

ABSTRACTS – 2008

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

DeVaney to Kley

0037 Fish Systematics IV, Salon A&B, Monday July 28, 2008

Phylogeny of Elopomorpha Based on Nuclear and Mitochondrial DNA

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The clade Elopomorpha is composed of the bonefishes, ladyfishes, eels, and their allies. Adult elopomorphs vary enormously in body plan and ecology, but they are united based on the presence of a leptocephalus larval stage. Some authors, however, argue that the leptocephalus may be plesiomorphic and Elopomorpha may not be monophyletic. Furthermore, the relationships of elopomorph taxa (whether monophyletic or not) to other lower teleosts has been the subject of some debate. The object of the present study is twofold: first, to test the monophyly of Elopomorpha; second, to examine the relationships of elopomorph fishes to other extant lower teleost groups. Taxon sampling for this study includes 40 species, 17 of which are elopomorphs; the remaining taxa are other lower teleosts with *Amia calva* the designated outgroup. The character set includes DNA sequence data from three nuclear genes: the recombination activating gene RAG1, the zinc finger protein gene ZIC1, and the myosin heavy chain gene MYH6; and one mitochondrial gene: the cytochrome oxidase gene COI. Phylogenetic inference was performed using three different methods: parsimony, maximum likelihood, and Bayesian inference.

0038 Poster Session I, Friday July 25, 2008

Phylogenetic Relationships of Myctophiformes Based on nDNA and mtDNA

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The order Myctophiformes (lanternfishes and allies) is generally considered to be the most basal member of the clade Ctenosquamata, sister to Acanthomorpha. While this placement is currently widely accepted, some recent analyses have recovered different relationships for this group. As the sister group relationships of Myctophiformes are important for subsequent analyses of intrarelationships of myctophiforms and of the phylogeny of Acanthomorpha, we are revisiting the question using new data. The character set includes DNA sequence data from three nuclear genes: the recombination activating gene RAG1, the ectodermal neural cortex gene ENC1, and the myosin heavy chain gene MYH6; and one mitochondrial gene: the cytochrome oxidase gene COI. Phylogenetic inference was performed using three different methods: parsimony, maximum likelihood, and Bayesian inference.

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

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

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

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

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

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Habitat loss is considered to be a key causal factor in losses of native biodiversity around the world, while the habitat that remains faces a growing threat from invasion by exotic species. Despite the fact that some of the most successful and widespread of these exotics are plant invaders, and the habitat alterations they initiate can be extensive, there is little information on the impact of plant invasions on native fauna. One common exotic plant in the eastern United States is the Asian grass *Microstegium vimineum*; this plant invades habitats where amphibians are commonly found, such as forests, wet meadows and bogs. In order to evaluate the effect of these invasions on amphibian survivorship we constructed 16 enclosures, one on either side of eight independent *M. vimineum* invasion fronts, into each of which we released 100 metamorphic American toads (*Bufo americanus*) in two cohorts of 50 toads each. These cohorts were separated based on time to metamorphosis, with the release of the second cohort occurring two weeks after that of the first. Survivorship estimates conducted six weeks later revealed that the survivorship of

the first cohort was significantly lower in invaded pens ($p=0.015$), while there was no significant effect of invasion on the second cohort ($p=0.515$). Our results indicate that invasion by exotic plants can negatively affect amphibian survivorship, perhaps through the loss of food resources or changes in the environmental structure, but that these effects may be mediated by the timing or condition of these animals as they enter the terrestrial environment. As amphibian populations are especially sensitive to reductions in survivorship during their terrestrial life phases, increases in mortality occurring during these stages may represent a significant threat to amphibian biodiversity.

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

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

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To examine the movements of manta rays in the Komodo Marine Park, Indonesia an acoustic array was installed at up to seven sites in the park between 2000 and 2003. A total of 41 acoustic tags were deployed in three separate deployments. Mantas were recorded in the park for up to 526 days with an average duration of 183 days (± 136 days) when mantas made from 3 to 303 individual visits to different sites (median 58 visits). There was a clear preference for three sites that comprised over 90% of manta activity. The most popular site (German Flag) was off the southern tip of Komodo Island in an area with a high degree of bathymetric structure. Examination of the longest records suggests some site preference with 5 of 7 individuals spending greater than 90% of their time at the location where they were tagged. Using a general linear model it was possible to examine the effects of daytime, lunar phase, aggregation site, season and tidal phase on visitation patterns. The vast majority of visits were recorded during daylight hours at all sites. The strongest effects of both the lunar and tidal phase were apparent in the northern sites with the most visits occurring when tidal intensity was the greatest during full and new moons. The strongest seasonal pattern was observed in the south where no mantas were recorded during the first quarter in any year. This coincides with a regional increase in temperature and reduction of productivity associated with monsoonal shifts. This study improved the predictability of manta visitation patterns, which will increase the success of manta-based ecotourism. The long-term fidelity indicates that marine protected areas centered around aggregation sites is one tool that could help protect this species from overexploitation.

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

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

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

0670 Fish Ecology I, Drummond, Thursday July 24, 2008

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

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Predators often drive phenotypic diversification of prey. In livebearing fishes, the fitness gradient imposed on body shape by predators has driven population differentiation into “fast” and “slow” swimming morphologies (*Am. Nat.* 164:335-49). But do populations differ in morphology due to canalized genetic differentiation, phenotypic plasticity, or both? A previous result (*Evolution* 58:2305-18) demonstrated strong quantitative genetic differentiation and cast doubt there was any room left for plasticity to contribute to the diversification observed in nature. Here, we report results of a reciprocal common garden rearing study which tested

for predator-induced morphology in prey fishes. Livebearing fish of three species (*Brachyrhaphis rhabdophora*, *Gambusia affinis*, *Poecilia reticulata*), from populations containing or lacking native piscivorous fishes, were raised in both the presence and absence of predators (*Parachromis dovii*, *Lepomis cyanellus*, *Crenicichla altifrons*). Resulting prey morphology was assessed using geometric morphometrics. Prey exhibited phenotypically plastic morphology induced by predator cues. Furthermore, the axis of plasticity through trait space paralleled both the fitness gradient and genetic differentiation. Such parallelisms, for reasons we will detail, are a hallmark of divergent natural selection. This study system suggests that divergent selection so strongly structures the architecture of phenotypic variation, that the signature of diversification is echoed at several levels of the biological hierarchy, including developmental (plasticity, allometry and developmental noise) and phylogenetic (among family, population and species differentiation) axes.

0056 AES Student Papers II, Kafka/LeMaratine, Friday July 25, 2008; GRUBER

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

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

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

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

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

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

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

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Escape responses are vital to the survival of prey during predator-prey interactions. This study documented the kinematics of the escape responses of white spotted ratfish, *Hydrolagus colliei* (Chimaeriformes). Three *H. colliei* (345-460 mm TL) were trawled off the coast of San Juan Island, WA and housed in flow through aquaria at the University of Washington, Friday Harbor Laboratories. Seven escape responses were elicited with a forceful tap on the caudal region and recorded using a high speed camera at 250 fps. The video sequences were digitized for both lateral and dorsal views, obtained simultaneously from a mirror suspended at a 45° angle above the tank. Video analysis was based on displacement of center of mass, calculated from straightened frozen specimens. Escape responses generally included a large vertical excursion which corresponded to $77 \pm 14\%$ (mean \pm SEM) of the horizontal displacement. Large vertical excursions in escape locomotion are relatively unusual

in fish, although they have been observed in previous work (e.g. hatchet fish, *Carnegiella strigata*, and knifefish, *Xenomystus nigri*). The potential advantages of this type of response may lie in eluding predators that have little vertical maneuverability. The average latency time to response was about 200 ms (108- 332 ms), which is higher than the latency values commonly observed in teleosts (10-50 ms). This was unexpected, since ratfish are the only chondrichthyans whose adults are known to have Mauthner cells, the giant neurons largely responsible for the fast response time. The average head turning rate during stage 1 was $1515 \pm 548 \text{ deg. s}^{-1}$, which is in line with results on other fish. Maximum acceleration was $75.3 \pm 19 \text{ m s}^{-2}$ and maximum speed was $3.01 \pm 0.45 \text{ m s}^{-1}$. Overall, locomotor performance appears to be higher than that observed in the only other chondrichthyan species studied (*Squalus acanthias*).

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

Markers of Hypoxic Stress in Fishes: A River Restoration Evaluation

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

0216 Herp Systematics, Drummond, Friday July 25, 2008

Can Reptile Species be Distinguished with Solely Morphometric Characters?

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

0437 Fish Ecology I, Drummond, Thursday July 24, 2008

Homing and Straying Following Experimental Translocation of PIT Tagged Fishes

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Stream habitats continue to be fragmented, affecting the normal movements of fishes. How fish respond to fragmentation, by homing and straying, can affect the size, structure, recruitment and persistence of local populations. We examined the movement behaviour of sea lamprey *Petromyzon marinus*, white sucker *Catostomus commersoni*, and rock bass *Ambloplites rupestris* in five study streams on the north-shore of Lake Ontario, Canada in two translocation experiments where fishes were marked using Passive Integrated Transponder (PIT) tags. Three of the study streams have dedicated low-head sea lamprey barriers and two streams have perched culverts with no fish bypass. In the first experiment, tagged, naïve sea lamprey were translocated from outside of the study area and randomly released in equal numbers close to the mouths of the five study streams. As a reference sample, sea lamprey

caught within the streams were also tagged and released within their stream of capture. In the second experiment, one subsample of fishes netted in the study streams was tagged and translocated to a randomly assigned study stream, while another subsample was released in the stream of capture as a reference. Movements of translocated and reference fishes from both experiments were monitored using stationary PIT tag-detecting arrays placed at two locations within each stream. Frequencies of inter-stream movements for translocated and reference groups were then compared. Within a reproductive season, translocated sea lamprey exhibited greater inter-stream movement than sea lamprey caught in our study streams. Translocated and reference groups of white suckers and rock bass exhibited little inter-stream movement. Among reproductive seasons, 68% of translocated white suckers and rock bass returned to their initial stream of capture, demonstrating a high degree of reproductive homing. The propensity for fishes to move between streams has important implications for fisheries management and conservation.

0223 Fish Conservation, Drummond, Sunday July 27, 2008

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

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Planktonic larval dispersal is of critical importance in the ecology, evolution and management of marine fish populations. However, little is known about the scale and pattern of larval dispersal for most marine fishes. A major obstacle to progress has been the impracticability of surveying distributions of larval fish species in planktonic communities. Identification by microscopy is labor intensive, often inaccurate and in many cases larvae can only be identified to family level. DNA barcoding is a novel method for taxonomic identification of organisms based entirely on the 5' portion of the mitochondrial gene, cytochrome oxidase subunit I (COI-5). Gobiidae is the most diverse family of marine fishes, with more than 30 genera and approximately 125 species described for the Western Atlantic region. We surveyed the distribution of larval gobies in plankton samples from the Bocas del Toro Archipelago, Republic of Panama, using DNA barcoding to identify individual larvae. Over half of the larvae were identified to at least genus level using this technique. Our study adds four additional species to the 11 previously reported as adults for this archipelago. Larvae of *Coryphopterus eidolon*, which had not previously been reported from this region, were collected along with three yet unmatched species. Our results suggest a strong correlation between species composition in larval assemblages and habitats associated with adult populations, including spawning and recruitment sites. Strong onshore winds are the likely reason for increased fish larval density and biomass recorded in shallow nearshore waters during the dry season. Goby larvae aggregations mostly occurred close to adult benthic habitats suggesting nearshore larval retention. Overall, our results demonstrate the practicability and accuracy of DNA barcoding in the identification of early developmental stages of fishes.

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

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

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

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

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

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The Rio Grande chub (*Gila pandora*) is endemic to the Rio Grande and Pecos River in southern Colorado and New Mexico, and has a limited distribution with a disjunct population in the Davis Mountains of Texas. This species is severely impacted by stream diversion, habitat degradation, fragmentation, and introduced nonnative fishes. To more fully understand ramifications of these processes, genetic diversity was assessed in populations of *Gila pandora* in the upper Rio Grande drainage of CO and NM. Results revealed shallow genetic diversity in *G. pandora*. Sequence data from four mtDNA regions were analyzed across 237 specimens and consisted of partial sequence of ATPase 8/6 and ND2 genes [671 and 656 base pairs (bp), respectively, and 694 bp of the D-loop region (all sequences from 5' end)]. While numerous haplotypes are distributed within and among populations, the divergence amongst these is relatively low (i.e., caused by differences at but a few basepairs only). However, on average, 70% of haplotypes found in a given population are

unique to it. Pair-wise comparisons show significant differences between populations. Genetic diversity is distributed mostly within and among populations, and shows only minor divergence among drainages. From a conservation standpoint, *G. pandora* should be managed solely by population, for populations-within-rivers and individuals-within-populations are significantly differentiated, whereas drainages are not.

0233 AES Student Papers I, Kafka/LeMaratine, Thursday July 24, 2008; GRUBER

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

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

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

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

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

dimensional scaling and ANOSIM routines. Consequences for region specific differences in trophic transfer and management issues are discussed.

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

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

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

0078 Poster Session III, Sunday July 27, 2008

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

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Aging of American shad by the Cating method, which uses scales, was developed for the Hudson River population of shad and validated for the Connecticut River population of shad. However, scales of American shad are difficult to read, and a

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

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

Using Trees to Save Sharks and Rays

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

0730 Poster Session I, Friday July 25, 2008

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

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The aim of this study was to describe the epithelial morphology of gills in potamotrygonid species. The Na⁺/K⁺-ATPase-rich cells are numerous on the filament epithelium, but they may also appear relatively abundant on the lamellae of the gills of *Potamotrygon schroederi*. In addition, a multicellular complex of chloride cells is usually found on the afferent edge of the gill filament of *Potamotrygon* sp. (a

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

0425 Poster Session I, Friday July 25, 2008

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

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

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

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

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Encroachment from invasive non-native species can change habitats, thus contributing to global amphibian declines. Leachates from invasive plants can add

metabolites (tannins) or toxins (phenolics) from decomposing leaf litter to aquatic systems and thereby potentially impact the development and fitness of larval amphibians. Amur honeysuckle (*Lonicera maackii*) is an invasive shrub that dominates many of the edge habitats of the eastern United States and is the predominant woody vegetation along many streams and ponds. Wood frogs (*Lithobates sylvaticus*) range throughout this area, and are one of the first to breed in the spring. If plant chemicals leached from *L. maackii* leaves do affect frog tadpoles, then *L. sylvaticus* larvae would be very susceptible due to their temporal proximity to when autumn leaf fall entered the water. We tested the hypothesis of invasive plant chemical impact on tadpole development in *L. sylvaticus* by examining tadpole digestive efficiency and metamorph fitness (performance & energetic) of larvae raised under varying concentrations in leaf "teas" from three sources: 1) the invasive Amur honeysuckle (*L. maackii*), 2) natural mixed hardwood leaf-litter, and 3) a pure water control. Our results suggest reduced digestive efficiencies, time to metamorphosis, and fitness performance of metamorphs in frogs raised in invasive plant leaf teas compared to natural leaf teas or a water control. Tannin uptake may disrupt tadpole digestion, thereby reducing absorption of nutrients, leading to slower growth rates and decreased fitness of metamorphs. We found that frogs raised in higher concentrations of *L. maackii* teas had significantly lower fitness than frogs raised in mixed hardwood teas or the water control. This indicates that the degradation of leaves from invasive plants, by changing water chemistry in ponds and streams, may reduce survival rates of developing amphibian larvae, thereby contributing in yet another way to the global decline of amphibians.

0104 Poster Session III, Sunday July 27, 2008

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

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

Loricariichthys brunneus, *Hypostomus plecostomoides*, *Plagioscion cassattii* and *Triportheus venezuelensis*.

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

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

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

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

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

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

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

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

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

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

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

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

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Species that exhibit alternate life history modes present a unique conservation case, because populations of each life history mode may have different habitat requirements and may be vulnerable to different environmental perturbations. Furthermore, population genetic assessments are necessary to maximize the conservation of intraspecific genetic diversity. The Oklahoma salamander, *Eurycea tynnerensis*, is endemic to the Ozark Plateau and is listed as a "Species of Special Concern" by the state of Oklahoma. This species has two discrete adult life history

strategies (paedomorphic and metamorphic). However, these alternate life history modes were previously considered separate species and conservation efforts focused only on the paedomorphic life history mode. I performed population genetic analyses of aquatic and terrestrial populations of *E. tynnerensis* from across their distribution using both mitochondrial and nuclear loci. I collected sequences of the ~1100 base pairs of the mitochondrial gene *cytochrome b* and the ~500 base pairs of the independent nuclear gene *proopiomelanocortin*. This data is used to examine the geographic distribution of genetic diversity and then integrated with patterns of life history variation to effectively develop conservation strategies for this species.

0604 Poster Session III, Sunday July 27, 2008

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

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Grasslands, shrublands, pastures and hayfields are important habitats for turtles, particularly the wood turtle (*Glyptemys insculpta*) and eastern box turtle (*Terrapene carolina*). Therefore, maintenance of these habitat types is essential, often requiring periodic mowing, though other methods of control are possible (e.g. prescribed burns, grazing). Mowing during the spring and summer months can also cause significant annual mortality; in several western Massachusetts populations of wood turtles mortality may be as high as 10%. Similarly, research in Quebec and Massachusetts found that in rural areas, adult mortality due to mowing is much higher than the mortality due to automobiles. We performed experiments with non-living surrogates to determine if mortality risks vary among different types of machinery, and to determine the mower blade height required to minimize the likelihood of killing or injuring turtles. We found a difference in mortality risk between mowing equipment at a 4" blade height; with 100% mortality due to flail mowers, 50% from brush hog rotary mowers, and 0% percent from sicklebar mowers (these results excluded the effects of tractor type, which is also likely to be significant). Our study also showed that blade heights of 6" or more decreased the mortality risk to turtles from 53% to 5%. Based on our results we developed a set of mowing guidelines. These guidelines provide a suite of options, each of which is predicted to reduce turtle mortality. We recognize that all options will not be appropriate for every circumstance and that land managers may need to modify these guidelines to accommodate the needs of other species as well. Things to consider include: mowing rotation, percent of area mowed, timing, mower style, blade height, directionality, and mower speed. In all situations, the most conservative option is to avoid using heavy machinery in early successional habitats from May 15-September 15.

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

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

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

0335 Poster Session I, Friday July 25, 2008

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

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

0588 Poster Session I, Friday July 25, 2008

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

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A longline and rod-and-reel survey for elasmobranchs was conducted in Port Royal Sound, a south-eastern South Carolina deep water embayment, from June – August 2007. This long-term project has four main objectives: (1) to determine which species of elasmobranchs are utilizing Port Royal Sound as habitat, (2) to determine if species partition themselves spatially, temporally, by sex and/or size, (3) to determine if Port Royal Sound is a nursery ground for elasmobranchs, and (4) to determine if species assemblages are unique by comparing results with previous studies in South Carolina. Three generalized areas were sampled regularly along with episodic wild card sites. Twenty adult lines (16/0 hooks) and twenty pup lines (12/0 hooks), baited with Boston mackerel were bottom-set concurrently during slack tides throughout the summer. Elasmobranchs were identified, measured, tagged (only sharks) and released. We caught 174 elasmobranchs ($n = 61$ on long-lines, 113 on rod-and-reel) comprising ten species: *Rhizoprionodon terranovae* ($n = 129$), *Carcharhinus limbatus* (17), *Dasyatis sabina* (12), *C. acronotus* (4), *C. plumbeus* (4), *D. americana* (3), *C. isodon* (2), *Galeocerdo cuvier* (1), *Sphyrna lewini* (1), and *S. tiburo* (1). Most individuals captured were young-of-year or immature. Catch per unit effort (CPUE, #sharks/100 hooks⁻¹ h⁻¹) for adult and pup lines was 2.7 ± 0.63 ($x \pm SE$) and 12.1 ± 1.83 ($x \pm SE$), respectively, for all areas. Port Royal Sound or nearby areas may represent Essential Fish Habitat for a number of species of sharks and rays. Next sampling season we are expanding the effort and we will investigate habitat partitioning. This is the first large-scale comprehensive survey for elasmobranchs in Port Royal Sound.

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

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

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

0601 Poster Session I, Friday July 25, 2008

Elasmobranch Fisheries off Northeastern Brazil, Western Equatorial Atlantic

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The conservation status of elasmobranchs is of worldwide concern since examples of rapid population declines caused by fisheries pressure have become commonplace. In Northeastern Brazil, interest in elasmobranch products has grown in the recent years, due to the increased value of shark fins and batoid sub-products. The goal of the present study was to provide preliminary data on both the identity and the quantity of elasmobranchs captured off Northeastern Brazil. Captures were recorded during industrial and small-scale fisheries landings in Fortaleza, CE. The industrial fisheries employing longlines ranged from 25 to 168 m in depth on the continental slope off Northeastern Brazil (1°00'S, 9°00'S). Twenty-one landings were monitored between November 2004 and November 2006. Overall, 1873 dressed shark carcasses were landed, including *Carcharhinus* spp. (n=661), *Ginglymostoma cirratum* (n=582), and *Carcharhinus acronotus* (n=445). 674 batoid carcasses were landed, primarily *Dasyatis* spp. (n=656). Small-scale fisheries, employing hook and line, and gillnets ranged from 10 to 100 m in depth on the continental shelf off Ceará State coast (03°23'S, 38°05'W; 03°25'S, 038°48'W). Landings were monitored weekly from September 2006 to March 2008. A total of 795 sharks were landed, including *Rhizoprionodon* spp. (n=427), *Ginglymostoma cirratum* (n=124), and *C. limbatus* (n=95). 1227 batoids were recorded, including *Dasyatis americana* (n=1073), and *D. guttata* (n=115). Results will be presented and discussed in light of shark fisheries monitoring and management.

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

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

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Genetic diversity is essential for organisms to evolve to changes in their environment. Although geologically relatively stable, southeastern Australia has experienced significant changes in landscape and climate conditions to which species have evolved. For freshwater taxa, variable hydrological regimes and habitat availability have been very strong determinants of current species distribution and population structure. We have conducted a range wide phylogeographical study of Macquarie Perch, *Macquaria australasica*, in order to understand the relationship between landscape and freshwater fish evolution in southeastern Australia, and to assess the levels of genetic diversity and divergence in this endangered species. We found 46 mtDNA control region haplotypes from 35 sampling locations with up to 6% sequence divergence between lineages. Phylogenetic reconstruction indicates that the species originated on the coast, east of the Great Dividing Range (GDR) and subsequently colonised inland to the Murray-Darling Basin (MDB), west of the GDR.

