

## 247 SSAR SEIBERT ECOLOGY II, Highland A, Friday 13 July 2018

Joshua Mead and William Stark

*Fort Hays State University, Hays, Kansas, USA*

### **Spatial Ecology of the Western Massasauga (*Sistrurus tergeminus*) in a Large Interior Wetland**

Insight into the spatial ecology of a population of animals provides information valuable to the management and conservation of a species. For cryptic taxa such as snakes, radio-telemetry allows for individuals to be reliably located on a consistent basis. We used radio-telemetry to investigate the spatial ecology of the Western Massasauga (*Sistrurus tergeminus*) at Cheyenne Bottoms in Barton County, Kansas. Eighteen individuals (12 male and 6 female) were implanted with VHF radio transmitters during 2016-2017 and tracked twice weekly throughout the active season. Data for 15 individuals (10 male and 5 female) with more than 30 unique locations each were used for our analysis. Home range estimates were calculated using 100% minimum convex polygon (MCP) and 95% kernel density estimators (KDE), along with 50% MCP and 50% KDE to give insight into core use areas. The average home range estimate using 100% MCP was 12.9 ha and the average estimate of core use area was 2.8 ha for 50% MCP. These results are similar to the 100% MPC estimates reported in Nebraska for *S. tergeminus*, but considerably smaller than those reported in Missouri. Male estimates were larger than female estimates across all estimators. We question the usefulness of the low KDE estimates in interpreting important aspects of natural history within our data.

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## 249 SSAR: Coloration in Fish, Amphibians, & Reptiles Symposium, Grand Lilac Ballroom North, Sunday 15 July 2018

Melissa Meadows

*Saint Francis University, Loretto, PA, USA. University of Tübingen, Tübingen, Germany*

### **Fish with Laser Vision and Other Fun Functions of Fluorescence**

Why do fish sometimes exhibit striking patterns of red fluorescence? Red fluorescent pigments absorb **blue** light - the most plentiful component of the ambient spectrum in clear marine water deeper than about 20 m - and emit **red** light, which is highly attenuated at the same depths. In this talk, I will discuss the diversity of fish that are fluorescent and some ecological correlates hinting at diverse functions for red fluorescence in fish; for example, fluorescence appears to be used for camouflage against red fluorescent algae in scorpionfish and to be concentrated in the irides of small predatory fish with a proposed visual function. Within species, we discovered that several small fluorescent fish show brighter fluorescence irides when collected in deeper, bluer water, also consistent with a possible visual function. Lastly, I will focus on research on on small and inconspicuous Mediterranean predator, the triplefin *Trypterigion delaisi*. Several

lines of research are consistent with the hypothesis that *T. delaisi* uses its tunable red fluorescence in **active photolocation**, lighting up the reflective eyes of microcrustacean prey items with a red light contrasting with the blue background. *In vivo* measurements of iris and background radiance at depth shows that irisi red fluorescence contrasts with the visual background. In lab experiments, *T. delaisi* modulates fluorescence over the long term based on ambient brightness. It behaviorally controls an **ocular spark**, which can be turned bright fluorescent red, bluish-iridescent, or off when looking at prey. Fluorescent pigments in fish likely have many additional exciting and novel functions.

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### 341 Herpetology Biogeography I, Highland B, Saturday 14 July 2018

Madhava Meegaskumbura<sup>1,2</sup>, Gayani Senevirathne<sup>3</sup>, Kelum Manamedra-Arachchi<sup>4</sup>, Rohan Pethiyagoda<sup>5</sup>, James Hanken<sup>6</sup> and Christopher J. Schneider<sup>7</sup>

<sup>1</sup>Guangxi University, Nanning, Guangxi, China. <sup>2</sup>University of Peradeniya, Peradeniya, Kandy, Sri Lanka. <sup>3</sup>University of Chicago, Chicago, IL, USA. <sup>4</sup>Postgraduate Institute of Archaeology, Colombo, Western Province, Sri Lanka. <sup>5</sup>Australian Museum, Sydney, NSW, Australia. <sup>6</sup>Harvard University, Cambridge, MA, USA. <sup>7</sup>Boston University, Boston, MA, USA

#### **Diversification of terrestrial direct-developing frogs across mountains on an island: radiation of *Pseudophilautus* (Anura, Rhacophoridae) on Sri Lanka**

