

ABSTRACTS – 2008

JOINT MEETING OF ICHTHYOLOGISTS & HERPETOLOGISTS COMPILED BY M.A. DONNELLY (underlined name = presenter)

Kneebone to Ristovska

0494 AES Age & Growth/Reproduction, Kafka/LeMaratine, 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

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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

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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, Salon 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, Salon 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, Salon 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, Salon 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, Salon 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. japonica*, 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. japonica* and *M. thurstoni*).

0250 AES Conservation, Kafka/LeMaratine, 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, Salon 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, Salon 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, Salon 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, FST = 0.084). These results give an insight into the evolutionary history of short-tailed stingrays in the southern hemisphere.

0008 Fish Systematics IV, Salon 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, Salon 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, Salon 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, Salon 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, Salon 6&7, Thursday July 24, 2008

Like Father, Like Son? Feeding Apparatus in Adult And Larval *Hippocampus reidi*

Heleen Leysen, Annelies Genbrugge, Dominique Adriaens

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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 rattfish) 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, Salon 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, Salon 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/LeMaratine, 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/LeMaratine, 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/LeMaratine, 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 ($\pm 23.6\%$) of the swordfish (*Xiphias gladius*) surveyed each week had cookie cutter shark bites and $43 \pm 16.7\%$ 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 ($\sim 15.3\%$), 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 more common around the Hawaiian Islands than previously expected.

0457 Fish Systematics I, Salon 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/LeMaratine, 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/LeMaratine, 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*

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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, Salon A&B, Sunday July 27, 2008; HL

Population Ecology Of The Greater Siren, *Siren lacertina*: The Enigmatic Giant Salamander Of North America.

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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 Marañón 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, Salon 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.

0429 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

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 ($LD_{50} = 1.35 \mu\text{g/g}$) 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, Salon 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, Salon 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 ecosystem 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 presently occupies no more than 5% of its historic range. *H. amarus* populations have been declining for over 100 years and the exact cause has not been identified. Many probable causes for the decline have been studied, yet very little attention has been paid to food resources. In this investigation, feeding trials were performed with three objectives; first, time to first feeding and peak utilization of food resource by examining the relationship between time and utilization. Second, substrate preference was examined (fine-grain sediment or coarse sand). Third, feeding preference was examined 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. palea* ($p < 0.001$). There was no difference in utilization between *N. linearis* and *N. palea* ($p = 0.48$). 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/LeMaratine, 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 \bar{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 genera, 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 \bar{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/LeMaratine, 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, Salon 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, Salon 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 Andrea Marshall¹, Michael Bennett¹, Leonard Compagno²

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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.

0150 AES Student Papers I, Kafka/LeMaratine, 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-lamnid 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.

0045 Poster Session I, Friday July 25, 2008

Cleaning Behaviour of a Photographically Identified Population of Manta Rays in Southern Mozambique Andrea Marshall, Michael Bennett

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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.

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 College, National Marine Fisheries Service, NOAA, California Department of Fish and Game, and the National Geographic Society.

0656 Herp Reproduction, Salon 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/LeMaratine, 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, Salon 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, Salon A&B, Sunday July 27, 2008 - STOYE GENETICS, DEVELOPMENT & MORPHOLOGY

Genetic Population Comparisons of Insular and Mainland Florida Cottonmouths (*Agkistrodon piscivorus conanti*)

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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

Frank McCormick, Alan Savitzky, Gerald Smith

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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 17 β -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/LeMaratine, 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/LeMaratine, 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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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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¹University of Melbourne, Victoria, Australia, ²Museum 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 specious (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

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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/LeMaratine, 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.

0011 Fish Morphology & Histology II, Salon 6&7, Saturday July 26, 2008

Comparative Osteology of the North-eastern Pacific Gobionellinae

Natascha Miljkovic, Gertraud Kindermann

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The members of the north-eastern Pacific Gobionellinae, comprising nine species in six genera named 'California bay gobies' (*Clevelandia*, *Eucyclogobius*, *Gillichthys*, *Ilypnus*, *Lepidogobius* and *Quietula*) were examined and subsequently discussed with regard to recent genetic research stating a complex genealogy of this supposedly monophyletic subdivision. In this study comparative osteological examinations of all calcified elements of the neurocranium, suspensorium and vertebral column with respective associated structures were conducted for each species. In several circumstances a major discrepancy of osteological structures was found in comparison to the assumed underlying genetic relationship of the species. For instance, *Clevelandia ios* often was not seen as closely related to the supposed sister species *Eucyclogobius newberryi* but to more basal species.

0236 SSAR Seibert Competition, Salon 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 pedomorphs and juvenile larvae) ate 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, Salon 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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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 pelvici*. 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, Salon 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, Salon 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-rhinatrematid, 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, uraeotyphiid 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, Salon 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/LeMaratine, 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, Salon 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. oculo-fasciatus* 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

John Musick

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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 seabastine 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/LeMaratine, Sunday July 27, 2008

Are there Cascading Ecosystem Effects of Depleting the Oceans' Great Sharks?

Ransom A. Myers (Deceased)¹, Julia K. Baum², Travis D. Shepherd¹, Sean P. Powers³, Charles H. Peterson⁴

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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/LeMaratine, 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, grey 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/LeMaratine, 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 intrapopulational variation and potential interpopulational activity and diet correlations.

0178 Herp Conservation, Salon 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, Salon 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, Salon 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, Salon 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.

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.

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.

0503 HL Graduate Research Award, Salon 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

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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. japonica* 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. japonica* 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, Salon 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.

0564 Fish Development/Reproduction, Salon 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 Gonadotropin (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-pregnen-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/LeMaratine, 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 benthopelagic 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.

0049 Poster Session III, Sunday July 27, 2008; STORER ICHTYOLOGY

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.

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, Salon 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, Salon 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

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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, Salon 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/LeMaratine, 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, Salon 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_-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, Salon 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, Salon 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, Salon 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 GRFIn 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 Eletrolyte 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, Salon 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, Salon 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/LeMaratine, 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 vanhynghini*, the Florida Brook silverside, was described by Bean and Reid, from Prairie Creek, near Gainesville, FL. Until recently, the taxonomic status of *L. s. vanhynghini* 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, Salon 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/LeMaratine, 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/LeMaratine, 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, Salon 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/LeMaratine, 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

Jennifer Pritchett, Mark Pyron

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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

Jake Pruett, Neil Ford

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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

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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, Salon 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, Salon 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, Salon 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, Salon 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, Salon A&B, Sunday July 27, 2008

Estimating Gene Flow between Black Salamander (*Aneides flavipunctatus*) Populations: A Multi-locus Coalescent Approach

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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, Salon 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 large impacts on amphibian survival than was previously known.

0607 Herp Conservation, Salon 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/LeMaratine, 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)

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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.