Mismatch analysis suggests that this colonisation may have been followed by demographic expansion of the population approximately 536kya. Nested clade and IM analyses also support a series of range expansions and fragmentations across the species range during the Pleistocene. We conclude that the unexpected high levels of diversity and divergence observed in *M. australasica* may be due to the interacting factors of habitat specificity, localised recruitment and Pleistocene climate fluctuations. The comprehensive phylogeographical approach used here has given valuable insight into the aspects of *M. australasica*'s biology and its interactions with the environment that may be critical to its conservation management.

0061 Poster Session III, Sunday July 27, 2008

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

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

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

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

Jeremy Feinberg

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The southern leopard frog (*Rana sphenoccephala*), once considered one of the most abundant frogs in coastal portions of New York State, has suffered drastic declines over the past several decades. Leopard frogs are now exceedingly rare if not completely extirpated from Long Island and the rest of the surrounding New York State coastal region, aside from one tenuous population on Staten Island. Their disappearance has occurred across a variety of landscapes and habitats ranging from areas of heavy development to pristine, well-protected natural areas. This study seeks to elucidate decline factors and identify primary threats, develop conservation

strategies, and prevent similar future extirpations of this species from the few known surviving populations elsewhere in the state. My research is testing and evaluating four potential negative threats associated with environmental perturbation and anthropogenic influence including: disease, invasive vegetation, contaminants, and overwhelming interspecific competition from two closely related frog species. I am collecting data *in situ* by raising leopard frog tadpoles in enclosures within historic Long Island wetland sites where this species is now extirpated. By using leopard frog tadpoles from nearby extant populations as bio-indicators, I am monitoring development and survival under various conditions and treatments with the goal of isolating specific causes and trends to help explain this decline and aid in future biodiversity conservation efforts.

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

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

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

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

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

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Holocephalans possess a fused upper jaw and a non-suspensory hyoid. They are commonly considered to be durophagous fishes, but there is evidence that they may

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

0411 Poster Session III, Sunday July 27, 2008

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

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Piscivory has evolved independently hundreds of times among aquatic-feeding vertebrates. Evolution of this foraging behavior is typically accompanied by convergent evolution of long-snouted, heavily-toothed jaws used for capturing fish. A few examples of vertebrates that possess this morphology include: ichthyosaurs (Sauropsida; Ichthyosauria), plesiosaurs (Sauropsida; Plesiosauria), crocodylians (Sauropsida; Crocodylia), ichthyorniform birds (Class Aves; Order Ichthyornithiformes), dolphins (Mammalia; Cetacea), gar (Osteichthyes; Lepisosteiformes), and pike (Osteichthyes; Esociformes). In these vertebrate lineages, an upper jaw that is fused to the neurocranium is used as a fixed element upon which force from the lower jaw is applied when trapping prey species between sharp, triangular teeth. Therefore, when closing, every one of these jaws could be considered to be a single class three lever. To our knowledge there is only one exception to this bauplan for piscivory: *Belonesox belizanus*, the "pike killifish." At first glance, this species shows gross morphological convergence with other piscivores in its elongate snout and tooth morphology. However, using high-speed

video-imaging, we observed a novel aspect of the anterior jaws: *B. belizanus* retain a mobile premaxilla that rotates anteriorly and dorsally during mouth opening. Thus, during mouth closing, the jaws of *B. belizanus* function like a pair of toothed 'tongs,' where two class-three levers are combined to simultaneously apply force to the prey item. We posit that this unusual morphology reflects the evolutionary history of the cyprinodontiform fishes, which, as a group, typically possess jaws that are modified for picking-based modes of prey capture.

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

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

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

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

Endemic Genera in the Family Rajidae

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

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

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

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Vomeronasal chemoreception, an important chemical sense in squamate reptiles, is mediated by paired vomeronasal organs (VNOs), which are only accessible via ducts opening through the palate into the oral cavity. Three biomechanical stages can be recognized for vomeronasal chemoreception: *sampling*, via tongue-flicking; *stage I delivery*, where the chemical-laden fluids are delivered to the VNO fenestrae in the palate; and *stage II delivery*, the movement of the fluid through the fenestrae into the lumina of the VNOs. In this study we conducted a comparative analysis of oral morphology in snakes and lizards to examine the mechanism of stage I delivery. We found that the foretongue lies within a chamber (or chambers if the tongue is deeply forked) formed primarily by the sublingual plicae ventrally, and the palate dorsally. There is little or no space around the foretongue (or tines of the tongue) when the

mouth is closed. We propose a hydraulic mechanism for stage I chemical transport in squamates: when the mouth is closed, the compliant tongue is compressed within the chamber(s) and the floor of the mouth is elevated, expressing fluid from the sublingual glands within the plicae. Chemical-laden fluid covering the tongue tip(s) is forced dorsally and posteriorly toward the VNO fenestrae. In effect, the tongue and floor of the mouth act as a piston, pressurizing the fluid surrounding the foretongue so that chemical transport to the VNO ducts is effected almost instantly. This is contrary to a previous hypothesis that posited that the sublingual plicae act as direct conveyors of chemicals to the VNOs. Importantly, our hypothesized mechanism works regardless of tongue form (which is highly variable in squamates), and it meets the important requirement that in species with deeply forked tongues the chemicals sampled by each tine remain separate throughout delivery – thus allowing for tropotaxis.

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

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

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

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

Morphological and Functional Investigation of the Radialis Muscle in Shark Tails

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The swimming kinematics and hydrodynamics of heterocercal tails in elasmobranchs have been the focus of a number of recent studies. However, the locomotor functions of the internal morphological structures of the heterocercal tail remain unexplored. In this study we examine the morphology and function of the radial muscle, or radialis, during swimming in the spiny dogfish *Squalus acanthias*. The radialis consists entirely of red muscle fibers and is located ventral to the segmented axial myomeres in the most distal region of the caudal fin, originating on the ventral processes of the vertebral column and inserting along the horizontal septum. The muscle fibers of the radialis share a similar fiber orientation and lie in close association with the deepest layer of the subdermal connective tissue sheets. We combined bilateral electromyography of the radialis with simultaneous video to determine the point of activation of the radialis within the tailbeat cycle. Our results indicate that the radialis is active immediately after maximum lateral excursion of the caudal fin to the ipsilateral side. We also find that the activity patterns of the radialis on the right and left side of the body are approximately 180 degrees out of phase. Morphology and motor patterns of the radialis suggest that this muscle is acting as postural reinforcement, and controlling the orientation of the dorsal lobe of the caudal fin during steady swimming.

0627 Poster Session III, Sunday July 27, 2008

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

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

these three clades; however, the three lineages were highly diverged and well supported, with Cypress Creek and Buffalo River clades differing by 3.9% sequence divergence and Flint River individuals differing from the Cypress/ Buffalo clade by 8.5% divergence. These results suggest that *E. boschungii* has been historically isolated among different drainages examined thus far. Samples from Shoal and Swan creeks are needed to further explain diversity within this species.

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

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

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

0419 General Ichthyology III, Drummond, Sunday July 27, 2008

Phylogenetic Relationships within the Subgenus *Fuscatelum* (Percidae: *Etheostoma*) based on Mitochondrial DNA sequences

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The subgenus *Fuscatelum* of *Etheostoma* (Percidae) contains two species, the Goldstripe Darter, *Etheostoma parvipinne*, and the Rush Darter, *E. phytophilum*. The Goldstripe Darter is wide-ranging across the Coastal Plain from the Colorado River drainage in Texas east to the Altamaha River in Georgia and north into southern Missouri and Kentucky. The Rush Darter is a candidate species for federal listing and is restricted to two disjunct populations in the Black Warrior River drainage (Mobile Basin) above the Fall Line in north-central Alabama, including Clear Creek

in the Sipsey Fork system in Winston County and Turkey and Little Cove creeks in the Locust Fork system in Jefferson and Etowah counties. Scale or fin-ray counts and male breeding pigmentation vary across populations for both species, yet little is known about molecular variation within and among members of this small subgenus. A molecular phylogeny based on complete mitochondrial cytochrome-*b* and control region sequences revealed a monophyletic *Fuscatelum*, however, neither species was recovered as monophyletic. Western populations of *E. parvipinne* were basal within the subgenus. Samples of *E. parvipinne* from the Black Warrior River near the Fall Line were sister to *E. phytophilum* from the Sipsey Fork; Locust Fork specimens of *E. phytophilum* were resolved within a separate clade. Within the Locust Fork clade of *E. phytophilum*, the single specimen from Cove Spring was basal to a well supported clade of Turkey Creek samples. These results reveal two uniquely diverged lineages of *E. phytophilum* with further genetic differentiation among Locust Fork populations, all of which mirror differences in underlying physiographic provinces between populations. The distinctiveness of these three populations of *E. phytophilum* will affect future conservation and management strategies for this imperiled species.

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

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

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

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

Life History Traits of Cottonmouths (*Agkistrodon piscivorus*)

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It is important to understand the factors influencing adult body size, growth, age at first reproduction and reproductive traits because these characteristics affect distribution and abundance of species. General studies that include considerable data for life history traits of cottonmouths have been conducted in Southwest Missouri, Northeast Texas, Northwest Arkansas, Virginia, North Carolina and Florida. Growth rates are faster in juveniles than adults and females stop growing sooner than males. Males grow larger than females in all areas but the eastern subspecies reach larger adult body sizes and take longer to mature than the western

form. Age at first reproduction is 3 years or longer for all populations. Reproductive frequency is variable and appears to be consistent with a capital breeding strategy; females in some populations can reproduce in consecutive years but most take two or more to gain enough energy. Mean litter size varies by population but is greatest in the southeast (5.5 to 7.7) and lowest in northwest Arkansas (4.1). For most populations litter size is correlated with maternal SVL. Neonate length and mass are variable and often negatively correlated to litter size but also increase with maternal body size. Energy input is likely to be the factor producing the variation in life-history traits within and between populations.

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

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

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

0299 Poster Session II, Saturday July 26, 2008

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

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Atlantic cod, *Gadus morhua*, is one of the most commercially important species in New England waters. Despite their importance, little is known about their stress physiology. As with most fisheries, some captured cod are subsequently discarded because of their small size or because quotas are exceeded. The fate of these discarded fish is not well understood. Understanding the amount of trauma endured during capture and the ultimate fate of these fish becomes important to fisheries regulators when assessing fishing mortality and its impact on stock sizes. In a pilot study designed to assess stress physiology, wild caught cod were kept in flow

through seawater tanks are the University of New Hampshire's Coastal Marine Lab (New Castle, NH). Blood samples, taken to measure plasma cortisol levels, were obtained in two different ways to compare the stress induced by each sampling method. In one method, fish were captured from the tank, anesthetized, and blood samples were taken by syringe from the caudal vein. This occurred 3 times per week. In the second method, fish were cannulated by surgically inserting a piece of PE-50 tubing into the second afferent branchial artery, and were sampled once daily for a week. Plasma cortisol levels were analyzed by radioimmunoassay and compared statically using an ANOVA and a Tukey's test. It was hypothesized that plasma cortisol levels in the undisturbed, cannulated fish would be lower than those in the disturbed fish, and their plasma cortisol levels would better reflect baseline levels. Cortisol levels and cortisol profiles for each of the blood sampling methods will be reported.

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

Revisiting The Territorial Imperative: The *Desmognathus* Paradox!

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The Mountain Dusky Salamander (*Desmognathus ochrophaeus*) is reported to exhibit territorial behavior. We conducted experiments to determine whether adult salamanders exhibit prior residence during encounters with equally sized conspecifics (*i.e.*, does familiarity with a territory predict successful defense). We collected 154 adult salamanders (72 females, 82 males) from the Allegheny Mountains of western Maryland, USA and divided them into pairs matched by size and gender. Salamanders were housed and tested in a climate controlled room (16±2°C; 15L:9D photoperiod) and fed fruit flies twice weekly. Prior to testing, we placed 'resident' salamanders in individual bioassay trays (12.5 x 12.5 cm) on a substrate of moistened filter paper for one week, and allowed them to establish territories. At the beginning of a trial, we added an 'intruder' to the dish and monitored the behavior of both salamanders for 20 minutes under dim red light. Two weeks after the first trial, we performed a reciprocal trial, with the previous intruder becoming resident. We catalogued a suite of agonistic behaviors including: fore-trunk raised (FTR), all trunk raised (ATR), nudge, bite, multiple bite and jaw lock. We calculated an index of aggression (IA) for each animal as a resident and intruder. Our data reveal that males are significantly more aggressive than females (mean combined IA for 41 pairs of males during the first round =16.0; 36 pairs of females=7.1; $W=1205$, $p \leq 0.043$), but resident salamanders (regardless of their sex) are not significantly more aggressive than intruders. Salamanders of both sexes displayed significantly less aggression during their second trial (perhaps due to familiarity) and when the data were pooled across sexes this decrease was significant ($p \leq 0.037$). Although *D. ochrophaeus* exhibit stereotypic, agonistic behaviors similar to those reported for *Plethodon*, unlike *Plethodon* the outcomes of symmetrical social encounters are not influenced by residential status.

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

Foraging Site Selection in Prairie Kingsnakes: An Experimental Examination

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

0593 Fish Conservation, Drummond, Sunday July 27, 2008

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

Susan Foster, John Baker, Rachel Chock, Matthew Wund

Clark University, Worcester, MA, United States

The adaptive radiation of the threespine stickleback, *Gasterosteus aculeatus*, is unusual in that modern oceanic stickleback are thought to closely resemble the oceanic populations that gave rise to the post-glacial radiation in coastal freshwater habitats. Thus, we can use modern oceanic fish to infer ancestral character states with unusual assurance, and can use them to infer character polarity in the radiation. This allows us to address a wide range of evolutionary issues in ways rarely possible in the vertebrates- potential that is further enhanced by genome sequencing and development of an array of molecular tools that permit evaluation of the genomic causes of diversification and parallelism in this remarkable radiation. The value of this radiation for exploration of the causes of evolutionary diversification depends on the continued existence of both oceanic and unusual, derived freshwater populations. In some cases, extreme populations and even species pairs have been lost to extinction. In other cases however, the loss has been more cryptic, involving hybridization or microevolutionary loss of some extreme phenotypes. In the latter cases, the unusual phenotypes are lost through evolutionary reversion to ancestral types, or to types more typical in the region. We argue that anthropogenic change tends to homogenize environments, and that it is causing a cryptic reduction in

population diversity in the radiation. Because this loss of biodiversity occurs without extinction it can easily proceed unnoticed. We conclude by arguing that such cryptic decline in diversity poses a tremendous threat to this radiation – and that it will be very difficult to curtail given the general abundance of threespine stickleback throughout its range.

0290 Fish Conservation, Drummond, Sunday July 27, 2008

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

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

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

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

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Understanding the reproductive behavior of secretive species is an important aspect when conducting studies for conservation and management. In order to make decisions related to management it is beneficial to know the proportion of individuals contributing to the gene pool, as well as the patterns of dispersal. The sand skink, *Plestiodon reynoldsi*, is a fossorial lizard, currently listed as threatened throughout its range along the scrub habitat of the central ridges in Florida. Genetic differentiation has been found among distinct geographic samples across the range of the sand skink, but there is information lacking regarding its mating system and fine-scale dispersal patterns. The goal of this study is to investigate parentage,

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

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

Distribution and Assemblages of New Zealand Demersal Chondrichthyans

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

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

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

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The eastern Bering Sea is an area of high skate abundance and diversity. Relative to their abundance, however, little is known about the basic life history traits for most of the skate species living there. Researchers from the Pacific Shark Research Center

at Moss Landing Marine Laboratories are continuing their efforts to collect, analyze, and synthesize important life history information, including age, growth, and reproduction, of various chondrichthyans and other fishes, to be used for fisheries management. The four species in the current study include the commander skate, *Bathyraja lindbergi*, whiteblotched skate, *Bathyraja maculata*, whitebrow skate, *Bathyraja minispinosa*, and mud skate, *Rhinoraja taranetzi*. Samples have been, and will continue to be, collected during NOAA Fisheries survey cruises in the eastern Bering Sea and through the observer program. At this time, more than 230 *B. lindbergi*, 170 *B. maculata*, 215 *B. minispinosa* and 145 *R. taranetzi* have been collected. Vertebrae, caudal thorns, and reproductive organs from each species will be used to estimate age and maturity. Preliminary estimates of total length at 50% maturity are: *B. lindbergi* females 77.9 cm and 84.2 cm for males, *B. maculata* females 96.0 cm and 98.0 cm for males, *B. minispinosa* females 66.38 cm and 68.85 cm for males, and *R. taranetzi* females 61.4 cm and 57.9 cm for males.

0057 Fish Physiology, Salon 6&7, Sunday July 27, 2008

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

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

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

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

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

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

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

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The subfamily Chiloglanidinae of the Mochokidae contains more than 60 nominal species widely distributed in African river systems. Members of this subfamily are readily distinguished from other African catfishes by distinctive jaws and lips modified into a sucker or oral disc used for adhering to and feeding upon objects in fast flowing waters. The overall body form of chiloglanidins is remarkably convergent with similar morphologies that have evolved independently in some Neotropical catfishes (Astroblepidae and Loricariidae) and some Asian catfishes (Subtribe Glyptosternina of the Sisoridae). As currently recognized, this clade contains just 3 genera, *Chiloglanis*, *Atopochilus*, and *Euchilichthys*. Recent fieldwork for the All Catfish Species Inventory along with a review of museum collections has

revealed a much higher level of morphological and taxonomic diversity than was previously known. Preliminary results of our ongoing systematic study of this clade will be presented. This will include rediagnoses of genera, the synonymization, resurrection, and reassignment of some species, and the descriptions of new taxa.

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

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

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

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

The Effect of Hypoxia on Habitat Selection of Juvenile Estuarine Fishes

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Hypoxic events where dissolved oxygen concentrations fall below 2 mg/l are becoming a wide-ranging phenomenon. However, there has been little research on the impact of hypoxia on habitat selection of juvenile fishes. We designed a series of mesocosm experiments to assess the relative influence of hypoxia and seagrass on

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

0148 Poster Session I, Friday July 25, 2008

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

Jinzhong Fu

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

0707 Poster Session III, Sunday July 27, 2008

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

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The present work carried in Bahía de Banderas south coast of the State of Nayarit, between Cabo Corrientes and Punta Mita during the construction of Marina La Cruz. The objective was to describe the composition of the marine fish for fishing system select the localities for fisheries. The commercial capture was studied in March of 2007, time considered as transition of ENSO-NEUTRAL to conditions The Niña and in March of 2008, time with more intense conditions of The Niña, and with the lowest TSM for the last 14 years. It was also studied the month of November of the 2007, considered transition to coldseason and when presented moderate intensity of conditions The Niña, period when *Lutjanus peru* prevailed (huachinango) and other species of the genus (pargos), captured together with *Nematistius pectoralis*, (rooster), *Scarus perrico*, (parakeet), *Euthynnus affinis* (tuna) and a group of 19 more species. The proportion varies between 50 and 65% of the goal species against associate. The

goal species objective in March 2008 was *Scomberomorus sierra* (sierra), and other eight species of high commercial value: *Paralichthys aestivalis*, *Ancylorsetta dendritica* and *Citarichthys gilberti* (soles), *Seriola peruviana* (pirriri), *Caulolatilus affinis* (conejo), *Hoplopagrus guentheri* (coconaco), *Lutjanus guttatus* (lunarejo) and *L. argentiventris* (yellow grunt), with a net meshes of a net of 3", then an average proportion of 60% (objective) 40% (associate). In these last ones the group of Carangidae, Haemulidae, Sciaenidae, Callyonimidae, Gerreidae, Mullidae, Triglidae, Polynemidae and Stromateidae, among other families, being on the whole 35 species.

0470 Poster Session III, Sunday July 27, 2008

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

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

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

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

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Painted turtles are captured in large numbers in Minnesota for the pet and biological supply trades. I will describe the scope and management of this harvest and its implications on painted turtle populations. I conducted fieldwork, using trapping methods comparable to those used by commercial harvesters, to approximate the

proportion of a painted turtle population “harvested” given varying amounts of effort. Incorporation of this effort data into an age-structured matrix model, using previously published population parameters, suggests there is the potential of long-term impact of commercial harvest on painted turtle populations. Minimal harvester effort can result in population declines in the model although increasing the time between harvest events allowed a larger portion of the population to be sustainably removed. Even allowing for infrequent harvest events, the typical range of harvester effort was enough to initiate population decline. I discuss how violations of modal assumptions may buffer the actual impact of commercial harvest in the field.

0376 Poster Session I, Friday July 25, 2008

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

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

0708 Poster Session I, Friday July 25, 2008

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

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The Mexican tetra, *Astyanax mexicanus* is successful species with high capacity to dispersion and adaptation to different habitats, including aquifers. Along its range this species have two morph-types; a normal epigeal and other ones hypogean blind and without pigmentation habiting aquifers in Northwestern of Mexico. The morphological monotony a long its range had raised confusion on specie's taxonomic status; however it is possible there is cryptic species. We are interested to know the genetic structure along the most part of its range along Mexican Atlantic slope and contribute to knowledge of life historic traits of blind morph is habiting on three caves of Northwestern Mexico. Here we are present the polymorphism of two microsatellite loci (Ast-01 y Ats-09) on seven epigeal populations of *Astyanax mexicanus* form Coahuila (COA), Tamaulipas (TAM), San Luis Potosí (SLP) y Veracruz (VER). We studied a total of 203 individuals. The polymorphism observed was moderated; nine alleles were detected on Ast-01 and eight in Ast-09; average

observed heterocigosity was of 0.79. We found a genetic differentiation ($F_{st} = 0.18$, $P = 0.001$) and an isolation by distance structure. We found three different groupings; Northern ones and very different (Cuatrociénegas, COA); other intermediate ones (San Fernando y Soto la Marina, TAM) and finally a southern ones (Pánuco SLP and Tuxpan, VER). Also we are presenting biological data (length and weight relationship, sex ratio, sexual maturation and food consuming) of 650 individuals studied from the caves Pachón, Sabinos y Tinajas.