Both islands and montane regions act as pumps that generate high species diversity through similar evolutionary processes, especially in the tropics. Island diversifications, largely driven by ecological opportunity and/or taxon-specific key innovations, usually have an early burst phase and are often rapid. Here, using a time-calibrated and nearly complete phylogeny, we analyze the biogeography and tempo and mode of the species-rich radiation of Sri Lankan *Pseudophilautus*, which are characterized by terrestrial direct development (TDD). Lineage-through-time plots and dating estimates suggests a gradual diversification through Late Miocene and Pliocene periods (from 31 MYA), without an apparent early burst phase. Diversification was seeded by ancestral migrants from India followed by a long speciation phase on Sri Lanka, which culminated in a Late Miocene back migration to India (about 8.8 MYA); the clade representing Indian *Pseudophilautus* comprises only a few species. Different patterns of diversification between Sri Lanka and mainland India may be explained by ecological opportunity and the time available for diversification. Ancestral area reconstructions show sister species distributed on adjacent mountain ranges and also within a given geographic area (i.e., geographic and non-geographic speciation). We reconstruct the most recent common ancestor of *Pseudophilautus* as a cool-wet adapted form, whereas the back-migrating (to India) ancestor is reconstructed as a dry-adapted form, suggesting significantly different climatic conditions during these migrations. Point endemism facilitated by TDD across the cool-wet habitats of cloud forest refuges seems to have promoted speciation in this old radiation, albeit at a steady pace.

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## 166 General Herpetology III, Highland B, Sunday 15 July 2018

Jazmine Mejia Munoz

*California State University, Bakersfield, Bakersfield, California, USA*

### **Potential Use of Museum Samples for Tetrodotoxin Quantification**

Each year many animals that are captured for research, and subsequently euthanized, are submitted to museums' collections of specimens. Some of the animals collected are known to harbor Tetrodotoxin (TTX). TTX is a powerful neurotoxin, primarily known for its ecological role as an antipredator defense mechanism. Current knowledge on the potential use of museum samples for Tetrodotoxin (TTX) quantification is lacking. Thus, the purpose of this research is to determine whether fluid preserved specimens of organisms with TTX, can be used for the accurate quantification of TTX levels. Fluid preserved specimens, such as museum samples, are fixed with formaldehyde, to stop autolysis, and then stored in ethanol (Waller and Simmons 2003). Tetrodotoxin levels were analyzed from skin samples of stored specimens following the standard preservation process, using a Competitive Inhibition Enzymatic Immunoassay (CIEIA). The results of this study will provide a clear understanding of the potential uses and accuracy of preserved TTX holding tissues, such as those from museum samples, in future TTX related projects that require accurate TTX quantification data.

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## **28 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Corie Mellinger<sup>1</sup>, Dominique Didier<sup>1</sup>, William Bemis<sup>2</sup>, Catherine Boisvert<sup>3</sup> and Peter Currie<sup>4</sup>

<sup>1</sup>Millersville University, Millersville, PA, USA. <sup>2</sup>Cornell University, Ithaca, NY, USA. <sup>3</sup>Curtin University, Bentley, WA, Australia. <sup>4</sup>Monash University, Clayton, VIC, Australia

### **Morphological Analysis of Electroreceptive Organs in the elephantfish, *Callorhynchus milii* (Chondrichthyes; Chimaeriformes)**

Among Chondrichthyes, the chimaeroid fishes are notable for their unique snout morphologies. In particular, the snout of the elephantfish, *Callorhynchus milii*, has a plow-like flap of tissue that extends anterior to the mouth. Ampullae are concentrated on the head and snout of *C. milii* with pores of varying sizes and regional differentiation in the location of different sized openings. The morphology of these ampullary organs appears to differ both externally and internally. To test this hypothesis we used traditional anatomical techniques to examine the ampullary organs in embryonic and adult *C. milii*. Comparisons were also made to *Hydrolagus coliei*, a species that lacks the plow-like snout. Gross anatomical examination of the location, number and size of pores was completed on both species. Internal anatomy was studied using LM and whole mount cleared and triple stained embryos and snouts. Ampullae

of Lorenzini with large pores and long canals are concentrated in specific regions on the dorsal and lateral sides of the head, while shallow, pit-like ampullae are found on the ventral surfaces of the snout. The anatomy and location of these shallow ampullae are consistent with the miniampullae described for other chondrichthyan fishes. The unique arrangement and morphology of ampullae in chimaeroid fishes suggests different electrical detection capabilities with possible differences in function specifically related to prey detection.

