amounts of physiological stress. We subjected 28 adult snakes to a one-week constant exposure to 0, 9, 18, and 27 ppt saline solutions in a repeated measures design. Plasma osmolality and corticosterone concentrations were measured before and after the exposure. To test salt tolerance in small snakes, we divided 39 neonates into one of three treatments (0, 9, and 18 ppt saline solutions) for one-week constant exposure and measured survivorship. Under the testing regime, the LD50 for salt was 27.0 ppt in adults and calculated to be 22.8 ppt in neonates. Baseline plasma osmolality and corticosterone in adults averaged 312.6 ± 22.5 mMol/kg and 5.5 ± 4.2 ng/ml, respectively. *Nerodia rhombifer* is a strong hyper-/hypo-osmoregulator, but shows decreased osmoregulatory performance and signs of salt stress above 9 ppt, with increases in plasma osmolality of up to 150 mMol/kg over baseline and a corresponding increase (up to 5-fold) in corticosterone. Increases in corticosterone have been shown to negatively affect the sex steroids, which may affect reproductive success. Salt intolerance may potentially play a role in limiting the species' distribution along rivers that have an estuarine zone.

0199 Cottonmouth Symposium, Salons 4&5, Monday July 28, 2008

Ecophysiological Research on Cottonmouths: Model Species and Special Cases

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The ecology of cottonmouths (*Agkistrodon piscivorus*) has been well studied in a variety of systems. Despite being a ubiquitous feature of both natural and man-made habitats throughout the southeastern United States, cottonmouths have received surprisingly little attention in physiological investigations. Cottonmouths are not only interesting in their local ecophysiological context, but also potentially important as model organisms. Krogh's principle states, as cited in Bennett (2003), "For a large number of problems there will be some animal of choice, or a few such animals, on which it can be most conveniently studied. (August Krogh [1929])". In many ways, cottonmouths embody this principle. Cottonmouths serve as key members of both aquatic and terrestrial food webs and their generalist diet provides links to many species. The species has wide latitudinal and altitudinal ranges and occurs in a variety of freshwater, terrestrial, and insular habitats where they exhibit considerable local adaptation. From a practical viewpoint, cottonmouths are ideal focal species. They are often locally abundant and easily captured. In the laboratory setting, cottonmouths are easily maintained, tractable, and require a relatively small amount of space. Adequate precautions must be taken, of course, to ensure their safe care and use. In our presentation, we will review and discuss the ecophysiological literature related to cottonmouths, organized according to sub-disciplines of investigation (e.g., thermal biology and energetics, osmoregulation and water balance, digestive physiology, toxicology, etc.). We will examine current research and propose future directions in the hope of better understanding this organism and promoting its use in research.

Two New Species of *Hypostomus* Lacépède (Teleostei: Loricariidae) from the Rio Paranaíba and Rio Grande, Upper Rio Paraná Basin, Central Brazil

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Widespread through Neotropical region species of the genus *Hypostomus* constitutes one of the most speciose genus of the Siluriformes encompassing from 117 species (without synonymization of *Squaliforma*, *Aphanotorulus* and *Isorineloria*) to 138 species (with synonymization). However, misidentification are commonly found in the literature. These errors were attributed to the broad morphological variation of most species, great number of available names, very old original descriptions, and ill-conserved type specimens. Aggravating that situation, molecular data has shown that about one-third of the current *Hypostomus* species are still undescribed. Monthly ichthyological surveys were carried out from March 1996 to March 2002 in the rio Corumbá basin, a tributary to the rio Paranaíba, upper rio Paraná basin, Goiás State, Brazil. The analysis of several collected *Hypostomus* specimens allowed the recognition of two undescribed species of *Hypostomus*. One of them, *Hypostomus* sp. n. 1, is distinguished from all congeners, except *H. albopunctatus*, by having pectoral-fin spine equal or smaller than pelvic-fin spine. From *H. albopunctatus*, it is distinguished by having roundish dark spots over body and fins (vs. clear spots). The second, *Hypostomus* sp. n. 2, is distinguished from all its congeners, except *H. multidentis*, by having more than 115 dentary and premaxillary teeth (vs. less than 109) and by having teeth with two symmetrical cusps (vs. asymmetrical). It is distinguished from *H. multidentis* by having dark roundish spots over body and fins (vs. clear spots). Additional samples of *Hypostomus* revealed that the two new species were also found in the rio Paranaíba and in the rio Grande, upper rio Paraná basin.

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