0696 Fish Conservation, Drummond, Sunday July 27, 2008

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

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

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

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

Tom Geerinckx¹, Dominique Adriaens¹, Anthony Herrel²

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

The neotropical loricariid catfishes use their sucker mouth not just for respiration and feeding, they also use it to stay attached to the substrate, be it a rock or a submerged tree in a South American river, or an aquarium wall in the Ghent University. This represents a very useful and amazingly evolved ability, especially for those species living in fast flowing rivers. Following a morphological study of the armored suckermouth catfish *Pterygoplichthys disjunctivus* and several other loricariid species, to examine those internal structures involved in the mouth and head movements, a kinematic analysis of the focal species was done to establish which how the mobile parts are engaged in the respiratory processes during

breathing free from any substrate, touching the substrate and powerfully adhering to the substrate. High speed video recordings of external and internal structures (using X-ray equipment) of several specimens were analysed to determine how respiration is adjusted or constrained during weak or powerful suction onto substrates. Apart from a close adhesion of the suction disc, the respiration rhythm is strongly affected: hyoid movements vary, the lateral inspiration openings (operated by the modified maxillary barbel) are minimized or only unilaterally used, and the gill openings stay closed as much as possible to maintain underpressure. The role of the oral valve or velum, unique in being muscularly controlled in these fishes, becomes critical. It appears that the functions of breathing and adhering can be combined in all but most extreme situations, in which suction fails, due to either muscle tiredness or impaired respiration.

0344 Poster Session III, Sunday July 27, 2008

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

Tom Geerinckx¹, Anthony Herrel², Dominique Adriaens¹

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

Loricariidae or suckermouth armored catfishes possess upper and lower jaws that are ventrally oriented, and bear teeth that touch the substrate from which algae and other food items are scraped. The ventral orientation and the highly specialised morphology of the jaws, characterised by protrusible upper jaws and left-right decoupled lower jaws are observed in *Pterygoplichthys disjunctivus*. Kinematic data of the scraping feeding movements, obtained by external high-speed and X-ray recordings are used to test the hypothesis that the decoupling of the jaws has led to increased functional mobility and versatility. Results show that the mobility of the jaws is indeed high. The upper jaws are able to perform a substantial degree of protrusion, unique for catfishes. The ventromedially oriented lower jaws with the teeth and the coronoid process at opposite sides of the jaw bones, display an even larger mobility: they rotate around the suspensorial articulation and around their longitudinal axis, resulting in an extended scraping movement thereby covering a large surface area. The lower jaws also show a left-right asymmetry in their movements during scraping. These results suggest that the extreme morphological specialisations of the jaws in loricariid catfishes have indeed resulted in increased mobility and functional versatility, allowing these animals to efficiently scrape algae off the substrates with irregular surfaces.

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

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

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The Pearl River is a diverse Gulf Coastal drainage in Mississippi and Louisiana. Approximately 119 species of freshwater fishes occur in the basin. Multiple

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

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

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

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

0750 Poster Session I, Friday July 25, 2008

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

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

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

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

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I measured the activities of 13 digestive enzymes in the guts of four species of loricariid catfishes representing xylophagy (wood-eating) and detritivory. Enzyme activities were measured from the hepatopancreas (representing fish enzymes), as well as from pelleted gut contents (representing microbial enzymes), gut fluid (representing fish and microbial enzymes), and rinsed gut wall (also representing fish enzymes) from three regions of the gut in wild-caught *Panaque nocturnus*, *P. panope*, *Hypostomus pyrineusi* (formerly of genus *Cochliodon*), and *Pterygoplichthys disjunctivus*. Cellulolytic and xylanolytic activities were low and largely restricted to the pelleted gut contents of the proximal intestine. β -glucosidase, β -mannosidase,

and chitobiase activities were each found in the pelleted gut contents and in the gut walls of the fish. However, the Michaelis-Menten constants (K_m) of β -glucosidase and chitobiase from the gut walls of the fish were an order of magnitude lower than those of the pelleted gut contents, indicating that the fish more efficiently digest disaccharides than do microbes in the pelleted gut contents. All digestive enzymes decreased in activity moving distally along the intestine. Because the cellulolytic and xylanolytic activities were largely found in the pelleted gut contents of the proximal intestine, this suggests that the sources of these enzymes are microbes ingested with wood and detritus rather than an endosymbiotic community. Transmission electron microscopy has revealed no conglomerations of microbes in any region of the digestive tracts of the four species, and gut transit times for wood are less than four hours. I hypothesize that xylophagous catfishes of the genera *Panaque* and *Hypostomus* represent specialized detritivores among a detritivorous lineage of fish (family Loricariidae), all of which possess similar digestive machinery, and take advantage of decomposition already occurring in their environment.

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

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

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To investigate how evolutionary history affects digestion, we examined gut structure and function in eleven taxa composing sister clades of minnows with different dietary affinities: *Campostoma* are herbivorous whereas *Nocomis* are carnivorous. Additionally, *Nocomis leptocephalus* is carnivorous (Chatahoochee drainage) or herbivorous (Altamaha drainage) depending on collection locale. Thus, we were able to examine the effects of diet and evolutionary history on digestion among the clades and within a single species. The species of *Campostoma* had longer guts, higher amylase and laminarinase activities, and lower chitinase activities than their carnivorous counterparts. This same pattern was observed among the populations of *N. leptocephalus*. Independent contrasts indicate that the evolution of diet and gut function are indeed correlated in these fishes. Trypsin and lipase activities followed no pattern relating to diet or phylogenetic history. Gastrointestinal fermentation, indicated by concentrations of short chain fatty acids, was found in representatives of both clades, and was not necessarily correlated with diet. Overall, the results of this study indicate that a longer gut and high amylase and laminarinase activities are associated with the evolution of herbivory, whereas a shorter gut and higher chitinase activities are associated with an insectivorous diet.

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

Anuran Sex Identification Using Hormone Metabolites in Urine

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

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

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

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

asynchronous pairwise activation during prey processing. In contrast, smooth-hounds used a stereotyped relatively synchronous activation pattern during prey capture and processing. Based on these comprehensive analyses, spiny dogfish are generalist predators that exhibit flexibility to feed on a variety of prey items. Although smooth-hounds did not show the same dietary specialization they do in the wild, the stereotyped behavior and function indicates these sharks are specialist predators. In a natural environment, smooth-hounds are constrained to feed on a specialized resource using morphological, behavioral and functional specializations.

0041 Poster Session II, Saturday July 26, 2008

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

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São Sebastião Channel is a 25-km stretch along the coast of São Paulo (23°41' to 23°54'S and 45°19' to 45°30'W) situated between the continent and an island of the same name. The main goal of this study was to compare the structure, composition, species richness, and fish diversity associated to rocky substrata at the two margins of the channel and at the outer margin of São Sebastião Island, facing the open sea (three regions; ten sites per region; 12 randomly samples per site). The comparisons are based on seasonally replicated quantitative samples using stationary procedures (388 visual censuses). Nine environmental variables were considered, and 210 hours of SCUBA dive efforts were logged; a fish inventory was also conducted. All of this information may be useful as a baseline for future assessments and monitoring in the area that includes the port of São Sebastião, which is also an important dock for petroleum and thus subject to many disturbances. Additional data is being collected in adjacent and more distant sites, such as Alcatrazes Archipelago, Búzios and Vitória islands. The rocky shore fish fauna from the study area consists of about 100 species, belonging to 39 families. The carnivore (62%) and diurnal (73%) fishes were predominant. *Haemulon aurolineatum* and *Abudefduf saxatilis* accounted for 48% of the total number of individuals, illustrating the numerical dominance of just a few species. Even though of no significant differences among the three regions (one-factor ANOVA: $F=0.17$; $p=0.85$), the two margins of the channel were more similar in terms of species composition and taxa overlap, whereas the sites turned to open sea were richer and less impacted. The occurrence and abundance of the studied species were correlated to environmental variables, and the main influential variables were depth, distance from coast, water transparency, and type of bottom substrate.

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

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

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Sand Lances, *Ammodytes* spp., exhibit a peculiar burrowing behavior in which they swim rapidly into the substrate. This genus of small, schooling fishes uses this behavior for hibernation and predator avoidance. While burrowing, sand lances experience a physical transition from water, a relatively inviscid Newtonian fluid, to a mix of sand and water, a relatively more viscous, non-Newtonian granular fluid. This system allows for a novel investigation into the mechanics of undulatory locomotion. Although anguilliform and serpentine undulatory locomotion have both been well studied, naturally-occurring transitions from one of these to the other are scarce, which results in a paucity of study in this area. I used standard high-speed video and high-speed x-ray video to investigate three-dimensional kinematic behavior throughout the burrowing process of three species of sand lances. Burrowing can be divided into three discrete stages: (1) typical anguilliform swimming; (2) the main aquatic propulsive stage of the burrow (in which amplitude and frequency of undulatory waves increases); and (3) a transition to subterranean propulsion. From an above-ground view, this last stage involves the tail becoming still, appearing to glide effortlessly into the sand. As is typical of anguilliform locomotion, the undulatory wave travelling along the body moves posteriorly in both an organism-based coordinate system as well as a world-based one in the above-ground portion of the animal throughout all three stages. The waves travelling along the subterranean portion of the body move posteriorly in an organism-based coordinate system but not a world-based one. Throughout this process, sand lances appear to be using an anguilliform mode of locomotion above ground and a serpentine mode of locomotion below ground. I propose that this change is the result of a switch in locomotor style necessitated by changing environmental conditions.

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

Cyclicality and Stereotypy in Teleosts Chewing Compared with Tetrapods

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Prey-processing in teleost fishes has been extensively examined, but the variation existing across a broad phylogenetic range of vertebrates has received minimal attention, which is perhaps why the ubiquity of chewing in fishes has never been made evident. To quantify the variation in stereotypy and cyclicality of chewing in teleosts compared with other vertebrates, we used EMG from the adductor mandibulae of a wide diversity of teleosts: the bowfin (*Amia*), three bony-tongue (Osteoglossomorpha), four salmonid (Salmonidae) and two pike species (Esocidae). All taxa were found to process prey using a distinct open-mouth chewing behavior, which in all species except for *Scleropages jardinii* occurred in repetitive trains – a pattern that at least superficially resembles chewing in tetrapods. Cyclicality of AM activity, or the duration from the onset of one chew to the onset of the next, was transformed into coefficients of variance (CVs). The degree of chewing cyclicality

among fishes was intermediate to that reported for lepidosaurians and mammals. Chewing stereotypy, or the duration from onset to offset of AM burst activity, (also in CVs) was compared between basal and derived species within each of the osteoglossomorph and salmonid lineages, and between basal (*Amia* and bony-tongues) and more derived groups (salmonids and pikes). While chewing stereotypy is conserved in salmonids, it varies significantly among the osteoglossomorphs we examined. We discuss how our data contributes to emerging evidence that the origin of prey-processing feedback control predates the differentiation of tetrapods and fishes. Supported by NSF IOB 0444891, DBI 0420440.

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

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

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

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

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

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

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

Stream Community Responses to Riparian Recovery in an Agricultural Watershed

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Intensive agricultural practices have long been critical for providing the food resources required by a growing national and world human population. While these practices have undeniably altered stream ecosystems within agricultural watersheds, there has been some progress in recovering riparian function through directed efforts (e.g., restoration and best management practices) as well as incidental improvements occurring when lands are no longer farmed. However, the spatial extent of these improvements can be quite limited, and riparian recovery may not reflect concomitant recovery of stream communities in adjacent streams. I used existing condition riparian reach treatments and *in situ* artificial shade treatments to evaluate the extent to which stream communities track with riparian improvements in an agricultural watershed. The reach treatments reflected differing levels of shade (a local factor) and sediment-nutrients (a local and larger-scale factor) as main effects expected to influence stream communities. Most measures of fish and benthic macroinvertebrate community integrity were not different between high and low

shade regimes. Within the benthic community, only grazing taxa responded to changes in shade regime. Fish community integrity was different between sediment-nutrient regimes of local sites, although the only macroinvertebrate community integrity measure that was related to sediment-nutrient regime was Family Biotic Index. The higher incidence of relations between community measures and sediment-nutrient regime compared to shade regime suggests that local stream communities are likely more responsive to multi-scale environmental properties than highly localized riparian properties. This, in turn, suggests that highly localized and fragmented riparian recovery may have little benefit for stream biota and ultimately agricultural sustainability. However, more specific measures of taxonomic response or alternative measures of community integrity may indicate more localized responses, and hence greater benefits of localized riparian recovery for stream communities.

0709 Herp Stressors/Snake Conservation, Salon 6&7, Monday July 28, 2008

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

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

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

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

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Deserts of interior Australia support the most diverse lizard faunas of any place on Earth. Understanding how species diversity is maintained requires knowledge of how potentially competing species coexist. A simplified niche-based model might argue that species coexistence is facilitated through partitioning resources along

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

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

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

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The Mojave fringe-toed lizard, *Uma scoparia*, is restricted to sand dunes and fine windblown sand habitats in the Mojave Desert of California and extreme western Arizona, resulting in a fragmented and geographically complex distribution. Previous molecular genetic research using mitochondrial DNA suggests the existence of a previously unrecognized distinct population segment in the Amargosa River basin (Murphy *et al.* 2006). Here, we describe findings using multiple independent and selectively neutral loci in a statistical-coalescent framework to estimate gene flow between these and other populations of *U. scoparia*. Moreover, geographic information systems software is being used to develop landscape-based models to explain gene flow and genetic subdivision among these populations. The implications of our findings with respect to present efforts by government agencies to evaluate the endangered species status of these lizards will be discussed.

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

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

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During a pelagic longline pilot study conducted by NOAA/NMFS SEFSC Mississippi Laboratories (MSL) along the U.S. Atlantic Ocean coast (NOAA Ship OREGON II OT-06-02-269), a loggerhead turtle was captured with longline gear equipped with time-temperature-depth recorders (TDR) attached in proximity to the

hooks. TDR data documented changes in hook depth and water temperature, and reflected the behavior of the loggerhead turtle (rates of descent and ascent, time at depth, time near surface). NOAA/NMFS sea turtle mortality mitigation recommendations for pelagic longline gear proved effective for the loggerhead turtle capture since there were successive ascents to surface, and the viability status was good after landing.

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

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

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Manta rays (*Manta birostris*) are the world's largest batoid and little is known about its population or behaviour throughout its broad distributional range. We present the first information on manta ray populations and behaviour in the Gulf of Mexico. Using the photo identification catalogue compiled by the Flower Garden Banks National Marine Sanctuary staff, we used distinct ventral spot patterns to identify a minimum of 32 individual manta rays that have visited the banks over three decades. Mantas have been resighted between years indicating site fidelity to the sanctuary banks. Additionally, we conducted an 18 month study of the site fidelity and inter bank movements of mantas at the Flower Garden Banks National Marine Sanctuary. We tagged eight mantas with coded acoustic tags and placed receivers on the three banks encompassed by the marine sanctuary. Mean disc width of tagged mantas was 1.8 m, suggesting that all animals tagged were juveniles. Based on time recorded at the receiver, manta site fidelity was highest on the East Flower Garden Bank. Three mantas undertook inter-bank movements ranging from 18 km to 67 km distance and provide proof of connectivity between the distant banks that comprise the sanctuary.

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

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

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The Appalachian Mountains of eastern North America are characterized by high faunal diversity and many endemic species; especially in the unglaciated southern latitudes where lineages have been accumulating for tens of millions of years. The brownback salamander, *Eurycea aquatica*, is an enigmatic species that dwells in unique springs in isolated locations in southeastern North America. Brownback salamanders have often been dismissed as simply a robust spring-adapted ecomorph of the widespread and more gracile species *Eurycea cirrigera*. We sequenced mitochondrial and nuclear genes from *E. aquatica* across their presumed distribution and compare them to *E. cirrigera* from nearby populations. We explicitly test if *E.*

aquatica is simply a local spring-adapted ecomorph of *E. cirrigera* or a single lineage that resulted from fragmentation of (or dispersal to) isolated spring habitats. We discovered that brownback salamanders are a well-supported monophyletic group that is nested amongst *Eurycea cirrigera*, *E. wilderae*, and *E. junaluska*. Furthermore, we uncovered three very divergent lineages of brownback salamanders that we estimate have been diverged for several million years and may represent distinct species. The first clade, centered in springs in the Birmingham Valley, includes the type locality of *Eurycea aquatica*. Clade two extends from northeastern Alabama through northwest Georgia into Tennessee. Finally, clade three occurs in northern Alabama and includes the “cole springs” morph described in early taxonomic treatments. Springs checker the sedimentary regions of the southern Appalachians and may represent relictual habitat for an unexpected diversity of unrecognized endemic species that are currently threatened by development.

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

How Amphibians Conquered the North

David M. Green

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

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

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

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The use of space is one of the most important aspects of snake ecology because it is affected by a multitude of factors. Understanding variation in snake home range size and movement patterns has been a common objective of numerous radiotelemetry

studies which have often revealed proximate influences of resource distribution and behavioral interactions on spatial patterns. Recent studies on the cottonmouth have indicated that spatial variation, both within and among populations, may be explained by a combination of ecological factors. Prey distribution appears to be an important influence on home range size and location in several locations. In a southwest Missouri cottonmouth population, distinct spatial differences among adult snakes were attributed to differences in their foraging ecologies and thermoregulatory needs. Adult male home ranges were always centered on grassland habitat patches that contained preferred prey while gravid females typically associated with very small rocky outcroppings that provided optimal thermal regimes for gestation. Differences in the location and dispersion of key resources and physiological challenges in different environments should help elucidate the ecological causes of spatial differences in comparative studies. Additionally, recent studies in cottonmouth neural biology have begun to investigate correlations between brain anatomy and activity with movement patterns. Plans to further this research by integrating cognitive approaches to cottonmouth spatial ecology are ongoing and will be suggested to provide new directions for future research.

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

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

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

0219 Poster Session II, Saturday July 26, 2008

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

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

0746 Poster Session III, Sunday July 27, 2008

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

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Cottonmouth testes were examined ultrastructurally to determine the distinct morphological changes that spermatids undergo during spermiogenesis. Testicular tissues from cottonmouth snakes (n=22) were collected year round from Hammond, Louisiana. The tissues from the months of April, May, October, and November, which demonstrated heavy spermiogenesis, were washed with cacodylate buffer, treated with osmium tetroxide, dehydrated through a graded series of ethanol solutions, embedded in epoxy resin, sectioned with an ultramicrotome and diamond knife, stained with both uranyl acetate and lead citrate, and analyzed using a transmission electron microscope. A distinct set of morphological changes can be seen during the development of spermatids. The acrosomal proteins are delivered to the developing germ cells from the golgi during the early stages of spermiogenesis. An outer layer of membrane proteins, which were absent in the previously studied

swamp snake, lines the inside of the acrosome. As the spermatids mature, the acrosome granule flattens and the acrosome extends dorsally along the developing spermatids. The chromatin condenses and adopts a spiral formation, which is different than that seen in the swamp snake. Distinct microtubules, termed the manchette, run parallel to and assist in the elongation of the nucleus. The microtubules that run perpendicular to the elongating nucleus, which are present in the swamp snake are absent in the cottonmouth. Two centrioles align perpendicular to each other at the base of the elongated nucleus and demonstrate the conserved 9+2 microtubule arrangement. The distal centriole elongates and makes up the body of the flagellum. This is the first study to describe the complete ultrastructural events that occur during spermiogenesis within a temperate crotalid. The morphological similarities and differences that can be seen during germ cell maturation may help to determine future evolutionary relationships among the large clades of reptiles.

0309 Herp Systematics, Drummond, Friday July 25, 2008

Preliminary Phylogeography of *Leiolepis belliana* and *Leiolepis reevesii*

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The southeast Asian lizard genus *Leiolepis* has seven species, of which *L. belliana* and *L. reevesii* have the broadest distributions. *Leiolepis belliana* ranges from Peninsular Malaysia northward through out all of Thailand and eastward through Cambodia, and *L. reevesii* ranges from southern China southward throughout Vietnam and southern Laos and westward through Cambodia. The taxonomy of *Leiolepis* has long been problematic. Much of this is seeded in the high degree of morphological variation in the two most wide spread species, *Leiolepis belliana* and *L. reevesii*. These species have been considered distinct from one another and to date all studies involving these species have use specimens from the distant ends of their distribution (where their morphologies are distinct from one another) adding to the evidence that these species are distinct from one another. Recent expeditions in southern Cambodia have revealed a contact zone between these two species. Morphological data in Cambodia suggests that these two species are conspecific and morphologically grade into one another. A phylogenetic analysis was performed to test the specific status of *L. belliana* and *L. belliana*. If there is, in fact, only one species, throughout the range this would suggest that all other species of *Leiolepis* have arisen from one wide-ranging species.

0210 SSAR Seibert Competition, Salon 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Assessment of the Effects of Roads and Crabbing Pressures on Diamondback Terrapins on Georgia's Coast

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Commercial and residential development of coastal habitats places significant pressure on wildlife. The diamondback terrapin, *Malaclemys terrapin*, is one of Georgia's "high-priority" species for conservation attention in coastal habitats. In

Georgia, vehicle induced mortality has been proposed as a potentially important factor contributing to terrapin population declines; however, studies in other states suggest that bycatch mortality from neglected or abandoned crab pots may explain the declines in terrapin populations in coastal environments. The objective of our project is to assess whether road density or historic crabbing pressure is correlated with the current abundance of terrapins in tidal creeks along Georgia's coast. We used GIS to characterize road density and crabbing effort in all of Georgia's tidal creeks, grouped creeks into one of four classes (no roads:no crabbing, high roads:no crabbing, low roads:high crabbing, and high roads:high crabbing), and then selected 24 creeks for study using a stratified random design. We seined each creek 5 times over a 100 day period between April and June, and all terrapins captured were aged, measured, and marked uniquely. We used general linear models and standard regression techniques to examine the relationships between road density and crabbing pressure on closed population estimates of terrapin abundance.

0476 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

A Comparison of Diel Vertical Movements of Bluntnose Sixgill Sharks (*Hexanchus griseus*) in the Atlantic and Pacific Oceans

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The bluntnose sixgill shark (*Hexanchus griseus*) occurs worldwide in tropical and temperate seas. *H. griseus* often associate with geomorphological features (e.g. submarine canyons) between continental and insular shelf edges and slopes where they are top predators and scavengers. While *H. griseus* have been captured from the surface to depths of 1,875 meters, very little is known about their movements and behavior. These sharks typically occur deeper than 200 m, though they are common much shallower in some areas where waters remain cool year-round (e.g. Puget Sound). Much of what is known about the movements and behavior of *H. griseus* has been gleaned from submersible and baited camera sightings and from a single, short-term telemetry study. We used modified longlines from small vessels to capture adult *H. griseus* (267 to 451 cm total length) at depths of 250-500 m near submarine canyons off Hawaii (Central North Pacific Ocean) and Virginia (Northwest Atlantic Ocean). A subset of the sharks were fitted with high-rate, archiving, pop-off satellite transmitters to 1) assess survivorship and recovery time following capture, 2) examine patterns of vertical movements, and 3) compare patterns of vertical movements between locations. Results to date indicate *H. griseus* have high post-release survivorship, but require 48 to 72 hours recovery time until resuming what we interpret as normal behavior. Swimming depth and water temperature ranges were 196-839 m and 4.9-17.3°C for *H. griseus* tagged offshore of Hawaii and 171-623 m and 5.2-14.3°C for *H. griseus* tagged offshore of Virginia. Following recovery, all *H. griseus* displayed obvious diel patterns in vertical movements. Offshore of Hawaii, swimming depths were 500-700 m (6-7°C) during day and 225-325 m (13-16°C) during night. Offshore of Virginia, the diel pattern was shallower, with swimming depths of 250-300 m (10-12°C) during day and 175-225 m (12.5-13.5°C) during night.