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**452 ASIH STOYE GENERAL ICHTHYOLOGY II, Grand Lilac Ballroom South,  
Thursday 12 July 2018**

Bruno Melo<sup>1</sup>, Melanie Stiassny<sup>2</sup>, Jairo Arroyave<sup>3</sup>, Fábio Roxo<sup>1</sup>, Ricardo Benine<sup>1</sup>, Luz Ochoa<sup>1</sup>, Brian Sidlauskas<sup>4</sup>, Brant Faircloth<sup>5</sup>, Michael Alfaro<sup>6</sup> and Claudio Oliveira<sup>1</sup>

<sup>1</sup>*São Paulo State University, Botucatu, SP, Brazil.* <sup>2</sup>*American Museum of Natural History, New York, NY, USA.* <sup>3</sup>*Universidad Nacional Autónoma de México, Ciudad de México, Mexico.* <sup>4</sup>*Oregon State University, Corvallis, OR, USA.* <sup>5</sup>*Louisiana State University, Baton Rouge, LA, USA.* <sup>6</sup>*University of California, Los Angeles, CA, USA*

**Phylogenomics and the Timing of Diversification in Characiformes (Teleostei, Ostariophysi)**

The order Characiformes includes more than 2,000 diverse species distributed throughout the freshwaters of tropical Africa and the Neotropics. Though several recent papers have hypothesized phylogenetic relationships among characiform families, incongruences and poorly supported clades remain and the timing of diversification remains uncertain. To address these issues, we used a genome-wide dataset of 1,288 ultraconserved elements (UCEs) spanning 310 species, 221 genera and 23 families to reconstruct phylogenetic relationships using concatenated likelihood and Bayesian analyses and a coalescent species-tree approach. Six characiform fossils time-calibrated these trees. Results indicate that the four large suborders originated during the early Cretaceous and 17 of the 23 characiform families originated during the Paleogene. Our phylogenomic tree supports the paraphyly of Characiformes due to the placement of most Neotropical characiforms as more closely related to Siluriformes than to the African suborder Citharinoidei. The newly proposed Crenuchoidei (only Crenuchidae) is resolved as the sister group of a clade containing two major suborders: Anostomoidei, composed by 11 families (Alestidae, Hepsetidae, Erythrinidae, Hemiodontidae, Cynodontidae, Serrasalminidae, Parodontidae and superfamily Anostomoidea) and the restricted Characoidei with nine families (Ctenoluciidae plus Lebiasinidae, Chalceidae, Bryconidae, Gasteropelecidae, Triportheidae, Iguanodectidae, Acestrorhynchidae, and the monophyletic Characidae). These results provide the temporal framework needed to understand the evolutionary history of one of the major groups of teleosts.

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**205 ASIH: If Salamanders Could Speak Symposium, Grand Lilac Ballroom North,  
Saturday 14 July 2018**

Joseph Mendelson

*Zoo Atlanta, Atlanta, GA, USA*

**The remarkable career of Edmund D. Brodie, Jr.: if salamanders could speak**

Here I present a summary of my data and personal observations from the Middle Brodiecene, based on extensive field work in Arlington, Texas, and Logan, Utah. Of especial interest are anecdotes of graduate-student terror, obsessively large data sets, and a pioneering pursuit of truly cross-dimensional programs of research.

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**512 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: PHYSIOLOGY &  
MORPHOLOGY, Empire Hall South - JF Rochester Riverside Convention Center,  
Friday 13 July 2018**

Arianne Messerman and Manuel Leal

*University of Missouri, Columbia, Missouri, USA*

**Latitudinal Desiccation Risk Among Juveniles of Five *Ambystoma* Salamander Species**

Habitat suitability is determined by both the physiological tolerances of an organism, and the biotic and abiotic conditions acting on that organism. When conditions and an organism's physiology are misaligned, that individual may be unable to maintain minimum activity levels necessary for achieving energy balance (e.g., through sufficient foraging or movement to tolerable conditions). Energetic imbalances may affect growth, dispersal, reproduction, and increase the likelihood of mortality. Therefore, quantifying local conditions and identifying mechanisms by which organisms cope with stressors enable ecologists to better understand species distributions and population dynamics. Further, elucidating physiological responses to varying environmental conditions will improve predictions of habitat suitability and inform a growing body of conservation efforts in the face of global biodiversity losses. One diverse group of amphibians experiencing declines is the genus *Ambystoma*, which includes numerous pond-breeding salamanders. Terrestrial juvenile and adult ambystomatids require moist skin and are thermoconformers. Further, juveniles are both important for population viability and understudied. We therefore examined whether juveniles of five *Ambystoma* species differed in physiological rates of water loss across a latitudinal gradient of temperature and moisture in Missouri. We found that physiological water loss rates differed between individuals, species and populations. As there was not a strong latitude signature on physiological water loss, we characterized the abiotic microhabitat conditions across study sites. Insights into both the physiological tolerances of *Ambystoma* and the abiotic conditions experienced by juveniles of

these species can inform efforts to protect a sensitive life stage among a diverse genus of amphibians.