0179 Fish Systematics III, Drummond, Saturday July 26, 2008

Ontogeny, Variation and Homology in Salmonid Caudal Skeleton

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Skeletal ontogenetic data are highly relevant in defining homologies, interpreting skeletal variation, and inferring atavisms. Over the years, the actinopterygian caudal skeleton has generated a great deal of controversies concerning the homology and the development of its elements. Furthermore, some of these features have phylogenetic significance; the presence of uroneurals (i.e., modified elongated ural neural arches) has been recognized as a teleostean synapomorphy (homoplastic with respect to the Cretaceous aspidorhynchiform *Vinctifer*), and six hypurals or less has been considered as a clupeocephalan synapomorphy (seven hypurals are present in the Jurassic teleost *Orthogonikleithrus*). Considering this disparity among teleostean clades, it becomes important to investigate the interrelationships of these elements (e.g., uroneurals, hypurals) with their respective centra. An ontogenetic series of Arctic charr (*Salvelinus alpinus*) was reconstructed based on 448 clear-and-stained larval and juvenile specimens ranging in size between 12.8-45 mm of standard length (SL). We demonstrate the presence of caudal skeletal elements never reported previously in adult salmonids. Instead of three uroneurals (considered a generalized salmonid condition), a fourth uroneural has been identified bilaterally or unilaterally in 156 specimens. The earliest occurrence of a fourth cartilaginous uroneural is found in a 21-mm SL specimen. A fourth uroneural is also present in some of our largest studied specimens; thus, there is no indication of ontogenetic resorption. In contrast to the generalized condition of six hypurals, a seventh hypural has been found in 12 specimens suggesting atavism. The skeletal variation observed in our study calls for reinterpretation of previously proposed relationships of caudal elements with their centra in salmonids. These data corroborates the development of a polyural caudal skeleton in a teleost homocercal tail with a one-to-one relationship between centra and their associated elements.

0407 Cottonmouth Symposium, Salon 4&5, Monday July 28, 2008

Assessing the Utility of Nuclear Markers to Examine Phylogeography of *Agkistrodon piscivorus*

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We have identified two mitochondrial lineages of the cottonmouth (*Agkistrodon piscivorus*) and three mitochondrial lineages of the copperhead (*A. contortrix*) using both likelihood and Bayesian methods (Guiher and Burbrink, in press). Using 'relaxed phylogenetics' methods we estimate a Late Pliocene/ Early Pleistocene origin for all five lineages and unique demographic responses to Pleistocene glacial cycles based on coalescent methods. The current focus of this study is to corroborate the mitochondrial lineages or offer competing phylogeographic hypotheses, better define contact zones and identify putative hybrid zones using multiple independent nuclear loci. We have assessed the utility of nuclear loci obtained from several sources including an anonymous loci library, markers used in diverse vertebrate taxa taken from the literature, and a collaboration that has used high throughput

sequencing to produce genomic data for a variety of snake taxa. Increased sampling, while adding unlinked loci will allow us to more concisely define the current distribution of each lineage and improve estimates of demographic histories. In addition, it will be possible to estimate immigration rates and the degree to which these lineages hybridize.

0550 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Mitochondrial Haplotype Analysis of the Bull Shark, *Carcharhinus leucas*, (Valenciennes, 1839) Control Region

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The bull shark, *Carcharhinus leucas*, is known for its wide distribution, along the coastal areas of tropical and subtropical seas, and its ability to penetrate freshwater systems. This species is usually found close inshore in marine habitats, in water less than 30m deep and occasionally less than a metre. These characteristics combined with its distribution bring this elasmobranch into contact with humans on a regular basis and make it especially susceptible to anthropogenic effects. The bull shark is considered an important fisheries species and although mainly sought for its fins for shark-fin soup, it is also utilised fresh, fresh-frozen or smoked for human consumption. Knowledge of the genetic structure is essential for effective fisheries management and comparative phylogeography, using mitochondrial DNA (mtDNA), has become a powerful tool in the study of populations. An 820 base pair fragment was sequenced from the control region of 102 samples from Eastern Australia ($n=51$), South Africa ($n=19$) and the United States ($n=32$). Seven samples included in the analysis were previously sequenced (Nova Southeastern University, Florida). The sequences were aligned and analysed, yielding 18 haplotypes (diversity 0.831, standard deviation ± 0.024). A preliminary analysis of molecular variance (AMOVA) indicates significant differences among sample sites across ocean basins (77.3% variation, F_{ST} 0.773, $p < 0.00001$). These early results indicate the presence of at least three separate stocks, with the likelihood that U.S. East Atlantic coast and Gulf of Mexico form a single population. More samples are required to explain the low genetic diversity in Eastern Australia and make firm conclusions on the structure of these stocks, and their potential vulnerability.

0306 AES Student Papers II, Kafka/LeMaratine, Friday July 25, 2008;
GRUBER

Social, Size and Species Group Living Preferences in Juvenile Lemon Sharks, *Negaprion brevirostris*

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Group living in sharks is a widespread phenomenon but relatively little is known about the composition and organization of these groups. Using 40 juvenile lemon sharks, *Negaprion brevirostris* caught in the South Bimini, Bahamas nursery area a range of choice tests were conducted to determine whether individual lemon sharks make non-random grouping decisions. Results of the trials revealed that juvenile lemon sharks exhibit a strong preference to behave socially even when the conspecific stimulus group was reduced to a single lemon shark (Wilcoxon matched pairs, $n = 8$, p -value = 0.015). Additional size-preference trials indicated that during the juvenile phase of the lemon shark's life cycle there was evidence for association (t test, $t = -2.37$, $n = 10$, p -value = 0.038) with size-matched groups of lemon sharks. Further species-preference testing using juvenile nurse sharks, *Ginglymystoma cirratum* also demonstrated that lemon sharks have a strong preference to group with conspecifics (Wilcoxon, $n = 10$, p -value = 0.00013). Implications of these social preferences for group living of wild sharks are discussed, along with the potential factors that may contribute to the development of non-random grouping behaviours. Supported by the Leverhulme Trust, University of Leeds, Hoover Foundation and Bimini Biological Field Station.

0548 Poster Session I, Friday July 25, 2008

Morphological Variation in the Dwarf Round Ray *Urotrygon nana* (Miyake & McEachran, 1988) from the Gulf of Tehuantepec, Mexico

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In order to describe morphologic variation in the dwarf round ray *Urotrygon nana* we examined 468 individuals from the shrimp trawl fishery of the Gulf of Tehuantepec. We determined the sex and state of maturity, and 9 morphometrics measures: total length (TL), disc length (DL), disc width (DW), preorbital length (POL), interorbital distance (IOD), preoral length (Porall), internasal distance (IND), tale length (LC) y mouth length (LB) for each sampled individual. The number and total length of embryos was determined for pregnant females. Factor analysis was used to identify the meristics responsible for variation in body shape. Additionally three statistical models were tested to analyze for allometry in morphometrics relationships; the potential model produced the best fit in the majority of cases (R^2 greater value). Discriminant analysis was used to identify sexual dimorphism in adults. Females ranged between 8.2 and 37.6 cm TL, and males between 8.0 and 29 cm TL. The shape of the dwarf round ray is determined by three dimensions (factors,

70% of the total percentage of the explained variance) related to disk (24.8%), eye-mouth-nose region (50.9%) and mouth width (69.8%). Most morphometric relationships showed negative allometry significant. *Urotrygon nana* presents sexual dimorphism in total length ($\rho = 0.620$), disc width ($\rho = 0.598$), internasal distance ($\rho = 0.592$), interorbital distance ($\rho = 0.579$), preoral length ($\rho = 0.578$) and dentition morphology. Females have molariform teeth, but neonate and young males present cuspidate teeth and adult males acute cuspidate teeth.

0201 AES Age & Growth/Reproduction, Kafka/LeMaratine, Saturday July 26, 2008

Comparative Life History Characteristics of the Aleutian skate, *Bathyraja aleutica*, in Two Alaskan Ecosystems

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The Aleutian skate (*Bathyraja aleutica*) is a large deep-water species that commonly occurs in bycatch of Alaskan trawl and longline fisheries. Although prominent in the skate biomass of both the eastern Bering Sea (EBS) and Gulf of Alaska (GOA) ecosystems, minimal biological information exists for this species. This is of concern, because skates often exhibit *k*-selected life history characteristics that make them susceptible to fishery exploitation. To increase our understanding of this potentially vulnerable species, and address the possibility for two separate populations in Alaskan waters, the age, growth, and reproductive biology of *B. aleutica* was studied. In total, 1,281 skates were collected since 2004 in the EBS and GOA during exploratory trawl surveys, by fisheries observers, and from fishery landings. Gonads were examined using visual and histological analysis, and compared with external morphology to determine maturity stage and reproductive seasonality. Vertebral thin sections were examined for age determination, and multiple growth models were used to evaluate growth characteristics. Median sizes at maturity were similar between sexes, but significantly different between areas. TL_{50} was 124.4 cm TL for females and 122.8 cm TL for males in the EBS, and 120.7 cm TL for females and 117.7 cm TL for males in the GOA. The presence of males with mature spermatozoa and gravid females indicated reproductive capability during all months sampled (April – September). For skates from the EBS, maximum age estimates were 16 and 17 years for males and females, and the three-parameter von Bertalanffy growth functions generated estimates of $k = 0.11 \text{ yr}^{-1}$ and $L_{\infty} = 172.6 \text{ cm TL}$. Age determination is nearing completion, but estimates thus far indicate skates from the GOA attain greater ages. Final age estimates and growth parameters will be presented. These data suggest *B. aleutica* is a moderately slow-growing and late-maturing species.

0406 Amphibians in Ecosystems Symposium, Salon 6&7, Sunday July 27, 2008

Influence of Forest Salamanders on Invertebrate Populations, Leaf Litter Decomposition, and Nutrient Flux

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Understanding nutrient cycling dynamics is an essential aspect of sustainable forest management. In particular, the forest floor represents a key source of organic matter that is carbon and nitrogen rich as well as containing many other essential nutrients. Changes in the rates of inputs (litterfall) and loss (decomposition) following natural or anthropogenic disturbances can significantly alter forest nutrient cycles. Invertebrates in the forest floor play an important role in forest nutrient cycling, both directly and indirectly, based on their feeding habits. As major predators of soil invertebrates, salamanders may alter leaf litter decomposition and in turn nutrient cycling rates in forest ecosystems. We examined the impacts of changes in salamander abundance on mixed-oak forest floor decomposition rates and nutrient mineralization in a two-year mesocosm experiment using *Plethodon cinereus* and with data from plots from a stand-level silvicultural manipulation. There are challenges in designing an enclosure that can serve as a barrier to salamander movement but not water or nutrient flux. Using primarily oak leaf litter, we did not detect differences in decomposition rates across the salamander density treatments. Invertebrate populations did not show strong response to the density treatments, either. However, we did see an initial decrease in NO_3^- in the soil of mesocosms with higher salamander densities. Because soils in southern Appalachian hardwood forests have a net cation exchange capacity, monovalent anions such as NO_3^- often leach readily through the soil profile, often resulting in base cation leaching. Lower NO_3^- concentrations may serve to retain base cations in the system. In 2006, the most abundant items in stomach content analyses of red-backed salamanders in the mesocosms were insect larvae, collembola, and mites. Worms and larvae accounted for the greatest volume. Abundance of collembola was higher in 10-year old clearcuts than in control (over 90 year old) stands.

0533 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Theoretical Calculations of Feeding Biomechanics in Bull Sharks over Ontogeny

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Bull sharks (*Carcharhinus leucas*) are one of the most aggressive coastal shark species inhabiting subtropical and tropical seas worldwide. Although a very broad head, robust jaws, and large serrated teeth are obvious and notorious features of *C. leucas*, the feeding biomechanics of this species have scarcely been investigated. The goal of this study is to describe the functional morphology of the jaw apparatus and investigate ontogenetic changes in bite performance in this top level predator. Theoretical calculations of jaw leverage and bite force were performed for an ontogenetic series of ten individuals using a three dimensional static equilibrium model. Values of theoretical bite forces ranged from 68 to 1023 N at the most anterior tooth of jaw and from 194 to 3721 N at the corner of the jaw in a range of sizes of 73-

258 cm, TL. Although little is known about the feeding ecology for this species, dietary literature suggests that bull sharks exhibit an ontogenetic dietary shift where type of prey ranged from bony fishes to elasmobranchs and mammals at approximately 140 cm TL. Bite force as a measurement of performance could provide a better understanding of the feeding ecology and foraging capabilities of this apex predator over ontogeny.

0180 Herp Genetics, Salon A&B, Sunday July 27, 2008

Genetic Structure of a Hybrid Zone Between Two Lizard Species: Differences in Patterns of mtDNA and Nuclear Genes

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An important question in evolutionary biology is how species identity is maintained when interbreeding occurs between sister species in zones of secondary contact. Hybridization between Long-tailed brush lizards, *Urosaurus graciosus*, and Common tree lizards, *U. ornatus*, was found using mtDNA sequences from populations where their ranges overlap in western Arizona. MtDNA sequence analyses showed *U. ornatus* type mtDNA in individuals with *U. graciosus* morphology, but not the reverse, indicating only matings of *U. graciosus* males and *U. ornatus* females occurred. I examined variation in genomic DNA markers (microsatellites) to determine if individuals with *U. graciosus* morphology from the geographically intermediate populations: (1) grouped between the two parent species, indicating hybridization is currently ongoing with F1s present and/or symmetrical backcrossing, (2) grouped with the "paternal" species *U. graciosus*, indicating matings with female *U. ornatus* were rare and hybrids tended to backcross successfully only with the paternal species, or (3) grouped with the maternal species, *U. ornatus*, indicating a bias for hybrids only successfully backcrossing with this species. Genetic structure across the hybrid zone was determined for at least three microsatellites in two populations on each side of the area of geographic overlap and three geographically intermediate populations. The program STRUCTURE was used to estimate population assignment based on allele frequencies. Two "populations" were clearly delineated from the microsatellites with individuals from outside the zone of contact forming distinct groups of their respective species. Individuals with *U. graciosus* morphology (but *U. ornatus* mtDNA) from intermediate locations all grouped within the *U. graciosus* population genetic structure with no indication of admixture with *U. ornatus*. It appears that in the intermediate populations, little if any current hybridization is occurring and hybrid individuals have backcrossed with the paternal species such that their nuclear markers are currently indistinguishable from those of the paternal species.

**0438 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE
GENERAL ICHTHYOLOGY**

A Multi-gene Phylogeny of the *Etheostoma zonale* Species Group: Patterns of Diversification in the Central Highlands of North America

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Detailed phylogeographical histories are required to unravel the complex biogeographical relationships of freshwater fishes in the Central Highlands of North America (the Appalachian, Ozark, and Ouachita mountains). I have recovered such a phylogeography for the *Etheostoma zonale* species group in an attempt to shed light on this area. The Banded Darter, *Etheostoma zonale*, and its sister species the Brighteye Darter, *Etheostoma lynceum*, together form a clade that is widespread throughout the Central Highlands and nearby lowland areas. *Etheostoma zonale* is one of the more wide-ranging species in the species-rich darters (Acanthomorpha: Percidae: Etheostomatinae). I have obtained DNA sequences for approximately 150 individuals of the species group from throughout their range, for both the mitochondrial cytochrome b gene and the nuclear S7 ribosomal protein first intron, and obtained phylogenies using the maximum parsimony, maximum likelihood, and Bayesian methods. Variation within the group is strongly partitioned geographically, with approximately 15 clades evident in a tree based on the cytochrome b data, and a smaller number in an S7 tree; these clades generally corresponding to drainage basins within the Central Highlands. The different methods of analysis retrieve the same clades, but show some variation in their branching order. A biogeographical comparison with the phylogenies of other taxa from the same region shows some correspondences, but a substantial number of taxon-area relationships within the *E. zonale* group is incongruent with other taxa. This suggests that unique events may be responsible for the spread of *E. zonale* throughout its range, or that lineage sorting events, or multiple cycles of colonization and extinction, have obscured the true phylogeographic history of the species group.

0506 HL Graduate Research Award, Salon A&B, Sunday July 27, 2008; HL

The Coachwhip Selects Scrub: Is It for the Grub?

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The use of space by individual animals strongly influences the spatial extent, abundance, and growth rates of their populations. We analyzed the spatial ecology and habitat selection of the Coachwhip (*Masticophis flagellum*) at multiple spatial scales to determine which habitats are most important to this species. Home ranges and mean daily displacements of the Coachwhip were large, even for this vagile species. Individual home ranges contained a greater proportion of xeric Florida scrub habitat than did the study site, and individuals positively selected Florida scrub within their home ranges. Mesic cutthroat seep and hydric swamp habitats were avoided at both scales of selection. Several non-mutually exclusive mechanisms, including prey abundance, availability of refugia, thermoregulatory opportunity, and structural attributes of Florida scrub may underlie the positive selection of Florida scrub by the Coachwhip. Historic rarity and anthropogenic loss and fragmentation of Florida scrub, coupled with the long-distance movements, large home ranges, and positive selection of Florida scrub by the Coachwhip, indicate that

large contiguous tracts of land containing relatively open-canopied, xeric habitats will be essential for the persistence of the Coachwhip in central Florida.

0737 Poster Session III, Sunday July 27, 2008

Taxonomy and Phylogeography of *Hippocampus kuda* in Papua New Guinea

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Over 14 synonyms exist for the “Common Seahorse”, *Hippocampus kuda*. Putatively found from the Hawaiian Islands to the coast of East Africa, it may be the most widely distributed seahorse species. A previous cytochrome *b* phylogeographic analysis focused on Southeast Asian populations of *H. kuda* found significant population structure across this portion of their range (Lourie *et al.* 2005), but no evidence for cryptic species. In Papua New Guinea, at least two distinct morphotypes of *H. kuda* are distinguished by merestic measures, prompting examination of the validity of *H. taeniopterus*, currently recognized as one synonym for *H. kuda* in Indonesia, Papua, and northern Australia. We investigate the geographic distribution of *cytb* variation in two morphotypes of *H. kuda* distributed among 3 populations, from northern, southern and eastern New Guinea. In addition, we include populations from Palau and Fiji, extending the northern and eastern range of sampled *H. kuda* sequences. Twenty-one haplotypes were defined by 688 bases of *cytb* analyzed for 69 specimens from 6 populations. A deep phylogenetic split defines two clades of PNG haplotypes, with all Fiji samples related to one clade and all Palau samples allied with the second. Both morphotypes are found in each PNG clade, indicating a lack of concordance between morphological and genetic differentiation. While results indicate substantial genetic structuring ($F_{st} = 0.28$), geographic distance is a poor predictor of genetic distance. Over 70% of genetic variation found within populations, with only 29% found between populations. Nucleotide diversity is an order of magnitude higher in PNG populations than in Fiji and Palau. These results suggest a relatively deep and complex history for *H. kuda* in the eastern edge of the coral triangle, and the presence of substantial intraspecific morphological variation. Pending more robust evidence, we suggest *H. taeniopterus* remains a synonym of *H. kuda*, and that comparative analysis of debated synonyms such as *H. hilonis*, *H. moluccensis*, and *H. tristis* will further clarify the status of *H. kuda*.

0069 Herp Physiology/Bar Codes, Salon 4&5, Thursday July 24, 2008

An Introduction to FISH-BOL, the Fish Barcode of Life Initiative

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The Fish Barcode of Life initiative (www.FISHBOL.org) is an international research collaboration dedicated to assembling a standardized reference sequence library for all fishes. New primer cocktails have been developed targeting 650 bp of the 5' end

(e.g. the “Folmer” region) of the mitochondrial cytochrome *c* oxidase I (COI) gene enabling broad amplification of fishes. The resulting sequence profiles or “DNA barcodes” conform to standards established by the Consortium for the Barcode of Life (CBOL) and are typically derived from expert-identified voucher specimens archived in accessible reference collections. The Catalog of Fishes, FishBase and ITIS contribute to a taxonomic authority file for the initiative, while FISH-BOL serves as a conduit of communication for ichthyologists to provide information updates back to the aforementioned community resources. More than 4500 species have already been barcoded, with an average of five specimens per species. Current results indicate that barcodes separate >98% of previously described fish species that have so far been analyzed. Several genetically divergent specimens have also been confirmed by integrative taxonomic analysis as new species. The benefits of barcoding fishes include the global disambiguation and reconciliation of names, highlighting cases of range expansion for known species, flagging previously overlooked species and, enabling identifications where traditional methods cannot be applied. In this respect, DNA barcoding democratizes access to species level identifications: unknown sequences, from any fish or its filets, fins, eggs and larvae can be matched against these reference sequences using BOLD: the Barcode of Life Data System (<http://www.barcodinglife.org>).

0608 Poster Session II, Saturday July 26, 2008

The Effect of Light Intensity on Predatory Luring by *Nerodia clarkii compressicauda*

Kerry Hansknecht, Joshua Chandler, William Pittman, Jacob Randolph

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Mangrove Saltmarsh Snakes are reported to be largely nocturnal but often active during the day. To aid in determining if these snakes might exhibit lingual luring during particular times of the day, we observed 27 juveniles in the presence of fathead minnows, *Pimephales promelas*, for 15 min under each of three different light intensities: 8.6, 70.0, and 285.2 lx. Ten subjects exhibited lingual luring during 23 trials. There was no significant difference in the number of snakes luring at the different light intensities. Thus, it seems likely that these snakes might lure prey at any hour of the day.

0605 Herp Behavior, Salon A&B, Thursday July 24, 2008

Stimulus Control of Predatory Luring by *Nerodia clarkii compressicauda*

Kerry Hansknecht

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In order to better understand the ecology of a particular behavior, it is helpful to know the importance of the various stimuli likely to be involved in eliciting that behavior. I sought to determine the relative importance of chemical and visual prey stimuli to the exhibition of lingual luring by the piscivorous Mangrove Saltmarsh Snake. Subjects (N=23) were observed for 15 min in the presence of four different prey-stimulus treatments: chemical cues only, visual cues only, both chemical and visual cues together, and control (no prey cues). While chemical and visual cues were each by themselves sufficient to elicit luring in the absence of other prey stimuli, they

did so infrequently; the number of snakes luring in the presence of chemical cues only and visual cues only did not differ significantly from each other or from the number of snakes luring in control trials. The combination of visual and chemical cues, however, was highly effective in eliciting luring; the number of snakes luring in the presence of both chemical and visual cues together differed significantly from all other treatments. These snakes thus appear to rely heavily on multimodal information for positive prey identification.

0331 Poster Session I, Friday July 25, 2008; CARRIER

Assessing the Ultrastructure of the Elasmobranch Retina: The Application of Microwave and High Pressure Freezing Techniques

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Numerous studies have examined the ultrastructure of the vertebrate retina. However, few have examined the retina in elasmobranchs, an ancient group that has existed for more than 400 million years. In order to trace the evolution of the vertebrate retina and optimise the ultrastructural detail that has been lacking in previous studies, we examined the retina of the brown banded bamboo shark (*Chiloscyllium punctatum*) using a range of techniques including standard chemical fixation (CF), microwave chemical fixation (MCF) and high pressure freezing (HPF, using either a Leica EM PACT2 or a Bal-Tec HPM 010). Following anaesthesia with MS222 (1:2,000 in sea water), the eye was enucleated and retinal tissue was immediately extracted. For HPF, retinal samples were rapidly processed in hexadecene, elasmobranch Ringer, DMEM (Dulbecco's Modified Eagle's Medium) Ringer, or with no preincubation, with and without prior oxygenation. HPF samples were freeze substituted with 2% OsO₄ + 0.5% uranyl acetate in 100% acetone (dry). CF and MCF fixed samples were fixed in Karnovsky's fixative and post-fixed with 1% OsO₄. The quality of the retinal ultrastructure after the various fixation processes was assessed based on the integrity of cellular organelles, membrane contrast and fixation artefacts (if present). The ultrastructural definition of cone photoreceptors was of particular interest, since traditional histological processing has previously revealed substandard morphology. Various trials resulted in the elasmobranch Ringer being the most effective with or without oxygenation. MCF and HPF using the Leica EM PACT2 proved to be the most effective techniques for revealing superior ultrastructure. Membrane contrast was best using HPF, and mitochondria with visible cristae and Golgi complexes were clearly discernible using only this technique. MCF using DMEM Ringer resulted in large gaps in the tissue and very low membrane contrast. The Bal-Tech HPF technique and HPF with no ringer proved to be ineffective methods.

0170 AES Student Papers III, Kafka/LeMaratine, Friday July 25, 2008;
GRUBER

The Development of Visual Function in the Embryonic Brown Banded Bamboo Shark, *Chiloscyllium punctatum* (Elasmobranchii)

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Anatomical studies have shown that the retina of the oviparous brown banded bamboo shark, *Chiloscyllium punctatum*, is fully differentiated about 30 days prior to hatching (158 days post deposition, dpd). However, it is not known whether the retina is physiologically capable of vision at this early stage and, if so, why. To assess the onset of retinal function, we used microspectrophotometry (MSP) to measure the presence of visual pigment in photoreceptor outer segments and electroretinography to assess light sensitivity. MSP revealed the presence of a vitamin A₁-based (rhodopsin) visual pigment (wavelength of peak absorbance, λ_{\max} 500 nm) in the rods as early as 115 dpd, providing the fundamental basis for light detection. Retinal sensitivity to light and temporal resolution (indicated by flicker fusion frequency, FFF) were recorded electroretinographically from whole animals and isolated eye-cup preparations using a graduated series of light intensities and flicker frequencies in embryonic sharks from 110 dpd (50 days pre-hatch) to hatched sharks up to one year old. The youngest shark that produced a measurable response to light was 127 dpd, which correlates well with the timing of the appearance of retinal synaptic connections. Peak voltage responses to light were observed in animals at the time of hatching (just prior to, or within 24 hours post-hatch). Temporal resolution (FFF) ranged from 6 Hz to 22 Hz, which is relatively slow compared to other aquatic predators. This study shows that the retina of *C. punctatum* is both anatomically mature and physiologically functional prior to hatching. The behavioural advantage of a functional visual system early in embryonic life is unclear, especially for an animal that develops in an opaque egg case, but we suggest it may allow time for fine-tuning of the system prior to birth, providing the animal with optimised vision upon hatching.

0449 Fish Systematics II, Salon A&B, Friday July 25, 2008

Cypriniformes Tree of Life: Phylogenetic Relationships of the Catostomidae, with Emphasis on the Catostominae, based on Mitochondrial and Nuclear Gene Sequences

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Our previous studies have focused on relationships among basal-lineages within Catostomidae, and relationships within the Moxostomatini. While both studies contributed to our understanding of relationships among suckers, questions remained regarding the validity of some resolved relationships, especially in light of resulting biogeographic patterns. Herein, we present a phylogeny of the Catostomidae, with emphasis on the Catostominae, based on complete mt cytochrome b and ND2 and nuclear IRBP and S7 gene sequences. A phylogeny of 126 taxa resolved intrafamilial relationships consistent with those previously proposed by Harris and Mayden (2001). Within Catostominae, parsimony analysis

recovered a trichotomy of Erimyzonini, Catostomini, and Moxostomatini plus Thoburniini. Within Catostomini, *Catostomus* (*Pantosteus*) was recovered as monophyletic, and sister to a clade containing the remaining taxa in this tribe. *Deltistes* was sister to *Chasmistes* and *Catostomus* from the Klamath Basin. *Xyrauchen* was embedded within *Catostomus* and resolved as part of a clade containing *C. insignis* and *C. latipinnis*. *Thoburnia* was always resolved as paraphyletic, with *T. rhothoeca* sister to *Hypentelium roanokense*. Species relationships within Moxostomatini are consistent with Harris and Mayden (2001), with 'Scartomyzon' being embedded within *Moxostoma*. In both tribes, species relationships in terminal clades exhibit strong geographic concordance.

0071 Poster Session I, Friday July 25, 2008

Ecological Aspects of the Whale Shark (*Rhincodon typus*) at Saint Peter and Saint Paul Archipelago, Brazil

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The first record of a whale shark in Brazilian waters was in the coast of Bahia State in 1921. Since then, additional sightings have been reported along the Brazilian coast, but knowledge on the species biology and ecology in the region has remained poor. Whale sharks are most frequent observed at the Saint Peter and Saint Paul Archipelago (SPSPA), a small group of rocky islands located on the mid-Atlantic Ridge, just north of the Equator. In July 1998, the Brazilian Navy established a scientific research station in the Archipelago, which allowed researchers to remain in the area for more extended periods and enabled the study of local whale sharks. After compiling all existing data on the whale sharks recorded in the SPSPA, we proceeded to observe locations of occurrence, estimated the lengths of those sharks, analyzed the trends in occurrence over the last nine years, and investigated possible ecological factors that might influence their distribution and seasonal occurrence. Sharks ranged in total length from 2.0-14.0 m and sightings were most common from January to March. The higher density of whale sharks in the Archipelago during this time period appears to be associated with an increase in the abundance of eggs and larvae of flying fish (Exocoetidae), which spawns in the area at this time of year.

0538 AES Reproduction, Kafka/LeMaratine, Saturday July 26, 2008

Why is there Multiple Paternity of Nurse Shark?

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Multiple paternity has been demonstrated in several shark species including placentially viviparous hammerhead and requiem sharks and the lecithotrophic nurse shark (*Ginglymostoma cirratum*). Cited reasons for multiple paternity in sharks include indirect genetic benefits or convenience polyandry. Most studies either dismiss or do not mention fertility assurance as potentially important. Nurse sharks produce very large energy-rich eggs that slowly pass through the reproductive tract

one at a time, precluding rapid fertilization of multiple eggs. Because nurse sharks do not store sperm, they likely require multiple matings to fertilize all egg clutches in a litter. Based on nurse shark mating behaviors, reproductive anatomy, and genetic analysis of clutches, we believe that fertility assurance is the most parsimonious explanation for multiple paternity in nurse sharks. We examined three complete nurse shark litters and found that each had six to seven sires with the number of pups per sire ranging from one to 17. The mean number of pups per sire was five. We have observed hundreds of copulations and failed copulations in nurse shark as well as cooperative breeding behavior among males. Female nurse sharks can usually control copulation by refuging and successfully avoid mating with pursuing males and even groups of males. Because clutch sizes are small, we cannot invoke kin selection to explain the more successful group mating behavior among males and instead hypothesize that male cooperation is a strategy of less dominant males to overcome a female's ability to avoid mating. Fertility assurance may be less important for viviparous species with many pups because there is less energy invested in an unfertilized egg. Because most sharks are either oviparous or ovoviviparous, fertility assurance has important consequences for elasmobranch conservation.

0020 General Ichthyology I, Drummond, Saturday July 26, 2008

Genetic Divergence in Life History, Body Shape, Swimming Performance, and Mating Behaviour Between Lake and Stream Stickleback

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Threespine stickleback in Misty Lake and its inlet stream show dramatic differences in a number of phenotypic traits. We used common-garden experiments to determine the genetic basis for observed differences in life history (egg size and number), body shape (geometric morphometrics and univariate traits), swimming performance (burst and sustained), and male inter-sexual behavior. We find that many of these traits strongly differ between lake and inlet fish reared for their entire lives in a common-garden laboratory environment. These results show that the two ecotypes show considerable genetic differences in a wide suite of phenotypic traits. These differences likely reflect adaptive divergence and may influence the evolution of reproductive isolation.

0289 Sustainable Harvest Symposium, Drummond, Monday July 28, 2008

What REALLY Makes Long-lived Species more Susceptible to Overexploitation?

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Overexploitation of long-lived fishes, reptiles, and other species is more common than in short-lived species, such that long lifespan is assumed to be a direct, or at least indirect, driver of susceptibility to extinction. While a long adult lifespan is

naturally a direct result of low natural mortality, this does not in itself provide the direct cause of overexploitation because population processes such as density-dependent compensation should still occur in these species. And because long adult life is positively correlated with age at maturity, it would seem that the large number of age classes in these species could reduce their probability of extinction by allowing them to persist over many bad years. I explore the following hypotheses for the apparent increased vulnerability of long-lived fishes and reptiles: a) their life histories and population dynamics are fundamentally different from short-lived species, or at least from those assumed by the simplified models that are used to determine harvest levels, b) management actions are inadequate to respond to exploitation that targets long-lived species, due to time lags or other factors, or c) data collection and analysis for long-lived species fails to provide the correct signals of population status, thereby leading to overestimates of allowable harvest levels or underestimates of extinction risk. Case studies of sturgeon, dogfish, and sea turtles suggest that all three of these may be viable alternative explanations, but all indicate a need for greater precaution in management.

0097 Poster Session III, Sunday July 27, 2008

Origin and Development of the Palatal Organ: Using Zebrafish to Investigate the Development of Trophic Morphological Novelty

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Exploiting the conserved developmental mechanisms seen in vertebrates, the zebrafish has become a popular model organism within the field of biomedical research. Yet, by ignoring what makes this cypriniform fish unique we are overlooking a powerful model organism for investigating the origin and development of morphological novelty. The trophic diversity that characterizes cypriniform fishes includes a unique feeding mechanism whereby small food particles often encountered in benthic feeding are extracted. The structure that plays a key role in separating edible from inedible prey items during benthic feeding is the palatal organ. Located in the anterior pharyngeal roof, the palatal organ is a muscular cushion composed of a highly disorganized mass of differently sized muscle fibers covered by an epithelium studded with mucous cells. During feeding the palatal organ secretes mucus to entrap food and the muscles work to entrap and move the food along to the pharyngeal teeth. Functionally, and indeed even in histological sections the palatal organ strongly resembles a small mammalian tongue. There is little, if any, data addressing either the embryological origin of this muscular organ or the ontogenetic stage at which it first develops. Here we describe the ontogeny of the palatal organ in several ontogenetic stages of the zebrafish. The palatal organ, while less well-developed in zebrafish than in other cypriniforms, is apparent from very early larval stages. Moreover, the combination of muscle fiber types seen in the adult may reflect the complex embryological origin of this organ. Identifying the developmental mechanisms responsible for the origin of this feeding adaptation may enhance our understanding of how functional novelties arise and evolve.

0087 Fish Development/Reproduction, Salon 6&7, Sunday July 27, 2008

Turning a Model on its Head: Using Zebrafish to Investigate the Origin and Evolution of Morphological Novelty

L. Patricia Hernandez

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Exploiting the conserved developmental mechanisms seen in vertebrates, the zebrafish has become a popular model organism within the field of biomedical research. Yet, by ignoring what makes this cypriniform fish unique we are overlooking a powerful model organism for investigating the origin and early development of morphological novelties. As cypriniforms, zebrafish possess a number of poorly investigated adaptations associated with feeding: enlarged pharyngeal jaws opposed to an enlarged basioccipital process of the neurocranium instead of upper pharyngeal jaws; a muscular palatal organ found on the roof of the buccal chamber; and the kinethmoid, a rostral ossification associated with premaxillary protrusion. Taking advantage of some of the molecular tools used by developmental biologists we describe the early development, growth and possible evolutionary fates of some of these novel structures. The palatal organ, while less well-developed in zebrafish than in other cypriniforms, is apparent from early ontogenetic stages. Vertebrate morphologists have long examined premaxillary protrusion and pharyngeal jaw function in Perciformes, however appreciably less emphasis has been placed on investigating the convergent acquisition of these functions in Cypriniformes. Given that cypriniform fishes lack oral jaw teeth, there must exist significant selection for efficient pharyngeal jaw processing in these species. The speciose Cypriniformes possess a novel median bony element, the kinethmoid, which allows for a unique mechanism of premaxillary protrusion. We have examined the development of this important feeding innovation. Identifying the developmental mechanisms responsible for the origin of these feeding adaptations will enhance our understanding of how functional novelties arise and evolve.

0390 Amphibian Ecology, Jarry/Joyce, Monday July 28, 2008

Trait Mediated Effects of the Salamander, *Plethodon cinereus*, on Large Invertebrate Predators in a Terrestrial Detrital Food Web

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Evidence suggests that the terrestrial salamander, *Plethodon cinereus*, plays an important role in forest-floor food webs by regulating the abundance of mesofauna prey, and the rate of leaf litter decomposition. Most detrital food web studies focus on the direct and indirect effects of trophic interactions among pathways in a web, or on total web dynamics. There is, however, a growing body of literature centering on non-trophic effects that may influence the ecology of organisms in food webs. Because *P. cinereus* is territorial, we expect aggression toward guild members. This makes *P. cinereus* a model organism to address questions about how different taxa respond to each other within a trophic level, and how that response affects trophic cascades. We conducted a four year, open field plot, study in the Cuyahoga Valley National Park (NE Ohio, USA) to explore how organisms in the forest-floor food web respond to density manipulations of *P. cinereus* and large invertebrate predators.

Our results suggest that *P. cinereus* has a strong negative effect on spiders and on lithobiomorph centipedes but has a positive effect on carabid beetles. Spiders and centipedes were most abundant in salamander removal treatments compared to controls. Carabid beetles were most abundant in treatments with the most salamanders and least abundant in treatments where salamanders were removed. Additionally, some macrodetritivores were positively correlated with the presence of *P. cinereus*. Previous research investigating intraguild predation on centipedes and spiders by *P. cinereus* suggests that adults of *P. cinereus* do not prey upon adults of either of these two predators. Based on our results it is likely that trait-mediated effects of *P. cinereus* on other forest-floor predators are quite strong and are potentially attenuating the effects of predation on trophic cascades in this system.

0075 Fish Systematics IV, Salon A&B, Monday July 28, 2008

Osteology of *Parastromateus niger*, with Comments on Its Systematic Affinities and the Gill Arches of the Family Carangidae

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The monotypic Indo-Pacific genus *Parastromateus* is morphologically peculiar among carangid fishes in its overall body form. Historically, this peculiarity was emphasized and *Parastromateus* was separated out as a member of the monotypic family Apolectidae (Formionidae), although it has more recently been conclusively demonstrated to be a member of the family Carangidae based on the presence of shared derived characters, including the separation between the second and third anal fin spines. Within the family Carangidae, it has been considered to be a member of Carangini due to the presence of scutes on the caudal peduncle (albeit weakly developed), although the understanding of its relationship to other carangids has been hindered due in part to a lack of detailed anatomical data available for this species. In this presentation, we will describe the osteology of *P. niger* based on cleared and stained and dry skeletons representing a broad ontogenetic range (11-325 mm SL). Many aspects of its skeleton are clarified (e.g., structure of the skull, ontogenetic reduction in the pelvic fin rays while retaining a robustly developed pelvic girdle). In particular, the gill arches of *Parastromateus* are very distinctive among carangid fishes, in part because of the greatly elongated, nearly filamentous teeth that are associated with all pharyngeal toothplates and gill rakers. There is also a toothplate that bridges the epibranchial 4-ceratobranchial 4 articulation; this toothplate was only otherwise found in *Hemicaranx* among all carangid genera surveyed and may be reflective of common ancestry. Alternatively, *Parastromateus* shows remarkable similarity to the genus *Paratrachinotus* from the Eocene Monte Bolca Formation in terms of a high number of dorsal pterygiophores in the first interhaemal space (7-11 and 7, respectively) and loss of (obvious) pelvic fin rays in juvenile and adult specimens.

0434 Poster Session III, Sunday July 27, 2008

Headstarting Gopher Tortoises (*Gopherus polyphemus*) in Southern Mississippi

Matt Hinderliter

The Nature Conservancy, Camp Shelby, MS, United States

Telemetry studies of neonate gopher tortoises (*Gopherus polyphemus*) in Mississippi and Florida have shown that 90 - 100% of tortoises die within the first two years, and mortality is almost always attributable to predation. Additionally, burrow surveys in southern Mississippi usually reveal a disproportionately low percentage of hatchling and juvenile burrows, possibly indicating low recruitment. To investigate whether the same mortality rates apply to yearling and young juvenile tortoises, we initiated a headstarting study in 2006 on the Camp Shelby Joint Forces Training Center in southern Mississippi. Hatchlings were obtained from naturally incubated eggs and from eggs artificially incubated in a laboratory. In October 2006, 31 gopher tortoise hatchlings were placed in an enclosure designed to prohibit predation by mammals, fire ants, snakes, and raptors. Objectives of the study are to release part of the population each year, radio-track them, and recapture them biannually in order to gather information on: 1) growth; 2) home range; 3) burrow use and construction; 4) movement patterns; 5) site fidelity; and 6) causes and extent of mortality. In September 2007, ten yearling tortoises with transmitters were released back to the burrows where they were originally oviposited, and to date are all still alive. Laboratory incubation of eggs was repeated in 2007 to add to the population residing in the enclosure, and the current plan is to incubate more eggs in the summer of 2008, and release hatchling, one-year-old, and two-year-old tortoises at the same time in the fall of 2008. By monitoring different-aged tortoises over several years, we should begin to determine when tortoises reach size or age thresholds that make them less susceptible to certain types of predation.

0540 General Ichthyology III, Drummond, Sunday July 27, 2008; STOYE GENERAL ICHTHYOLOGY

Dating the Cypriniformes Tree of Life

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Cypriniformes is a large group of primarily freshwater fishes containing more than 3,500 species in eight families and are found in Africa, Asia, Europe, and North America. Previous studies have used biogeography to estimate divergence times within Cypriniformes but I present the first large-scale analysis of divergence times of cypriniform families and subfamilies, as well as an estimate of the divergence of cypriniforms from the other ostariophysans using fossil calibrated molecular phylogenies. The oldest cypriniform fossils date to the Early Paleocene, approximately 62 million years ago, although there is speculation that the order originated in the Cretaceous or even earlier. We used the mitochondrial protein-coding gene, cytochrome *b* (1140bp) to infer interrelationships among cypriniform families and subfamilies using Maximum Likelihood and Bayesian methods. In the future, additional mitochondrial and nuclear loci will be added to better resolve the tree and to give more precise estimates of divergence times. Taxon sampling included representatives from all eight cypriniform families, all subfamilies, and representatives from other ostariophysan orders. Minimum ages for nodes on the

molecular phylogeny were determined from known fossils from each of the following cypriniform families; Catostomidae, Cobitidae, Cyprinidae, and Nemacheilidae, and from outgroups. Estimates of the divergence time of Cypriniformes from the other ostariophysans, as well as the divergence times of the families and subfamilies within the order, were calculated using penalized likelihood.

0162 Poster Session III, Sunday July 27, 2008

The Effects of Natural and Anthropogenic Disturbance on Red-backed Salamanders in Northern Hardwood Forests

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A significant body of literature exists on the effects of silvicultural practices on wildlife populations; however, research on wildlife responses to natural disturbance events occurs less frequently. Further, research comparing natural and anthropogenic disturbances is rare in forested ecosystems. However, one common goal of ecosystem management is to replicate natural disturbance regimes. Thus, understanding the degree to which silvicultural practices compare with natural disturbance processes is needed for informing ecosystem management approaches. We compared the initial effects of even- and uneven-aged timber management, and ice-storm damage on red-backed salamanders. This study was conducted within northern hardwoods in the White Mountain National Forest, New Hampshire, U.S.A. The abundance of salamanders on the forest floor was estimated using artificial cover boards and area constrained searches. In addition, we measured the effect of disturbance on microhabitat characteristics and the influence of microhabitat characteristics on salamanders to identify how changes in abiotic characteristics due to forest disturbance influence red-backed salamander populations. Even-aged harvests had a greater effect on salamander abundance than did either uneven-aged management or ice-storm damage. Salamander abundance was similar in natural disturbance and uneven-aged management habitats. Although abundance of salamanders was lower at ice-storm damage and single-tree selection sites compared to undisturbed sites, differences were not statistically significant. Among forest disturbance types, soil temperature and characteristics of leaf-litter predominantly influenced salamander distribution. Overall, even-aged management had greater initial effects on salamander abundance than uneven-aged management. However, to obtain a similar volume of timber uneven-aged harvests require a greater area of land than even-aged harvests. As such, the additional area of forest impacted under uneven-aged management practices may or may not counter the relatively small impact that this type of harvesting has on red-backed salamanders.