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## **497 SSAR SEIBERT CONSERVATION II, Highland B, Thursday 12 July 2018**

Arianne Messerman, Manuel Leal and Raymond Semlitsch

*University of Missouri, Columbia, Missouri, USA*

### **Peering into a Black Box: Survival Among Terrestrial Juveniles of Three *Ambystoma* Salamander Species**

To conserve declining populations, it is critical that researchers identify vital rates and life stages that importantly influence the population growth and persistence of target species. By doing so, environmental managers can optimize strategies for increasing population viability, particularly when the resources and threats experienced by differing life stages vary dramatically. Examples of such complex-lifecycle species are abundant among the diverse group of salamanders in the genus *Ambystoma*, with many species having aquatic larvae that develop into terrestrial juveniles and adults. Although we know relatively little about juvenile and non-breeding adult ambystomatids due to their fossorial nature, it is thought that amphibian population growth is most sensitive to changes in the vital rates of these terrestrial life stages. Using a mark-recapture approach in outdoor enclosures, we empirically estimated juvenile detection and survival rates for three species of *Ambystoma* over ten months. We designed the enclosures to approximate upland ambystomatid habitat and exclude predators. Recapture rates differed between species and over time, with temperature and precipitation explaining a majority of temporal variation in detectability for all species. Species-specific survival rates in the two-weeks between recapture occasions ranged from approximately 95-97%, and were constant through time. As such, the percentage of individuals of each species estimated to have survived over the ten-month study period was between 34-58% of those initially released. Subtle differences in terrestrial juvenile *Ambystoma* survival rates between species and populations may, therefore, dramatically impact annual adult recruitment, and thus the likelihood of population persistence among ambystomatids of conservation concern.

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## **532 ASIH STORER ICHTHYOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Vanessa Meza-Vargas<sup>1,2</sup>, Bárbara Calegari<sup>1,3</sup> and Roberto Reis<sup>1</sup>

<sup>1</sup>*Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, Rio Grande do Sul, Brazil.* <sup>2</sup>*Museo de Historia Natural (UNMSM), Lima, Lima, Peru.* <sup>3</sup>*Smithsonian Institution, Washington DC, Maryland, USA*

## A New Species of *Chaetostoma* (Siluriformes: Loricariidae) from Amazon Basin, Guiana Shield, Brazil

*Chaetostoma* is the second most diverse genus of Ancistrini, including 49 species, 22 of which are Cis-Andean. *Chaetostoma* are known as rubbernose armored catfishes because they lack plates and fleshy projections or tentacles on the anterior portion of the snout. Currently, the genus is distributed in Andean rivers in Peru, Ecuador, Colombia, Panama, Venezuela, and a single species in Brazil. Recent Expedition in the lower Amazon basin revealed a new species from the Maicuru River drainage, a north tributary of the Amazon River. The new species is recorded to the Guyana shield along with other two congeners, *C. jegui* and *C. vasquezi*, and represents the second species in Brazil. The new species is primarily diagnosed from most congeners by the modification on anal-fin morphology as well as color pattern of the head and trunk. Additionally, the new *Chaetostoma* is distinguished from both Guyana shield species (*C. jegui*, and *C. vasquezi*) by having the ventral surface of the premaxillary barbel dark brown and by shape of odontodes on the cheek plate. Also, the new species shows an unusual condition of the dermal keel on the parieto-supraoccipital, in which adults lack such keel that is present in juveniles.

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### 509 Lightning Talks III, Highland B, Sunday 15 July 2018

Vanessa Meza-Vargas<sup>1,2</sup>, Nathan Lujan<sup>3</sup> and Roberto Reis<sup>1</sup>

<sup>1</sup>Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, Rio Grande do Sul, Brazil. <sup>2</sup>Museo de Historia Natural (UNMSM), Lima, Lima, Peru. <sup>3</sup>University of Toronto Scarborough, Toronto, Ontario, Canada

### How many genera are *Hemiancistrus* (Siluriformes: Loricariidae)?

The genus *Hemiancistrus* was erected by Bleeker, 1862, for the species *Ancistrus medians* Kner, 1854, from Suriname. Although molecular phylogenetic evidence consistently indicates that *Hemiancistrus medians* is monotypic, up to 44 nominal species have been historically placed in this genus. Recent taxonomic revisions have reduced the number of valid *Hemiancistrus* species to 12, yet more work is required to fully resolve the genus-level taxonomy of species assigned to this genus. Currently valid *Hemiancistrus* species are broadly distributed across both cis- (Orinoco, Amazon, Maroni, Uruguay) and trans-Andean (Guayas, Esmeraldas, San Juan) river basins and at least four different phylogenetic lineages. Thus, a genus-level taxonomic revision is needed to better reflect phylogenetic patterns and better highlight morphological and biogeographical diversification patterns within the Loricariidae. However, taxonomic revision of *Hemiancistrus* is hindered by poorly detailed original descriptions, missing type specimens and apparently homoplastic morphological characters. Currently, the genus lacks an exclusive morphological diagnosis. In this study, we review morphological evidence for breaking up *Hemiancistrus* species in the context of a phylogeny based on a 4,162 base pair alignment consisting of two mitochondrial (16S, *Cytb*) and three nuclear loci (RAG1, RAG2, MyH6).

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**134 ASIH STORER HERPETOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Aryeh Miller<sup>1</sup> and Graham Reynolds<sup>1,2</sup>

<sup>1</sup>University of North Carolina Asheville, Asheville, NC, USA. <sup>2</sup>Harvard University, Cambridge, MA, USA

**Elucidating Cryptic Diversity in Burmese *Lygosoma* Skinks via Integrative Taxonomy**

Supple skinks (Reptilia; *Lygosoma*), named for their attenuate limbs, like many other Indochinese herpetofaunal groups, have experienced particular taxonomic turbidity over the past few decades. With a widespread geographic breadth (spanning most of Africa to continental and insular Asia), the majority of species within this group are exceptionally poorly known. As is the case with so many understudied cryptic species groups, Southeast Asian Lygosomine species-complexes, such as *Lygosoma quadrupes*, require comprehensive molecular and morphological assessments to resolve the evolutionary relationships of these cluttered taxa. Here, using comparative morphological and novel multilocus phylogenetic data, we apply targeted species delimitation techniques to the *Lygosoma quadrupes* complex, focusing in particular on species from Myanmar. In so doing, we reveal multiple cryptic lineages and provide insight on the taxonomic status of this group, as well as additionally biogeographic discussion. Our dataset also provides opportunities to examine the evolution of body elongation and limb attenuation, which has happened independently in several Indochinese skink lineages.

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**250 ASIH STORER ICHTHYOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Elizabeth Miller and John Wiens

University of Arizona, Tucson, AZ, USA

**The Role of Sexual Selection in Generating Freshwater and Marine Biodiversity**

The marine-terrestrial biodiversity gradient is the dramatic difference in species richness between marine and terrestrial environments. Species richness of actinopterygian fishes is comparable in freshwater and marine habitats, although less than 1% of Earth's habitable water is fresh. Traditionally, this pattern has been explained by greater opportunities for allopatric speciation in freshwater habitats, implying higher diversification rates in freshwater versus marine habitats. Our macroevolutionary analyses suggest freshwater fishes do have higher diversification rates on average than marine fishes. However, high diversification rates are not a

feature of freshwater clades in general. Instead, high rates are concentrated within a few freshwater clades that share a prevalence of sexual dichromatism. Here, we tested whether dichromatism evolves more readily in freshwater habitats, and whether dichromatism increases diversification relative to monochromatism across the Actinopterygii Tree of Life. We collected dichromatism data for over 6,000 species of actinopterygian fishes, a dataset of unprecedented size. Dichromatism is more prevalent in freshwater than marine habitats, and may be correlated with other ecological and life history characteristics. The tendency for sexual dichromatism to evolve in freshwater habitats and subsequently increase diversification rates is a novel explanation for the marine-terrestrial biodiversity gradient in fishes.

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**248 ASIH STOYE GENERAL ICHTHYOLOGY I, Grand Lilac Ballroom South,  
Thursday 12 July 2018**

Elizabeth Miller<sup>1</sup>, Kenji Hayashi<sup>2</sup>, Dongyuan Song<sup>3</sup> and John Wiens<sup>1</sup>

<sup>1</sup>*University of Arizona, Tucson, AZ, USA.* <sup>2</sup>*Brown University, Providence, RI, USA.* <sup>3</sup>*Fudan University, Shanghai, China*