0161 SSAR Seibert Competition, Salon 4&5, Friday July 25, 2008; SEIBERT CONSERVATION

Initial Effects of Experimental Forest Management on a Terrestrial, Woodland Salamander in Missouri

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Concerns have been raised regarding widespread declines of *Plethodon* salamanders over the past 15 years. Forest management is certainly not a universal cause of these declines, however, there is evidence that timber harvest significantly reduces amphibian populations. Clearcutting creates hotter, drier conditions that can deleteriously affect salamanders through desiccation and altered energy budgets. While clearcuts have been shown to be generally detrimental, few studies have examined the effects of alternative silvicultural techniques on salamanders. We established four experimental forest treatments at each of four sites in 2004-2005. The treatments were two clearcuts, a thinning cut, and an unmanipulated control. In February 2007, one of the clearcut treatments at each site was burned to simulate a timber management technique of regional interest. At three replicate sites, we placed sets of coverboards in two transects through each treatment. We checked coverboards for salamanders once every 7-10 days from April – October 2007. We captured a mean (SE) of 4.0 (1.9), 0.3 (0.4), 13.7 (9.3), and 15.3 (5.9) salamanders in the burn, clearcut, partial, and control treatments, respectively. Additionally, 75% of individuals captured in the burned treatments were juveniles, compared with 31% and 38% in the partial and control treatments. While the burn and clearcut treatments did dramatically reduce salamander captures, there were no apparent differences among the partial and control treatments. Our data suggest that thinning and single tree selection silvicultural practices may not have strong impacts on woodland salamanders. Finally, initial results indicate that burning following clearcut logging may not be more detrimental to salamanders than clearcutting alone. Continued monitoring is necessary to determine if habitat changes associated with burning, including the removal of coarse woody debris, have longer term effects on *Plethodon* salamanders.

0436 Poster Session II, Saturday July 26, 2008

A Hybrid Technique Using Visual Implant Elastomer and Toe-clipping to Individually Mark Anurans

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Here we report on the use of a hybrid marking technique (VIE-C) combining Visible Implant Elastomer (VIE) marks with toe-clipping to mark individual treefrogs (Hylidae). Our marking strategy entailed injecting elastomer into the plantar surface of the digits and clipping only one toe. This method allows large numbers of frogs to be individually marked without clipping multiple toes, and minimizes the frequency of elastomer migration from the injection site, a common problem with VIE marks on the body or limbs. We found retention rates of VIE marks in the digits to be similar

those for toe-clipping, indicating that VIE provides a satisfactory alternative to multiple toe-clips. In addition, cost of materials, frog handling time, and ill effects were minimal. We recommend this marking scheme to researchers considering techniques for marking anurans, as it reduces potential negative effects of clipping multiple toes, and provides inexpensive and long-lasting marks that can be easily and quickly read in the field by trained observers.

0301 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Seasonal Temperature Habitats of Skate Species off the Northeast Coast of the U.S.

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The role of temperature in affecting seasonal distribution patterns of skate species off the Northeast coast was investigated using Northeast Fisheries Science Center spring and autumn trawl survey data. Survey data on (a) skate catches and catch locations and (b) bottom water temperatures were analyzed to identify seasonal habitats and temperature preferences of juveniles and adults of each species, and to determine habitat overlaps. Temperature habitats differed among species, and some species exhibited partially overlapping habitats. Autumn and spring temporal habitats differ more for juveniles than for adults of the same species. Seasonal differences in catch-weighted temperature are species-specific, but most of the species are distributed in cooler waters during spring and in warmer waters during autumn.

0305 Poster Session I, Friday July 25, 2008

Age Validation of Little Skate and Winter Skate Using Tetracycline Marking at both Egg and Adult Stages

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The northeastern American skate complex is a data poor fishery resource. For example, age data are not available for all skate species in all areas. As part of an age validation study on multiple skate species, individuals were treated with tetracycline at egg and adult life stages. The main focus of this study is to validate the periodicity of vertebral bands in adult specimens that were given an intraperitoneal injection of tetracycline. Adult little and winter skates are currently being maintained in a seawater laboratory facility for a minimum of one year. Subsamples were sacrificed early and mid-way through the experiment to confirm that incorporation of tetracycline into the vertebrae occurred in each treated species. As part of a preliminary study attempting to validate the formation of the birthmark, egg cases of little and winter skates were injected with tetracycline. The birthmark is often defined as the change in angle of the corpus calcareum, but is not consistently

formed. Alternatively, defining the birthmark as the first visible band in the centrum may underestimate the true age. Two trials of injections were conducted: (a) tetracycline directly injected into the yolk-sac; and (b) tetracycline injected into the cavity of the egg case. After each treatment, egg cases were maintained at ambient water temperatures in separate tanks. Newly hatched individuals will be immersed in an alizarin complexone waterbath, in an attempt to mark the hatch mark. Successfully hatched skates will be maintained for various time periods to determine if the tetracycline was incorporated in the notochord. If this treatment is successful, it may be applied to other skate species in the complex to validate age determination.

0475 Poster Session I, Friday July 25, 2008

NOAA Southeast Fisheries Science Center Elasmobranch Tagging Management System: One Database to Bind Them All

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

0728 Poster Session III, Sunday July 27, 2008; STORER ICHTHYOLOGY

Predictive Modeling and Spatial Mapping of Rare Fish Species Using Boosted Regression Trees: A Step Toward High-Resolution Conservation Planning

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Understanding species distributions is a central precept of conservation research. I analyzed the relationship between landscape attributes and the distributions of rare fishes in the upper Green River system (Ohio River drainage) at multiple spatial scales. Analyses were carried out using boosted regression trees (BRT) and occurrence records from museum collections. BRT are a form of logistic regression employing a boosting algorithm which greatly improves predictive accuracy over traditional classification trees. The resulting models indicate variable influences of

natural and anthropogenic landscape attributes at each spatial scale and for each species. Specifically, the BRT models were able to capture complex interactions and instances where anthropogenic influences superseded the influence of natural environmental variables. The spatial distributions of each species were then predicted for each segment of the stream system using a Geographical Information System (GIS) and data quantified at multiple spatial scales. Validation of the modelling technique was completed using records for three proxy species with variable patterns of distribution and with similar numbers of occurrence records. In each case, the area under the Receiver Operating Characteristic curve (AUC) exceeded 0.75 – a useful amount of discrimination between sites of species presence and absence. The distributional maps from the analyses are now being used to visualize assemblages of rare fishes in the upper Green River. Furthermore, the modeled distributions and ancillary spatial data are being employed in the development of a spatial-selection algorithm to identify and prioritize freshwater biodiversity conservation areas in the aforementioned river system.

0350 AES Systematics & Biogeography II, Jarry/Joyce, Sunday July 27, 2008

Genetic Structure of the Gray Reef Shark (*Carcharhinus amblyrhynchos*), Based on Microsatellite and Mitochondrial DNA Analyses With Implications For Management

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The gray reef shark (*Carcharhinus amblyrhynchos*) is an Indo-Pacific, coral reef associated species that presumably plays an important role as apex predator in maintaining the integrity of coral reef ecosystems. Populations of this shark have declined substantially in some regions due to over-fishing, with recent estimates suggesting a 17% decline per year on the Great Barrier Reef (GBR) and projections of only 0.1% of current populations remaining after 20 years at current exploitation rates. There is no information on population structure of gray reef sharks to aid in their management and conservation. We are assessing genetic structure in this species by using entire mitochondrial control region sequences and 15 nuclear microsatellite loci as markers. 275 gray reef shark samples were obtained from across the species' Indo-Pacific distribution: Western Indian Ocean (Madagascar/Seychelles), Eastern Indian Ocean (Cocos (Keeling) Islands, Western Australia), Central Pacific (Hawaii, Palmyra Atoll, Fanning Atoll), and Southwestern Pacific (Eastern Australia - GBR). Mitochondrial and microsatellite data concordantly identify Hawaii, the western Indian Ocean and Cocos (Keeling) Islands populations as genetically distinct relative to other sampling locations. Interestingly, the Palmyra and Fanning Atoll sharks, although showing significant genetic differentiation from the geographically closer Hawaii population, are not genetically differentiated from the geographically farther GBR population. Overall, at least four genetically identified management units appear to exist despite the modest geographic sampling depth: 1. Western Indian Ocean, 2. Cocos (Keeling) Islands, 3. the Southwestern Pacific/Palmyra-Fanning Atolls, and 4. Hawaii. These results show strong genetic differentiation exists in gray reef shark populations separated by expanses of open ocean, and suggest proper management of this declining species will have to occur at the very least on a regional geographic scale.

**0624 Herp Stressors/Snake Conservation, Salon 6&7, Monday July28, 2008;
STOYE CONSERVATION**

**Possible Effects of Endocrine Disrupting Chemicals on Diamondback
Terrapins (*Malaclemys terrapin*) from Four Northeastern Sites**

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Many chemicals are known to disrupt the endocrine systems of some animals, leading to developmental and reproductive disorders. The waters of Jamaica Bay, NY (JB) contain high concentrations of known endocrine disrupting chemicals (EDCs). Jamaica Bay is also home to New York State's largest population of diamondback terrapins (*Malaclemys terrapin*). The purpose of this study was to determine the possible effects of EDCs on the terrapins of JB. At least thirteen clutches from Jamaica Bay and each of three comparison sites (Cape May Peninsula, NJ, Peconic Bay, NY, and Barrington River, RI) were collected from naturally laid nests. Eggs were randomly distributed among containers, incubated at a constant temperature, and weighed periodically. Hatchlings were reared and evaluated for six months. Body size (mass, carapace and plastron length) was measured routinely for each hatchling. Shell abnormalities were noted for each turtle. Righting response was tested on each turtle at various intervals to determine locomotor performance. Eggs and hatchlings from Jamaica Bay were larger than the other three sites. Cape May Peninsula turtles had the lowest percentage of shell abnormalities. Locomotor performance of turtles from all sites markedly increased with age. Although Jamaica Bay is probably the most heavily polluted of the four study sites, the results did not indicate that Jamaica Bay turtles were adversely affected. Major effects from EDCs on terrapins may occur over a more extended period of time in nature. The aromatase levels of hatchlings will be determined, as these may provide further insight to the effects of EDCs on diamondback terrapin hatchlings.

0576 General Ichthyology I, Drummond, Saturday July 26, 2008

**Temperature, a Sex-Linked Allele, and Autosomal Modifier(s) Control the
Expression of Melanism in Male Mosquitofish (*Gambusia holbrooki*)**

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The objective of this study was to determine the mechanisms responsible for control of the rare, melanic (black pigmented) phenotype in male mosquitofish (*Gambusia holbrooki*). Intrapopulation crosses of virgin female by melanic male mosquitofish were conducted for three populations of fish collected from nature. Between population crosses were also conducted for two of these three populations. Fish from all crosses were reared first in warm (31°C) then in cold (18°C) temperatures to evaluate the effect of genetics and environment on melanic (black) expression. Results demonstrate that melanic expression is best explained by a sex-linked allele, plus one (or more) autosomal modifier(s). In some populations melanic coloration is temperature-sensitive and requires cold temperature for expression, while in other populations it is not temperature-sensitive and melanic expression begins a few days after fry are born into a warm environment. In summary, melanism in mosquitofish is controlled by a few genes and by temperature. It is likely that more than one melanism 'allele' has arisen, since different populations express melanism during different gestational periods under different temperature regimes. Further, there is a

positive association between the sex-ratio of the progeny produced by melanic males and the frequency of melanic male fish produced. The higher the frequency of melanism in offspring, by population, the greater the male bias in these offspring.

0073 Amphibians in Ecosystems Symposium, Salon 6&7, Sunday July 27, 2008

Toads Change Litter Chemistry but Not Litter Invertebrates and Litter Decay Rates in an Asian Subtropical Forest

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Amphibian populations have declined globally in the past 20 years and over one-third of amphibian species worldwide are threatened. However, the role of amphibians in ecosystem processes is just beginning to be explored. Litter decomposition is an important process for biogeochemical cycles and plant production in terrestrial ecosystems. We report a field experiment conducted in a lowland forest that used field enclosures to evaluate effects of the toad, *Bufo bankorensis*, on litter invertebrates and litter decomposition rates. We collected litterbags from toad and control (toad-excluded) enclosures to determine the invertebrate communities, decay loss, and nutrient contents of the litter. The presence of *B. bankorensis* significantly increased phosphorus concentrations in the litter, but did not alter the densities of litter invertebrates or rates of litter decomposition. These results were not consistent with the previous studies, which showed that *Plethodon cinereus* in a temperate forest of north-east USA and *Eleutherodactylus coqui* in a tropical rain forest of Puerto Rico significantly changed litter decomposition rates. We suggest that the functional roles of amphibians may be species-specific and vary with different terrestrial ecosystems.

0426 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Movement Patterns and Environmental Preferences of Blue Sharks (*Prionace glauca*) Determined by Satellite Archival Tagging

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Blue sharks (*Prionace glauca*) are common, highly migratory, pelagic sharks with hundreds of thousands captured annually in pelagic longline fisheries. They also form the largest component of the international fin trade. Despite their prevalence in global fisheries, management relevant information on their habitat utilization and movement patterns is fragmentary. During the summer of 2007, twenty-three blue sharks (male, n=21; female, n=2) were tagged with Microwave Telemetry Inc., satellite pop-up transmitters near Cape Cod, MA. Programmed pop-off dates ranged from 30 days to 12 months. To date, tags have collected information ranging

between 4-186 days with seven tags still at liberty. Blue sharks preferred surface waters and spent 43% of their time at less than 2.4 m depth, 66% of their time at depths less than 5 m (± 2.4 m) and 77% of their time at less than 11 m (± 2.4 m). Sharks spent 70% of their time in waters between 14-20°C. When sharks traveled off the continental shelf into deeper waters they dove more frequently. Geoposition was determined based on light level data and analyzed using the Kalman-SST filter. Sharks remained on the continental shelf during summer months, but moved to distant, off-shelf locations as the seasons progressed. One male shark moved at least 2,485 km over 6 months from its September tagging location to coastal Puerto Rican waters; another male shark moved at least 1,447 km from Cape Cod to the east of Bermuda between August and February. We will report a more detailed perspective on movement patterns from these and additional tags scheduled to release within the next few months.

0238 Poster Session I, Friday July 25, 2008

Age and Growth Estimates for the Smallnose Fanskate, *Sympterygia bonapartii* in the South-west Atlantic and Derived from Captive Born

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The smallnose fanskate, *Sympterygia bonapartii* is common endemic skate specie from south-west Atlantic. Although the relative abundant and broad geographical distribution few studies were conducted on biology of the smallnose fanskate. In order to provide insight into the life history of *S. bonapartii*, age and growth were estimated using vertebral centra from skates captured from research cruises conducted by Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP) in Uruguay and north Argentina coastal waters (34°-42°S). As well, the reproductive success of smallnose skate at Temaiken aquarium provided an opportunity to obtained data on growth between 0-2 years under constant temperature (16.4-18.2°C) and fed daily. Both captive and wild size at age data were fitted to Gompertz growth model. Vertebral age estimates ranged from 0- 12 years for females and 0- 8 years for males. Age at 50 % maturity estimated to be 7.03 years (63.5 cm TL) for females and 8.51 years (62.3 cm TL) for males. From the 25 born in captive skates measured monthly, the parameters estimated for females and males were $L_{\infty} = 83.90$ cm, $k = 1.00$ cm year⁻¹ and $L_{\infty} = 72.78$ cm, $k = 1.08$ cm year⁻¹, respectively. Female size at maturity was reached at 61 cm Lt (1.78 years), considered at the moment of oviposition. Captive females and males grew an average of 25.44 cm year⁻¹ 22.78 cm year⁻¹, respectively. Theoretical longevity was estimated between 14.12- 14.32 years for wild population and 3.28- 3.62 years for captive skates. This study is the first contribution to estimate age and growth for *S. bonapartii*. This information greatly improves the understanding of smallnose fanskate biology, and will be applicable to the stock assessment and management of this species in Uruguay and north Argentina coastal.

0412 Poster Session III, Sunday July 27, 2008

Population Genetics of Four Species of *Pteronotropis*

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Fishes within *Pteronotropis* are distributed across small clear or tannin-stained streams of the Gulf of Mexico and Atlantic coastal plain drainages in the southeastern United States. Due to the inherent patchiness of their small stream habitats and recent habitat loss, the distributions of *Pteronotropis* have become increasingly fragmented across their limited species ranges. In order to elucidate population genetic patterns in species with fragmented distributions microsatellite variation in four species of *Pteronotropis* from two Gulf of Mexico coastal plain drainages was examined. *P. euryzonus* and *P. grandipinnis* from the Apalachicola River drainage and *P. merlini* and *P. hypselopterus* from the Choctawhatchee/Pea River drainage were included in the study. Analysis of microsatellite variation sheds light on patterns of gene flow in species with fragmented ranges and may have important conservation implications.

0030 AES Functional Morphology, Jarry/Joyce, Friday July 25, 2008

Chondrichthyan Feeding Biomechanics: Intra- and Inter-specific Scaling Patterns

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The feeding performance of chondrichthyans is paramount in their ecological and evolutionary success. As performance is determined in part by morphology, it can be expected to change as an organism grows, thereby resulting in changes in resource acquisition. Changes in bite force were therefore investigated over ontogeny in the horn shark (n = 12, 19-59 cm SL), blacktip shark (n = 14, 48-121 cm SL), and spotted ratfish (n = 8, 21-44 cm SL) (intraspecific scaling) via biomechanical modeling. As aquatic poikilotherms, chondrichthyans can grow very large, making them ideal subjects with which to investigate the effects of body size on bite force among species as well. Therefore, an interspecific scaling analysis of bite force among ten species varying in size by nearly three orders of magnitude (16-300 cm SL) was used to determine if the high bite forces of large chondrichthyans are simply a consequence of their large body size, or rather the result of diet-related adaptation, and if changes in bite force are correlated with changes in head and tooth shape among species. Positive allometry of bite force over ontogeny was observed in all three species via positive allometry of jaw adductor muscle force (horn shark), jaw leverage (spotted ratfish), or both (blacktip shark). However, bite force scaled isometrically among chondrichthyan species, perhaps indicating that at large sizes, high absolute magnitudes of bite force overcome any mechanical constraints set by prey, precluding the need for relatively high feeding performance. Additionally, head width was found to be the best predictor of bite force among these ten species. These contrasting scaling patterns are indicative of the unique selective pressures acting on chondrichthyans varying widely in size.

0525 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

Deep Diving and Distant Travels: Vertical and Horizontal Movements of Whale Sharks (*Rhincodon typus*) Tagged off Quintana Roo, Mexico

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Satellite-linked pop-up archival transmitting (PSAT, Wildlife Computers) tags affixed to eleven whale sharks (six male, five female) ranging 5.5-8 m TL off Isla Holbox, Mexico have successfully transmitted data on depth, temperature and geolocation of animal movements. Once off the continental shelf, the sharks display dives to as much as 1,720 m (over one mile deep). Four of the 11 tags have been recovered and two provided significant minute-by-minute data. In some cases dives show a distinct crepuscular pattern of deepest diving at sunrise and sunset. Dive profiles are steep with descents of more than 30 m/min and even faster ascents, with no leveling off between surface and deepest point of the dive, indicating that feeding may not be the primary purpose of the diving behavior. Most geographic movements observed to date have been confined to the Gulf of Mexico basin, the northwest corner of the Caribbean Sea, or the Straits of Florida. However, one female shark demonstrated a migration of at least 7,213 km in 150 days, during which the shark moved from the southeastern Gulf of Mexico, through the northern Caribbean Sea, into the North Atlantic Ocean and across the equator to the South Atlantic Ocean, where the tag popped up near the Mid-Atlantic Ridge between Brazil and western Africa. This long-distance movement is consistent with genetic evidence that the Atlantic probably contains a single population of whale sharks.

0622 Herp Biogeography, Salon 4&5, Saturday July 26, 2008

Box Turtles in Arkansas

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The status of three-toed and ornate box turtles is relatively unknown in Arkansas. The ornate box turtle (*Terrapene ornate ornate*) distribution includes most of western Arkansas where it overlaps with the three-toed box turtle (*Terrapene carolina triunguis*) and in some locations they are sympatric. I surveyed 18 locations in Arkansas to examine for presence/absence of both species. Habitat loss has probably contributed to increased sympatry as I found new site records. Morphological examinations and preliminary genetic analysis suggests that hybridization between individuals of the two species is occurring. This has important conservation implications for the rarer (in Arkansas) ornate box turtle.

0688 Herp Systematics, Drummond, Friday July 25, 2008

Molecular Systematics of the Chamaeleonidae: A Balanced view from Africa and Madagascar

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While the true chameleons (Chamaeleonidae) are one of the most recognizable groups of lizards, due of their unique morphology, the generic relationships within the family are not well resolved. This is largely due to sampling bias, with previous molecular studies focusing primarily on taxa within a single geographic region: Africa or Madagascar. Here, we present the most complete taxonomic sampling to date for the family, with representatives from all currently recognized genera and species groups. This survey builds on previous molecular studies, combining mitochondrial (ND2, ND4, 16S) and nuclear loci (RAG1, Cmos, BDNF). Our novel phylogenetic results are discussed here within both a taxonomic and biogeographic context for the group and we present the first divergence time estimates for the entire family.

0462 Herp Systematics, Drummond, Friday July 25, 2008

Phylogenetic Affinities of the Namaqua Day Gecko, *Phelsuma ocelatta*

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Phelsuma and *Lygodactylus* are two genera of diurnal geckos thought to be closely related to one another. *Lygodactylus* consists of 58 species and is distributed in Madagascar, Southern African and South America whereas *Phelsuma* is found primarily on Madagascar and surrounding islands. The only possible exception to the restricted distribution of *Phelsuma* is *Phelsuma ocelatta*, endemic to western South Africa and Namibia. Although the placement of this species into the genus *Phelsuma* from a previously monotypic genus *Rhoptropella* is well supported by morphological and allozyme evidence, some recent work on visual systems and DNA sequence have suggested a lack of support for a close relationship of this species to *Phelsuma*. To examine the relationships of these three taxa, we sequences both mitochondrial (ND2) and nuclear (RAG1, phosducin, and POMC) DNA for all major lineages of *Lygodactylus*, *Phelsuma*, and multiple samples of *Phelsuma ocelatta*. Our resulting phylogenetic hypothesis supports the morphological and allozyme data in placing *Phelsuma ocellata* as the sister taxon to *Phelsuma*. The mitochondrial data supports a weak alternative arrangement and decreased taxon sampling improves this conflicting relationship, suggesting that the previous phylogenetic placement of *P. ocellata* as sister taxon of *Lygodactylus* was the result of incomplete taxon sampling coupled with a lack of resolution of mitochondrial markers.

0131 Poster Session II, Saturday July 26, 2008; STORER HERPETOLOGY

Home Range Size of Male and Female Northern Pacific Rattlesnakes (*Crotalus o. oreganus*)

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Home range, behavior, and timing of movements vary in different populations of rattlesnakes. Through radiotelemetry work, home range size of male and female Northern Pacific Rattlesnakes (*Crotalus o. oreganus*) in the Carrizo Plain of Central California was compared. Global positioning systems (GPS) data and geographic information systems (GIS) were used to determine the home range size (minimum convex polygon) of each snake over a 1-2 year period. The home range analyses exhibited an effect of sex on home range size, with males having larger home ranges than females. There was also a strong correlation between the size of the snake and the size of the home range, as larger animals inhabited a much larger area than smaller ones. Because male *C. o. oreganus* are much larger in SVL and mass than females, the effects of sex and body size on home range are confounded. Further studies on snakes of a wide range of body sizes will help elucidate the relative contributions of sex and body size on home range size.

0032 Poster Session I, Friday July 25, 2008

Progress in Molecular Systematics and Inference of Reproductive Evolution of Characid Fishes (Teleostei: Ostariophysi)

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The ostariophysan family Characidae encompasses over 900 species, yet the monophyly of the family and the relationships among its genera are largely obscure. The large number of genera that are unassigned to a subfamily (i.e., *incertae sedis*) attests to this point. The characid subfamilies Cheirodontinae, Glandulocaudinae, and Stevardiinae, as well as some *incertae sedis* genera, contain all of the characiform fishes known to be inseminating. Molecular phylogenies that include multiple characid species are few, and even rarer are those molecular phylogenies that incorporate more than one inseminating characid species. We sought to infer the relationships among genera that contain inseminating species and deduce the number of times insemination evolved. Preliminary analyses included inseminating representatives of Xenobryconini, Corynopomini, the *incertae sedis* genus *Rachoviscus*, and certain externally fertilizing genera. DNA sequence data from multiple markers were analyzed using cladistic methods under the parsimony criterion. When insemination is optimized onto a cladogram, our results suggest that insemination has multiple origins within Characidae.

0228 Poster Session II, Saturday July 26, 2008

**Female Behavior Facilitates Mate Detection in Northern Watersnakes
(*Nerodia sipedon*)**

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Female snakes have historically been regarded as playing little more than a passive role in mating systems, simply waiting to mate with the male who is victorious in pre-copulatory intrasexual competitions. Though the advent of radio telemetry has afforded new insights into reproductive ecology, the vast majority of our current understanding of mating dynamics still stems from factors influencing male mate acquisition (e.g., movement tactics, agonistic bouts). Here, we examine the association between female ecdysis, movement, and mate detection in Northern Watersnakes (*Nerodia sipedon*). We monitored eight radio-equipped adult female *N. sipedon* for ecdysis events, movement, attractiveness, number of mates, temporal mating pattern, and mating frequency four times daily throughout the 2007 mating period (April–June). Females were alone during the majority of the mating period indicating they were not attractive to males. However, immediately following an ecdysis event, which occurred multiple times within the mating period, female movement (daily distance moved and frequency) peaked. The amount a female moved within a given mating period was a good predictor of the number of males she was located by and females were more likely to be located by a male immediately following an ecdysis event than during the remainder of the mating period.

0109 AES Student Papers II, Kafka/LeMaratine, Friday July 25, 2008;
GRUBER

**Influence of Temperature on the Habitat Use and Movement Patterns of
Round Stingrays in a Southern California Estuary**

Katherine Jirik, Christopher Lowe

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Sexual segregation among elasmobranchs often results in differential habitat use, with females of some species moving into shallow, inshore environments during summer. Although behavioral thermoregulation has been purported to explain this pattern, difficulties remain in linking a thermal preference to reproductive behavior or pregnancy. Generalizing habitat preferences can be complicated further if thermal regimes differ between habitat types within an inshore environment (e.g. restored vs. natural estuarine areas). This study compared the abundance and movement patterns of round stingrays (*Urobatis halleri*) in restored and natural habitats of the Anaheim Bay Estuary (California, USA) to determine whether rays prefer warmer water habitats and if females utilize these areas during pregnancy. Rays were seasonally abundant with the highest densities occurring from May–August and few rays present from October–April (2006–07). Higher ray densities correlated with warmer seafloor water temperatures. Ray densities were also higher in the restored habitat than the natural habitat, except during September. Sex ratios were highly skewed toward female rays in restored habitats but only slightly skewed toward females in natural habitats. Ultrasonography, performed on a subset of female rays in restored areas, confirmed that 80% of rays were pregnant. In addition, passive acoustic telemetry revealed that rays showed site fidelity to restored areas during

spring and summer, but moved into natural areas during early fall or emigrated from the estuary altogether by winter. This was supported on a shorter temporal scale by quantifying the daily activity spaces of rays during summer and fall. These results, combined, suggest that water temperature influences ray habitat preference and pregnant females that aggregate in restored areas may attain a thermally-derived reproductive benefit by selecting warmer habitats during gestation.

0668 Poster Session II, Saturday July 26, 2008

Form, Function & Fitness—Selection and Performance Gradients for Tadpoles Exposed to Predatory Naiads

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Natural selection acts on traits through the impact of those traits on organismal performance, which is the direct target of selection. To disentangle direct and indirect aspects of selection, we use the morphology, performance, and fitness path analysis of Arnold (*Am. Zool.* 23:347–361). In the classic predator-prey system of tadpoles v. predatory insects, there is conflicting evidence and intuition, which we address using the Arnold framework. Two hypotheses are generally advanced to explain how anuran morphology reduces predation risk: (1) by improving the tadpole's escape swimming performance, or (2) by using the tail to lure predator strikes away from the tadpole's body. We measured size, shape and burst swimming speed of 190 tadpoles and exposed them to predators to assess survivorship. Arnold's suggested path analysis, with additional direct paths from traits directly to fitness was used to understand patterns of selection and performance in the system. Tadpole morphology affected burst swimming speed, but swimming speed did not influence survival. Fast tadpoles were large, had long tails, deep tail muscles, and proportionally small bodies. However, tadpole body shape akin to published accounts of tail lure morphology had a direct relationship with survival. Thus, only the tail lure effect was supported. This study documents the utility of analyzing multiple trait effects. It also demonstrates that adding direct paths between traits and fitness to the classic Arnold path model can shed light on alternative functional hypotheses of selection. (published in *Evolution*, in press)

0430 Fish Systematics III, Drummond, Saturday July 26, 2008

Ontogeny and Homology of the Sucking Disc in Remoras (Teleostei: Perciformes: Echeneidae)

G. David Johnson

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Fishes of the carangoid family Echeneidae are characterized by a complex, adhesive, ovoid suction disc on top of the head with which they attach themselves to various marine hosts, including other fishes, sea turtles, and cetaceans. The moveable parts of the disc are serially arranged, bilaterally paired, rectangular, spinulose laminae

that can be raised and lowered like the shutters of Venetian blinds; these laminae are collectively encircled by a thick, marginal "lip" of flexible connective tissue. Since its earliest descriptions, there has been general agreement that the bony components of the echeneid disc are those of a highly modified, spinous dorsal fin that has migrated from the usual postcranial location to a supracranial one and would thus comprise the proximal, middle and distal radials of spinous dorsal pterygiophores and dorsal spines. Most early authors (e.g., Gunther, 1860; Beck, 1869; Storms, 1888; Regan, 1912) who studied the anatomy of the disc proposed that the bilaterally paired laminae represent two halves of a transformed spinous ray, although there was considerable disagreement about exactly how this transformation occurred. Surprisingly, however, three recent papers (O'Toole, 2002; Fulcher and Motta, 2006; Richards, 2006) rejected the earlier hypotheses that the paired disc laminae are dorsal spines and proposed instead that they represent "a laterally expanded distal pterygiophore, while the medial spine is a reduced dorsal-fin spine." An ontogenetic perspective is clearly critical to ultimate resolution of this long-standing homology question, but echeneid larvae of sizes at which the bony components develop and transform are rare in larval fish collections. In 2005, I spent seven weeks exploring the extensive unsorted larval fish collections that emanated from over twenty years of plankton sampling by Japanese vessels surveying scombroid spawning grounds. The still unsorted non-scombroid specimens were made readily accessible in 2001, when they were transferred from the Far Seas Research Laboratory in Shimizu to the National Museum of Nature and Science in Tokyo. The developmental series I managed to acquire there provides unequivocal evidence that the paired disc laminae do indeed represent two halves of a transformed spinous ray, and, perhaps more importantly, elucidate the precise ontogenetic trajectory through which this extraordinary transformation occurs.

**0582 AES Student Papers III, Kafka/LeMaratine, Friday July 25, 2008;
GRUBER**

Functional Consequences of Structural Differences in Stingray Sensory Systems (Elamobranchii: Batoidea)

Laura Jordan

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This comparative study of stingray species addresses the relationship of form and function in two sensory systems. Elasmobranchs demonstrate remarkable sensory capabilities. Particularly high interspecific diversity exists in batoid mechanosensory lateral line and electrosensory systems, which allow elasmobranchs to detect water movements and electrical fields respectively. This study compares sensory anatomy and detection capabilities of the lateral line and electrosensory systems in the benthic round stingray, *Urolophus halleri*, benthopelagic bat ray, *Myliobatis californica*, and the pelagic stingray, *Pteroplatytrygon violacea*. Predictions based on detailed sensory system maps were tested in behavioural detection experiments. *U. halleri* feeds primarily on small epifaunal benthic invertebrate prey and the lateral line shows a high proportion of ventral non-pored canals while the electrosensory pores are highly concentrated around the mouth. *M. californica*, which feeds primarily on infaunal benthic invertebrates, has extensive and highly branched pored lateral line canals and a high electrosensory pore number and density concentrated anteriorly. Both systems in *M. californica* have dramatic lateral extension toward the wing tips on anterior edges of the ventral surface of the pectoral fins. *P. violacea* feeds primarily on squid and teleost fish, and has an intermediate proportion of pored and non-pored canals with little branching of pored canals and a significantly reduced electrosensory pore number and density. Responses of each species to weak water

jets and electrodes are compared. *M. californica* responds to water jets at a higher rate over a significantly greater proportion of its disc width. Responses to weak electrical fields were comparable to those observed for sharks with minimum responses below 1 nanovolt per cm for benthic feeding species. Ecological and evolutionary implications of these results are discussed.

0530 Poster Session III, Sunday July 27, 2008

Temperature, Toads, and Trajectories: Morphological Ontogeny of Tadpoles in Different Thermal Regimes

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Recent progress has been made towards the explanation of how abiotic factors influence morphological phenotype in amphibians. Still, few studies have addressed the relationship between abiotic factors and morphological phenotype through ontogeny. Here, we examine development as a phenotypically plastic aspect of larval anurans and attempt to clarify the relationship between morphology, developmental temperature, and ontogeny in American Toad larvae. Fertilized eggs of the American Toad, *Anaxyrus* (= *Bufo*) *americanus* (Holbrook, 1836), were obtained from two pairs of adults, and larvae were reared in four temperature treatments (constant Mean, constant High, constant Low, and Fluctuating regime [Low night–High day]); developmental series were collected from each treatment (Gosner Stages 28–40). Distance measurements were recorded on various external features of tadpoles as well as on the internal skeleton. Linear morphometric data were used with geometric morphometric data taken from *A. americanus* chondrocrania in a previous study to make inferences about the effects of developmental temperature on morphology through premetamorphic ontogeny.

0684 AES Habitat & Movement I, Jarry/Joyce, Saturday July 26, 2008

White Shark (*Charcharodon charcharias*) Homing and Fidelity in the Eastern Pacific

Salvador Jorgensen¹, Scot Anderson³, Adam Brown³, Taylor Chaple², Chris Perle¹, Callaghan Fitz-cope⁴, A. Peter Klimley², Carol Reeb¹, Sean Van Sommeran⁴, Kevin Weng⁵, Barbara Block¹

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White sharks (*Charcharodon charcharias*) have been assessed as ‘threatened’ by the IUCN and are listed for protection under appendix II of CITES yet basic aspects of their biology such as habitat preference, distribution and population structure are still poorly understood. Through collaborative efforts under the Tagging of Pacific Pelagics (TOPP) research program, we have deployed over 100 satellite and 50 acoustic telemetry tags on white sharks at seal rookeries off central California, and are revealing a predictable migratory pattern highly structured in space and time. The consistent use of discrete offshore habitats, followed by a return to the same

coastal pinniped rookeries, was determined from long-term tagging and photo identification studies. During the coastal phase, the fine-scale movement of individuals was elucidated using passive acoustic telemetry. Individuals transited between Ano Nuevo, South East Farallon Island and other coastal white shark hotspots but resided at each site for periods of days to months. Satellite tracking revealed highly consistent use of two offshore habitats, one near Hawaiian waters, and another between Hawaii and Mexico known as the 'white shark café'. Despite a long migratory route and the potential for trans-oceanic passage, there was no evidence of straying from the eastern Pacific. Mitochondrial genetic data indicate that white shark females in the North eastern Pacific have maintained long term isolation from the other known white shark populations near South Africa and Australia. Despite a cosmopolitan distribution, site fidelity is a mechanism which may explain reproductively isolated populations.

0543 Poster Session II, Saturday July 26, 2008

Moisture Relations and Climbing Behavior in the Red-cheeked Salamander, *Plethodon jordani*

Eric Juterbock

Ohio State University, Lima, Ohio, United States

Although I have observed many species of southern Appalachian plethodontid salamanders climbing above the ground surface on vegetation, the Red-cheeked Salamander, *Plethodon jordani*, is one of a group of related species that does so frequently. I have observed them feeding, being aggressive and courting, as well as just sitting, while up on vegetation. Since salamanders cannot control water loss through their skin, and the above-ground environment is likely to be more prone to desiccation than the leaf litter-ground surface environment, questions are raised concerning their use of the elevated habitat. Are Red-cheeked Salamanders more active overall when vapor pressure deficit (VPD – a measure of water loss potential) is lower? Are they more likely to be climbing up on vegetation when VPD is lower? Is either behavior less likely as the number of days without rainfall increases? Salamanders were observed at night, by headlamp, with no other disturbance except for occasional photography, in Great Smoky Mountains National Park, TN, USA, between August 2006 and September 2007. There was no significant relationship between the number of dry days (0-3) and VPD, perhaps because temperature varies with the seasons and humidity tends to increase and temperature decrease as the evening progresses. The frequency of climbing behavior was correlated to VPD (lower VPD = more climbing); the activity level of the salamanders was not. The frequency of climbing behavior was only weakly correlated, and the number of active salamanders was not correlated, to the number of dry days (0-3). The activity level of the salamanders was not correlated to the amount of time since sunset; the frequency of climbing behavior was correlated with increasing time past sunset, although there may be a seasonal effect. This effect could be the result of a peak in the courtship season, as numerous courtships, attempted courtships, and other social interactions were observed during this period.

0487 Poster Session I, Friday July 25, 2008; CARRIER

Length Based Population Dynamics Analysis of Mako Sharks on the West Coast of North America

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Mako sharks, *Isurus oxyrinchus*, on the West coast of the United States and Baja California are impacted by commercial, recreational, and artisanal fishing pressures. Despite these pressures, little is known about the population sizes and dynamics of makos in this region. This study will endeavour to use genetic analysis to determine population structure of mako sharks in the region. This analysis will involve microsatellite genotyping of samples collected in conjunction with NMFS. We will then use length-based matrix models to determine population growth rates. The parameters for these models will be estimated based on both fisheries dependent and independent data as well as from available literature. We will then run elasticity analyses to determine which parameters have the greatest impacts on the population growth rate. Preliminary model runs suggest that the mako stocks are shrinking ($\lambda < 1$) and that the parameter to which model output is most sensitive is the survivability of large, reproductive sharks.

0570 Poster Session II, Saturday July 26, 2008

Brooding and Egg Feeding Behavior of a Rhacophorid Tree Frog (*Kurixalus eiffingeri*) From Taiwan

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¹Tunghai University, Taichung, Taiwan, ²Providence University, Taichung, Taiwan

We used an infrared digital camera to record the brooding and feeding behavior of *Kurixalus eiffingeri* (Rhacophoridae) in the field. Females of *K. eiffingeri* deposit fertilized eggs above the waterline on the inner walls of bamboo stumps. Male frogs exhibit paternal care during the embryonic period which ranges 9-14 days. Upon hatching, tadpoles drop into the pool of water where they grow and develop until metamorphosis. Female frogs visit and feed tadpoles at night at intervals of about 8 days. Tadpoles are obligatorily oophagous, and the length of larval period is 40~60 days. Results showed that during brooding, males lay on the clutches and often changed positions. Males frequently descended into the water, stayed for several minutes, and then climbed out of the water to lie on the clutch again. Egg feeding behavior was uniparental care in that male frogs did not involve during the whole behavioral sequences. As soon as the female entered the pool, tadpoles immediately became extremely excited and started to aggregate around her. Each tadpole stiffened its tail and began vibrating vigorously and nipping at the skin around her cloaca, thighs, and body. During the process, females stretched her body and allowed the tadpoles to touch her body. Tadpoles' movement became faster and more vigorous as the encounter progressed; this behavior was fastest and most vigorous moments before eggs were deposited in the pool. The "egg-begging" behavior lasted from few minutes to 15 min and females began to lay trophic eggs, a few at a time. As soon as the eggs are laid, the tadpoles swallowed the eggs

immediately. A video on the brooding and egg feeding behavior will be showed during the presentation.

0523 Herp Biogeography, Salon 4&5, Saturday July 26, 2008

Biogeography and Diversification of Homalopsid Snakes in Southeast Asia

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We examine the important role that river systems, geological history, and climate play in the generation and maintenance of biological diversity in Southeast Asia using freshwater semi-aquatic snakes in the Homalopsidae (Oriental-Australian rear-fanged water snakes). Southeast Asia has an exceptionally complex biogeographical history. Plate tectonics, volcanism, climate change, and sea level changes have influenced the history of river drainage systems in Southeast Asia. In terms of gene flow among populations, rivers and river basins can enhance connectivity among populations or create barriers leading to isolation and divergence, dependent on the biology and dispersal capabilities of species. We analyze how various events have changed the course of rivers, contributed to cycles of connectivity and isolation among populations, and influenced the generation of biodiversity in the region. Our current study focuses on the Khorat Basin, a prominent geographic feature in northeastern Thailand which creates a potential barrier to gene flow due to drainage basins, geological history, and climate. We have previously demonstrated differences in the structure of freshwater semi-aquatic snake assemblages related to the Khorat Basin. We are in the process of examining genetic variation among populations of the semi-aquatic homalopsid snakes, *Enhydris plumbea* and *Enhydris enhydris* inside and outside of the basin using DNA sequence analysis (two mtDNA genes, ATPase and cytochrome *b*). Preliminary results indicate that populations associated with the Khorat Basin are genetically divergent (10-14% for *E. plumbea* and 5-7% for *E. enhydris*) from populations sampled outside the Khorat Basin, thus supporting the hypothesis that the Khorat Basin and associated river basins are an important biogeographic feature in Southeast Asia.

0349 Amphibian Conservation, Salon 4&5, Saturday July 26, 2008

Relative Importance of Vernal Pools and Beaver Ponds for Amphibian Production

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Beaver ponds are a formerly ubiquitous component of the landscape in the northeastern United States and may play a significant, but as yet unknown, role in amphibian population dynamics. Notably, no study has contrasted amphibian production in vernal pools with that in any other wetland type. In the Adirondack Mountains of New York, we compared reproduction of wood frogs (*Rana sylvatica*) and spotted salamanders (*Ambystoma maculatum*) in beaver ponds to that in their primary breeding habitat, vernal pools. In 65 vernal pools and 37 beaver ponds over

3 years, densities of spotted salamander egg masses did not differ, yet densities of wood frog egg masses were nearly 2x higher, survival to metamorphosis and metamorph production were an order of magnitude higher, and metamorphs were 1.3 times larger in beaver ponds than in vernal pools. We estimated from simulation modeling that, depending on annual variation in rainfall and survival to metamorphosis, beaver ponds produce 2-70x the number of wood frogs that vernal pools produce and that beaver ponds may provide important source populations of wood frogs for vernal pools following periods of drought. Our study suggests that beaver ponds may play a role in maintaining wood frog populations in the northeastern U.S., and that beaver population management may represent a critical tool for creating and maintaining amphibian habitats in this region.

0316 Poster Session I, Friday July 25, 2008

Population Characteristics of *Manta birostris* Observed in Yaeyama, Okinawa, Japan, 1987-2006

Tom Kashiwagi¹, Takashi Ito², Jennifer Ovenden³, Michael Bennett¹

¹University of Queensland, St. Lucia, QLD, Australia, ²Marine Service Ito, Kohama Island, Okinawa, Japan, ³Queensland Department of Primary Industries and Fisheries, St. Lucia, QLD, Australia

Encounter-history records and biological observations of manta rays at Yaeyama, Okinawa, Japan have been compiled for over 4500 dives conducted on over 2400 days in the period from 1987 to 2006. A photo-identification methodology based on the unique skin patterns of individual rays was used to identify 303 different manta rays. The disc widths of the smallest free swimming individuals was 0.9m. Maximum disc widths observed were 3.6 m for male and 4.3m for female. The age at first pregnancy appeared to be about ten-years of age, with mature females appearing to give birth on a three or four year cycle. Newborn rays have been observed on many occasions, but preliminary analysis suggests that mortality or emigration from the study site is relatively high over the first three years of life. The longest period between the first and last sighting of a single individual was 27 years, for a female ray identified in 1980 that was still alive at the end of the study. Quantitative analyses indicate that this Japanese manta ray population is either stable or has increased over the study period.

0313 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

DNA evidence for cryptic species boundaries within *Manta birostris*?

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¹University of Queensland, St. Lucia, QLD, Australia, ²Queensland Department of Primary Industries and Fisheries, St. Lucia, QLD, Australia

Molecular evidence to support/refute hypothesised cryptic species boundaries within *Manta birostris* were investigated. Genetic profiles of Indo-Pacific manta rays showed two distinctive clusters, with a pattern supporting speciation rather than geographic differentiation.