### **Explaining the Ocean's Dominant Species Richness Gradient and Global Patterns of Marine Fish Diversity**

The longitudinal diversity gradient is the dominant richness pattern across the marine tropics. Global marine richness peaks in the Central Indo-Pacific region and declines longitudinally, a striking pattern that remains poorly understood. A challenge to understanding this gradient is that the relative roles of diversification rates versus colonization history have not been disentangled among regions. Here, we collected distributional data for percomorph fishes, a group containing >75% of marine ray-finned fishes. We then analyzed biogeographic data using a phylogenetic framework to reveal how colonization and diversification have generated species richness differences among marine regions. We also compared the processes generating species richness in the tropics with those operating in cold marine habitats. The high diversity of the Central Indo-Pacific was explained by replicated colonizations of the region across the percomorph phylogeny during the Oligocene-Miocene. These relatively old colonization events allowed more time for species richness to accumulate compared to other warm marine regions. Surprisingly, net diversification rates were decoupled from marine richness patterns, and clades in low-richness cold marine habitats had the highest diversification rates. Therefore, the high richness of the Central Indo-Pacific is due to greater time-for-speciation, not higher diversification rates. By directly comparing colonization and macroevolutionary rates among regions, these results extend beyond the existing framework for understanding the longitudinal diversity gradient.

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**144 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: PHYSIOLOGY & MORPHOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Eva Miller and Jennifer Deitloff

*Lock Haven University of Pennsylvania, Lock Haven, PA, USA*

**Comparing Population and Sex Differences in Head Shape for Two Populations of *Plethodon cinereus* (Red-backed Salamanders) in Pennsylvania.**

Morphological variation within a species depends on many factors, including development, sex, genetics, and phenotypic plasticity. Morphology can correlate with ecological factors such as location, environment, and intensity of competition. *Plethodon cinereus* occupies a broad geographic area across the United States and exhibits variations in morphology dependent on their region. In addition to variation between populations, morphology can also vary between sexes. We tested the hypothesis that head morphology differs between populations and among sexes (males, gravid females, and nongravid females) of *Plethodon cinereus*. We investigated both lateral and ventral head-shape morphology of *P. cinereus* from two populations in Pennsylvania while also comparing shape among sexes. Photographs of both the ventral and lateral views of the head of each specimen were taken, and each specimen was assigned biologically homologous landmarks which were analyzed using geometric morphometric methods. We concluded that head morphology differed among populations, but the sexes did not differ. Each population likely experience different environmental factors because of their different geographic locations, which could be correlated with this difference in head-shape. Further research examining differences in environmental conditions or resource use could provide insight into why head morphology differs between these populations.

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**142 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Kelsey Mitchell and Katherine Greenwald

*Eastern Michigan University, Ypsilanti, Michigan, USA*

**Climate Change Effects on Body Size and Population Composition of Unisexual *Ambystoma* Salamanders**

Climate change has been shown to drive changes in organisms' phenology, geographic ranges, and eco-morphology. Amphibians may show variable responses to climate change due to the diverse ecological, physiological, and genetic traits of these taxa. Unisexual (all female) *Ambystoma* salamanders reproduce via kleptogenesis, in which insemination by a sympatric sexual male is necessary to trigger egg development. The zygote can develop gynogenetically or via incorporation of the male's genome into the ovum, resulting in individuals that vary in

ploidy and genome composition. We will analyze genetic and morphological data of historic and modern-day unisexual and *A. laterale* specimens from the University of Michigan's E. S. George Reserve. Epidermal cell nuclei measurements will be used to establish ploidy levels of historic specimens (dating back to the 1960s) housed at the UM Museum of Zoology. Ploidy of current samples will be assessed using a panel of microsatellite loci. We predict that climate change (i.e. rising temperatures) will have driven population composition away from the more northern-distributed *A. laterale* and toward populations dominated by LLJ unisexuals. However, microclimate change (e.g. increased canopy cover) may mitigate the effects of these broader climatic shifts. We also predict that salamanders will show reductions in body size over the last half century. Changes in population composition and body size could inform our understanding of the susceptibility of amphibians to climate change, as well as whether adaptation can keep pace with rapid environmental change.