0276 Poster Session II, Saturday July 26, 2008

Habitat Use of Morphologically Poorly Diverged Geckos, *Gekko yakuensis* and *Gekko hokouensis* in Yakushima, Japan

Ushio Kawai

Kyoto University, Kyoto, Japan

Gekko hokouensis is widely distributed in southern Japan, Taiwan and eastern continental China, whereas the distribution of *G. yakuensis*, its close relative, is confined to a narrow area in southern Japan; southern Kyushu, Yakushima, Tanegashima and Magejima. These two species hybridize and the offspring is viable. Furthermore, the hybrid swarms that consist of post F1 generations are reported from a few localities in southern Kyushu. In Yakushima, it is suggested that the putative hybrids exist in relatively high proportions in several localities where both *G. hokouensis* and *G. yakuensis* are found. In this study, distributions of the two species and their hybrids in Yakushima were surveyed in a finer geographical scale. *Gekko hokouensis*, *G. yakuensis* and their hybrids were determined on the basis of morphological characteristics. Furthermore, putative hybrids were confirmed by allozyme analysis. Then, the sampling site of each specimen was mapped and habitat analyses were conducted. Hybridization and introgression of the two species in Yakushima was confirmed. This study also revealed the two species' habitat utilization and their affinity to residential area. The results showed that habitat use of *G. yakuensis* is significantly different at the localities where *G. hokouensis* co-exist when it is compared to the localities where *G. yakuensis* solely exist. This suggests the habitat use of *G. yakuensis* is affected by the presence of *G. hokouensis* through the ecological competition.

0735 Poster Session I, Friday July 25, 2008

Exploring Lightfish (Teleostei: Stomiiformes) Relationships: A Neuroanatomical Approach

Christopher Kenaley, Benjamin Frable

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The lightfishes of the basal euteleost order Stomiiformes are comprised of four families and over 250 species of meso- and bathypelagic fishes. The hypothesized origins of the Stomiiformes and interrelationships of the four constituent families are based on phylogenetic inferences recovered from osteological data. Tests of phylogenetic hypotheses concerning basal euteleost clades have most recently focused on molecular evidence. Using a Sudan-black nerve-staining technique, we attempt to explore how neuroanatomical data may inform phylogenetic inference and corroborate or amend previous hypotheses. Our specific goal in the study was to explore how neuroanatomical characters associated with the stomiiform acoustical-lateral system may be used to infer interrelationships of taxa within the order. Our results show that characters associated with lateral-line neuroanatomy are, for the most part, phylogenetically informative and corroborate previous phylogenetic hypotheses for the group.

**0652 Fish Morphology & Histology I, Salon 6&7, Thursday July 24, 2008;
STOYE GENETICS, DEVELOPMENT & MORPHOLOGY**

**Cast in a Different Light: Comparative Innervation and Homology of
Bioluminescent Organs in the Lightfishes (Teleostei: Stomiiformes)**

Christopher Kenaley

University of Washington, Seattle, WA, United States

The lightfishes of the basal euteleost order Stomiiformes, comprised of four families and over 250 species, are characterized by a suite of luciferin-mediated photophores along the ventrolateral aspect of the body and on the head. The size and number of these photophores have served as important systematic characters within families and genera, however, their phylogenetic value in informing higher level relationships within the order have gone largely overlooked. To assess established phylogenetic hypotheses of major clades within the order Stomiiformes, characters associated with innervation of cephalic and ventrolateral photophores are brought to bear. Specifically, the most informative evidence is associated with differential patterns of spinal and lateral-line nerve input of ventrolateral photophores, and trigeminal (cranial nerve V) input of cephalic photophores.

0288 Amphibian Conservation, Salon 4&5, Saturday July 26, 2008

Alberta Northern Leopard Frog Recovery Program

Kris Kendell¹, Dave Prescott²

¹*Alberta Conservation Association, Sherwood Park, Alberta, Canada,* ²*Alberta Fish and Wildlife, Red Deer, Alberta, Canada*

The northern leopard frog (NLF) (*Rana pipiens*) has suffered dramatic population declines in many parts of its range in Alberta, Canada. Although little studied, the decline in Alberta does not appear to be part of a natural cycle. The species' reduced area of occupancy and fragmented populations have led to its listing as Threatened under Alberta's *Wildlife Act* in 1996, and reaffirmation in 2003. A recovery plan was drafted and approved in 2005 and describes strategies and actions necessary for achieving the provincial goal of a "well-distributed, self-sustaining population of NLFs throughout their historical range in Alberta". The recovery plan focuses on the protection of existing populations from anthropogenic disturbances; population inventories and monitoring; habitat assessments; the reintroduction of frogs to some sites within their historical range; the implementation of stewardship projects with cooperative landowners; and the collection of additional data to aid in reintroduction efforts, including population genetics and disease surveillance work. Recently, recovery actions have included: a provincial inventory for the species (2005); the development of a reintroduction protocol, the reintroduction of frogs into several sites within their historical range; monitoring success at reintroduction sites; habitat protection activities, including stewardship projects; the production and distribution of outreach materials; and development of a GIS habitat model of potential NLF habitat.

0287 Poster Session III, Sunday July 27, 2008

Alberta Volunteer Amphibian Monitoring Program

Kris Kendell

Alberta Conservation Association, Sherwood Park, Alberta, Canada

The Alberta Volunteer Amphibian Monitoring Program (AVAMP) is a long-term community survey of amphibians that was implemented in 1992 under the auspices of the Declining Amphibian Population Task Force established by the Species Survival Commission of the World Conservation Union (IUCN). The goal of the program is to increase awareness of the conservation issues facing amphibians as well as to provide a better understanding of the distribution and general status of amphibians in Alberta, Canada. The program is lead by the Alberta Conservation Association (ACA), and carried out in partnership with Alberta Sustainable Resource Development (ASRD), and other agencies. Through the program, volunteers are encouraged to submit location information on amphibian observations as well as incidental reptile observations. Volunteers are supplied a peer-reviewed monitoring manual and a CD featuring the calls of the anurans found in Alberta. These materials allow program participants to become familiar with the identification and life history of Alberta's amphibian species. Included in the manual are detailed instructions on how to monitor amphibians, and record and submit observations. The time and energy volunteers put into the AVAMP is entirely up to them. To maintain communication with volunteers, they are sent a biannual program newsletter each spring and fall, called "Croaks and Trills". A dedicated toll-free phone number is also available to volunteers to contact the program coordinator if they have questions about the program, species identification, or conservation issues relating to amphibians (and reptiles) in Alberta. Hundreds of herptile observations are submitted annually to program coordinator, where they are verified for accuracy, entered into a spreadsheet and forwarded to ASRD for uploading into the Fisheries and Wildlife Management Information System.

0365 Poster Session I, Friday July 25, 2008; STORER ICHTHYOLOGY

Phylogeography of the Imperiled Redtail Splitfin (*Xenotoca eiseni*) in Mexico: Implications for Taxonomy and Conservation

Carys Kenway

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Xenotoca eiseni, the redtail splitfin, a member of the livebearing subfamily Goodeinae (Teleostomi: Goodeidae), is endemic to the Mesa Central of Mexico. It has a restricted distribution in the Western basins of the Pacific coast including the Rio Grande de Santiago, Compostela, Ayuquila, Coahuayana, and the endorheic Lago de Magdalena. Previous studies have noted high levels of genetic differentiation between the endorheic Lago de Magdalena and surrounding basins, which may be indicative of more taxonomic diversity within *X. eiseni* than currently recognized. Therefore, the objectives of this study were to use mitochondrial DNA sequences (cytochrome b) to assess levels of genetic differentiation and phylogeographic structure among the geographically isolated populations in each of the basins in Central Mexico. Sequence data was gathered from 6 populations and multiple individuals within each population. Cytochrome b yielded approximately a 2.6% nucleotide difference between populations in the endorheic Magdalena basin and all other locations. When compared to other goodeid studies, this level of intraspecific

genetic differentiation is more consistent with species level diversity for the Magdalena population. The taxonomic and conservation implications of this work will be discussed in light of these results.

**0465 AES Student Papers II, Kafka/LeMaratine, Friday July 25, 2008;
GRUBER**

Seasonal Residency And Migration Of Mature Lemon Sharks (*Negaprion brevirostris*) Off The Southeast Florida Coast

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¹*Bimini Biological Field Station, South Bimini, Bahamas*, ²*Cardiff University, Cardiff, United Kingdom*, ³*National Marine Fisheries Service, Miami, Florida, United States*

In 2001 aggregations, of ~75, mature lemon sharks (*Negaprion brevirostris*) were discovered just off the Jupiter coast, FL, by a local SCUBA diver. The presence of concentrated groups presented us with the first opportunity to study wild lemon sharks of mature life stage. To assess the potential of utilising this aggregation for research, feasibility studies were conducted from 2003 – 2005 revealing that these sharks could be caught for further study. During the subsequent winter seasons of January to March 2006 - 2008, sharks were caught on hooks using rod and reel and polyball drop-lines. Captured individuals were secured to the boat measured, sampled for DNA and tagged (NOAA M-type dart tag and PIT tag). All mature lemon sharks received a Vemco V16H transmitter implanted in their coelom. These three-year transmitters in concert with an array of 18 VR2 monitors along the putative aggregation migration route were used to describe local movements. Our monitors form part of the Florida Atlantic Coast Telemetry (FACT) VR2 array consisting of approximately 123 monitoring stations, with 26 to date receiving hits from our study population (total of 31 mature lemon sharks, 11 females and 20 males). A male previously caught off Long Key, FL, and another previously caught in Winyah Bay, NC, were originally tagged under the NMFS co-operative shark tagging program. This demonstrated that mature lemons will undertake long migrations to join this aggregation. Results from the monitors showed that males left the array area around March/April 2007 then returned between December 2007 and January 2008. In contrast, the females produced hits on the array year round. Contact at the most commonly visited station predominately occurred during daylight hours. The further deployment of two wildlife computer MK10 PAT tags (three and six months release) should further reveal the longer-term movements of the mature males.

**0117 Conservation in Canada, Salon 4&5, Saturday July 26, 2008;
CARCNET/RÉCCAR**

**Persistence and Prevalence of the Enzootic Amphibian Pathogen,
Batrachochytrium dendrobatidis, in Panama**

Vanessa Kilburn¹, David M. Green¹, Roberto Ibanez², Eldredge Bermingham²,
Oris Sanjur²

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The pathogenic chytrid fungus, *Batrachochytrium dendrobatidis*, is implicated in the population declines and extinctions of numerous species of tropical, principally montane, amphibians. If the fungus is enzootic, it may remain in the environment after an epidemic has passed and may infect both montane and lowland amphibians. Research sites at various elevations were established throughout Panama west of the Canal where abundances of amphibian populations at varying stages of epidemic infection could be examined. Chytrid prevalence and infection intensity were determined using sensitive DNA-based Real-Time Quantitative PCR amplification. Amphibian populations at all elevations were found to have at least some degree of chytrid infection, and the chytrid was found to persist on reptiles in addition to amphibians. Lowland amphibians appeared to be as susceptible to chytridiomycosis as their high elevation counterparts. These results suggest that the primary assumptions of chytrid ecology, which is that it causes fatal chytridiomycosis in the tropics only in areas of low temperatures and high moisture (i.e. highlands), should be reassessed. If the chytrid exists at all elevations, even if at low levels, then it is likely enzootic and perhaps only the current epidemic of chytridiomycosis disease is novel. Since the infection can remain in frog communities at any elevation, can persist for long periods of time (up to 11 years), and can survive on non-amphibian hosts, the eventual reintroduction of captive-bred amphibians as a plausible management plan for amphibian conservation should be carefully examined.

0185 Poster Session II, Saturday July 26, 2008

**Effects of a Long-term Elevation of Perceived Predation Risk on Territorial
Behaviour in Wild Juvenile Atlantic Salmon**

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Local predation risk has striking effects on the short term behaviour of prey, including juvenile salmonids, in both laboratory and field conditions. However, the long term consequences of increased predation risk have rarely been examined. To examine the potential effects of prolonged exposure to an elevated perceived predation risk on the individual behaviour of juvenile Atlantic salmon, we established three contiguous sections differing in perceived predation risk in each of seven reaches of relatively uniform habitat in Catamaran Brook, New Brunswick, Canada. Each reach consisted of a low predation site (stream water control) and a high predation site (conspecific alarm cue) separated by an undisturbed buffer zone. We manipulated the perceived predation risk over a four week period by releasing chemical alarm cue in the high predation site (skin extracts from juvenile Atlantic salmon) and stream water in the low predation site, when young salmon emerge from gravel nests and begin defending territories. As predicted, individuals in high predation risk sites had smaller territories compared to low predation risk sites. In

contrast, individuals in risky sites had higher foraging rates than in control sites. However, fish did not differ in body size or condition between the treatments. Our study shows that juvenile salmon detect habitats with a high risk of predation and modify their behaviour when using such sites.

0422 Cottonmouth Symposium, Salon 4&5, Monday July 28, 2008

The Effects of Mercury on the Behavior of *Agkistrodon piscivorus*

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Recent studies on a wide array of taxa have clearly demonstrated the adverse effects mercury can have on many life history traits. Symptoms such as ataxia, anorexia, and loss of locomotor and eye sight capabilities has been confirmed in birds, fish, and primates including humans. However, in spite of the wealth of data within this area, reptilian taxa are drastically understudied. The goal of this study is to compare cottonmouths from Caddo lake Wildlife Refuge, a historically contaminated site, with snakes from the Old Sabine Wildlife Management Area, an uncontaminated site, in order to reveal mercury's affect on the behavior of this top predator. Three series of tests, including predatory strike response, righting response, and sprint speed and endurance, were used in this study. Preliminary analysis shows a significant relationship with many components of the predatory strike response, including prey handling time. Additionally, righting response behaviors were significantly different between the Caddo lake population and the Old Sabine population. These results suggest that mercury contamination has subtle impacts on the behavior of snakes that likely would affect the long-term survival of the populations.

0563 Poster Session II, Saturday July 26, 2008

Body Temperatures of Hibernating Watersnakes

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The use of temperature-sensitive radio transmitters has provided a wealth of information about reptilian thermal biology. However, much of this information pertains to the active season. Relatively few studies have used this technology to assess body temperatures during hibernation. We collected 351 body temperature readings from 44 hibernating adult Lake Erie watersnakes at irregular intervals during the winters of 2000-2001 and 2001-2002. In both years, entry into hibernation occurred in September and October and emergence occurred in April and May. Body temperatures were at their lowest and remained relatively stable between December and March. However, individual watersnakes exhibited different temperature profiles. For example, body temperature minima varied between 1 and 10 C among individuals, a difference that may be bioenergetically important. Differences in minimum body temperatures between the sexes were small (1 C) and only approached significance ($P = 0.07$). Differences between years were larger (2 C, $P = 0.003$) but are likely due to differences in dates of data collection. Among nine watersnakes monitored in both years, there was no correlation in minimum body

temperature between years. Warm spells during the spring of each year were associated with above-ground activity and high watersnake body temperatures. These were followed by re-entry into hibernation and lower body temperatures on subsequent cooler days. This observation suggests that emergence date is a phenotypically plastic trait that may respond to global climate change.

0691 Poster Session III, Sunday July 27, 2008

Diversification and Phylogeography of *Melanophryniscus rubriventris* (Anura: Bufonidae)

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Andean montane forests have proved especially diverse in their anuran faunas. Moreover, many traditionally regarded Neotropical species (based primarily on morphology) have been revealed to contain incredibly deep divisions. We investigated patterns of molecular divergence in *Melanophryniscus rubriventris* (Anura: Bufonidae), an aposematic toad from the Andes of northwestern Argentina and southern Bolivia. We sequenced both nuclear (rhodopsin exon 1) and mitochondrial (16S rRNA) genes to quantify diversity within and among five populations spanning the Argentine portion of the species' range. We found two distinct mitochondrial lineages, one of which was restricted to a single site near Baritú National Park in northern Argentina. We found three rhodopsin alleles, which appear to show clinal patterns along a north-south axis. This raises the possibility that there exist two species where previously only one was recognized. Coupled with other research from our lab, our results point to the importance of orogeny, climate change, and shifting vegetational patterns in shaping diversification of anuran lineages. Our findings also highlight the importance of detailed genetic studies in revealing cryptic phyletic diversity and in guiding conservation priorities. Studies such as ours are desperately needed in light of recent drastic amphibian declines, especially among tropical and montane taxa.

0262 Poster Session III, Sunday July 27, 2008

Effects of PCB Exposure on the Reproductive Potential of Artificially Matured Male American Eels

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The population of the American eel, *Anguilla rostrata*, has declined over the past two decades. The cause of the decline is unknown, but possibilities include anthropogenic activities such as over fishing and pollutants, parasites, and oceanic changes. Stress factors, such as contamination, can affect reproduction and could hinder recruitment for the species. These eels spend the majority of their life living in rivers along the east coast of North America, potentially exposed to a plethora of contaminants. Gametogenesis is initiated while the eels are still dwelling in rivers but are preparing for migration into the Atlantic Ocean. Little is known about

reproduction in this species considering that during sexual maturation eels migrate to the Sargasso Sea, where spawning is presumed to occur, but has never been observed. This study aims to characterize artificial maturation of male eels and to test sublethal concentrations of a PCB mixture on spermatogenesis. Maturation was achieved by weekly injections of human chorionic gonadotropin (HCG). Sperm count, spermatocrit, and sperm motility were used to assess the quality of the sperm. A gonadal-stomatic index (GSI) was assessed for each eel and will be compared between treatments. Additional sampling and histological analysis are in progress.

0076 AES Devil Ray Symposium, Jarry/Joyce, Friday July 25, 2008

Migration Behaviour of the Giant Manta (*Manta birostris*) in the Central Maldives Atolls

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Worldwide, populations of Giant mantas (*Manta birostris*) exhibit three types of migratory behaviour which can be categorised according individual home ranges. These are: 1) resident, inhabiting a specific home range at one location year round; 2) migratory, moving from one location to another with changes in season; and 3) oceanic, travelling between different locations across open oceans. Although articles in SCUBA-diving related literature have suggested that mantas in the Maldives migrate between the western and eastern sides of atolls with the monsoons, perhaps in order to benefit from upwelling stimulated plankton growth occurring on the lee sides of the atolls, there has been no scientific research into this phenomenon prior to this study. Having developed a robust method for the visual identification of individual mantas, surveys were carried out throughout the central Maldives atolls recording manta visits to "cleaning stations" on reefs located along the peripheries of the atolls. Over 99% of 2680 manta encounters during the study occurred at leeward side cleaning stations. In North Male' atoll where the data set included sightings for all months in the year, 48.3% of mantas (n=153) that were re-sighted, were sighted on both sides of the atoll during the relevant monsoon. All those re-sighted in both North-east and South-west monsoon seasons had migrated between the west and east sides, suggesting that a single population migrates between the cleaning stations on opposite sides of the atolls with the alternating seasons, rather than there being two distinct, east and west populations. Pursuit of food was not the only factor involved in migration with some animals making journeys between different atolls, or between different sites along the side of an atoll during a single season, having travelled a distance of 20-160km between survey sites. In summary the Maldives population would be considered migratory.

0653 General Ichthyology III, Drummond, Sunday July 27, 2008

Genetic Evaluation of Lake Sturgeon (*Acipenser fulvescens*) Designatable Units in Canada

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Canada's largest landlocked fish, the lake sturgeon (*Acipenser fulvescens*), is a heritage species with considerable social, ecological and economic value. Over-exploitation

and habitat alteration has led to severe reductions in population size and number across the species range. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identified eight designatable units (DUs) in its most recent lake sturgeon status report. However, these population designations incorporated only extremely limited genetic data. In this study, eleven microsatellite loci are used to characterize 50 populations across the range of lake sturgeon in Canada. The robustness of the current designations are tested and discussed.

0220 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

Jaw Closing Mechanics in Caecilians: Biting with Two Joints and a Hyobranchial Muscle

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The caecilian (Lissamphibia: Gymnophiona) skull is characterized by numerous specializations to the fossorial lifestyle of these animals. Bones are fused to compound elements to make the skull more solid and compact. The skull of caecilians was shown to be kinetic – the quadrate-squamosal complex can be moved with respect to the remainder cranium (streptostyly). The jaw closing system of caecilians is unique among vertebrates in that a hyobranchial muscle, the m. interhyoideus posterior, acts as accessory jaw adductor on the ventral side of the lower jaw, caudal to the jaw joint. Here we present a new modeling approach to describe the function of the caecilian jaw closing mechanism. Our model includes information on lever arms, muscle fiber orientations, and physiological cross sectional area of muscles to estimate caecilian bite forces. We show that every muscle in the caecilian jaw closing apparatus has a critical gape angle above that, the muscle will act opposite to the jaw closing movement, i.e. against bite force. The integration of the ancestral jaw closing musculature and the m. interhyoideus posterior, however, results in almost constantly high bite forces over a wide range of gape angles. Cranial morphology has a direct impact on jaw closing mechanics in caecilians. The m. interhyoideus posterior contributes less to total bite force in species with a fenestral temporal region (zygokrotapy), than in species with a closed skull roof (stegokrotapy). The unusual muscle configuration of the caecilian jaw is correlated with a mandibular joint in which the fossa is extensively flanking the condyle. Streptostyly mediates mediolateral movements between lower jaw and the remainder cranium and is suggested to amplify bite force.

0535 Herp Genetics, Development & Morphology, Drummond, Saturday July 26, 2008

The Effects of Skull Morphology on Feeding Performance in Snakes: A Preliminary Study

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Uniquely among terrestrial vertebrates, snakes resemble fishes in relying largely on extensive and well-coordinated movements of complex skeletal linkage systems to

feed. In recent years, ichthyological biomechanists have developed increasingly sophisticated and accurate models to predict feeding performance in fishes, and such models have even been used to predict feeding performance in fossil taxa. In contrast, no such predictive models have yet been developed for snakes. In fact, no empirically derived data have ever been published that directly link any specific aspect of skull morphology with feeding performance in snakes. In this study, I quantified intraoral prey transport performance across a wide range of prey sizes for a phylogenetically and morphologically diverse sample of macrophagous alethinophidian snakes. I then quantified the cranial morphologies of all taxa included in these performance studies through detailed craniometric analyses, in which approximately 70 linear measurements were taken across all regions of the skull and jaw apparatus. Finally, regression analyses were conducted in order to develop a quantitative model predicting prey transport performance based on the relative proportions of individual bones and functional units within the head skeleton. Contrary to previous hypotheses, the relative lengths of neither the quadrate nor the supratemporal were found to be significant in determining feeding performance. Rather, these preliminary analyses suggest that the relative length the lower jaw is the single most important determinant of prey transport performance, explaining between 68 and 78 percent of the variance in the performance data, depending on which phylogenetic hypothesis is used for analysis.