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### **486 Ichthyology Conservation, Grand Lilac Ballroom South, Saturday 14 July 2018**

Shawna Mitchell and Bernie Kuhajda

*Tennessee Aquarium Conservation Institute, Chattanooga, Tennessee, USA*

### **Population Status and Life History of the Federally Endangered Laurel Dace, *Chrosomus saylori***

The Laurel Dace (*Chrosomus saylori*) is a federally endangered species endemic to the upper Tennessee River Basin in Tennessee. Their populations have suffered from heavy siltation and poor water quality from agriculture runoff. Laurel Dace historically occupied only eight streams on Walden Ridge of the Cumberland Plateau, however recent sampling indicates this species is only relatively common in two streams, Bumbee Creek and Youngs Creek. Previously, the northern population of Laurel Dace (Piney Creek system) appeared to be in relatively good shape, with high numbers of individuals in Bumbee and Moccasin creeks, but as of 2016 there have been no Laurel Dace found in Moccasin Creek. The abundance of Laurel Dace in Youngs Creek was low when it was last sampled in 2013; however in 2017 the site was visited twice, with the second survey capturing hundreds of young of the year Laurel Dace. Tennessee Dace (*Chrosomus tennesseensis*) are not listed in Tennessee and are a close relative to the Laurel Dace. They are found in Duskin Creek about 300 feet in elevation below Bumbee Creek and both creeks discharge into Piney Creek. We will be studying the life history of the Tennessee Dace in order to use it as a surrogate species for the life history of Laurel Dace. Studying the life history of the Tennessee Dace will allow us to make better informed decisions that will help determine what is needed for the recovery of the Laurel Dace.

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### **159 ASIH STOYE ECOLOGY & ETHOLOGY II, Highland C, Thursday 12 July 2018**

Patrick D. Moldowan<sup>1</sup>, Glenn J. Tattersall<sup>2</sup> and Njal Rollinson<sup>1</sup>

<sup>1</sup>University of Toronto, Toronto, Ontario, Canada. <sup>2</sup>Brock University, St. Catharines, Ontario, Canada

## **Population Ecology and Sensitivity to Environmental Change of the Spotted Salamander, *Ambystoma maculatum***

This presentation will highlight findings from one decade of a mark-recapture study and two decades of reproductive monitoring of Spotted Salamanders (*Ambystoma maculatum*) in Algonquin Provincial Park (APP), Ontario. Since 1992, the timing of breeding of APP salamanders has seemingly been advancing, and preliminary analyses demonstrate a negative correlation between reproductive effort and temperature during the pre-breeding period, suggesting that warmer spring temperatures discourage breeding activity. Relatedly, body condition and reproductive effort correlate negatively to previous summer temperatures, also suggesting that warmer temperatures curtail reproduction. Given changes in temperature, precipitation, and seasonality in APP in recent decades, we are interested in quantifying the relationship between changes in environmental conditions and changes in both individual-level (age-specific growth, body condition, reproductive effort) and population-level characteristics (breeding phenology, adult breeding abundance, age structure, timing of egg hatch and metamorphosis). We are studying what features of the life cycle are most sensitive to climate (change), and how the differential sensitivity of these features cumulatively impact population ecology and viability. We have recently established a comparative population sampling study involving minnow trap, cover board, and drift fence methodologies, and will be updating following our first field season of implementation. Continued research will address population demography via skeletochronology and the construction of an Integrated Population Model as a tool to jointly analyze data on population size and demographic data.

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**329 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: EVOLUTION, GENETICS, & SYSTEMATICS, Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018 AND Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center; part of ASIH symposium: If Salamanders Could Speak, Saturday 14 July 2018**

Haley Moniz<sup>1</sup>, Vicki Thill<sup>1</sup>, Robert del Carlo<sup>1</sup>, Jessica Reimche<sup>1</sup>, Michael Hague<sup>2</sup>, Edmund Brodie Jr.<sup>3</sup>, Normand LeBlanc<sup>1</sup> and Chris Feldman<sup>1</sup>

<sup>1</sup>University of Nevada, Reno, Reno, NV, USA. <sup>2</sup>University of Virginia, Charlottesville, VA, USA. <sup>3</sup>Utah State University, Logan, UT, USA

## **Costs of Adaptation: Tradeoffs in Organismal Performance of Tetrodotoxin-Resistant Garter Snakes (*Thamnophis*)**

Adaptive evolution of tetrodotoxin (TTX) resistance in certain garter snake populations (*Thamnophis*) has enabled a coevolutionary arms race between these snakes and their toxic, Pacific newt prey (*Taricha*). Resistance to TTX stems from mutations in the outer pore of

voltage-gated sodium channels that are the molecular targets of TTX. Because these ion channels are essential for action potential propagation in excitable cells, any changes to the outer pore that reduce TTX ligation may also have adverse consequences on nerve and muscle function. Here we examine this potential tradeoff between TTX-resistance and physiological function in both muscle and whole-animal. We examine several aspects of muscle mechanics (phasic contraction, time to maximum force, etc.), as well as aspects of whole organism performance (sprint speed, endurance, etc.) in a range of TTX-resistant and TTX-sensitive snakes that express different sodium channel alleles. If tradeoffs at the molecular level scale-up to the whole-animal, then resistant snakes may be at a disadvantage under certain ecological conditions. Clarifying the nature and extent of these tradeoffs impacts our understanding of the coevolutionary dynamic between *Taricha* and TTX-resistant populations of *Thamnophis*.

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## 608 Herpetology Biogeography II, Highland B, Saturday 14 July 2018

Dillon Monroe and Robert Espinoza

*California State University, Northridge, Northridge, CA, USA*

### **A Comparison of Traditional and Citizen-Science Approaches to Inferring the Distribution of an Invasive House Gecko (*Hemidactylus turcicus*) in Texas**

Citizen science has emerged as a practical, cost effective, and potentially prosperous means of collecting data. However, few studies have examined the extent to which decentralizing data collection introduces new sources of variance in patterns of spatial sampling. To assess this, we conducted a point-pattern analysis to compare traditional and citizen-science approaches to determining the invasive distribution of Mediterranean House Geckos (*Hemidactylus turcicus*; MHGs) in Texas. MHGs first arrived in Brownsville, Cameron County, Texas in 1950 and have since established populations in more than half of the 254 counties in Texas. Traditional data sources included museum/ university collections ( $n = 59$ ; 288 unique locations) and for the citizen-science databases we included HerpMapper and iNaturalist (1893 unique locations). Quadrature analysis was used to test whether the locations were non-random using variance-to-mean ratio and Poisson-distribution tests. To test whether the locations were clustered or dispersed, we used a nearest neighbor analysis. Our analyses support the notion that citizen-science data are comparable to traditional data sources for regional-scale inferences of species presences or absences. However, there were some differences in the location patterns that could pose problems when comparing small datasets. Overall, our results support the idea that citizen scientists can provide researchers with access to valuable data that would otherwise be challenging to acquire, particularly for human commensal species like house geckos.

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## 70 Amphibian Ecology II, Highland A, Sunday 15 July 2018

Carmen Montaña<sup>1</sup>, Christopher Schalk<sup>2</sup>, Tiffany Schriever<sup>3</sup>, T. M. S. D. G. Silva<sup>1</sup>, David Hagyar<sup>1</sup>, Jakob Wager<sup>1</sup>, Lindsey Tiegs<sup>1</sup> and Cyrus Sadeghian<sup>1</sup>

<sup>1</sup>Sam Houston State University, Huntsville, Texas, USA. <sup>2</sup>Stephen F. Austin State University, Nacogdoches, Texas, USA. <sup>3</sup>Western Michigan University, Kalamazoo, Michigan, USA

## **Revisiting ‘What do Tadpoles Really Eat?’: A Ten-year Perspective**

Tadpoles are diverse and abundant consumers and knowledge on their feeding ecology and trophic status is essential to understand their functional role within their aquatic habitats. Here we revisit Altig et al. (2007)’s paper that highlighted the knowledge gaps in tadpole feeding ecology and suggested application of modern techniques (stable isotope analysis, fatty acids, and ecological stoichiometry) to understand their trophic status in the context of species diversity and ecoregion. Our results highlight the importance of modern techniques for a better understanding of dominant food resources, food assimilation, and trophic position of tadpoles in aquatic ecosystems. Our findings indicate that most research on tadpole trophic ecology has been conducted in Neotropic and Nearctic regions, and primarily on species from the families Ranidae, Bufonidae, and Hylidae. Tadpoles play important roles in food webs and ecosystem functions, therefore there is a sense of urgency for more studies in tropical regions like Africa and Asia, where species diversity and endemism is of great importance. Declines in amphibian abundance and diversity are occurring worldwide. A combination of modern techniques and more natural and manipulated experiments would offer a powerful approach for understanding of tadpoles’ feeding ecology and trophic status and their consequences in food-web structure and ecosystem functions.

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## **201 Reptile Ecology II, Highland A, Sunday 15 July 2018**

Jennifer Moore, Patrick Laarman and Joseph Altobelli

*Grand Valley State University, Allendale, MI, USA*

## **Ecology of Neonatal Box Turtles with Implications for Prescribed Burning**

Eastern box turtle hatchlings are vulnerable to mortality incurred from various sources, including predation and management activities like prescribed burning, which is often used to promote fire dependent natural communities. Collecting data on neonatal turtles is challenging, thus the spatial ecology and mortality of young age classes of box turtles are not well understood. We investigated spatial ecology and survival of neonate eastern box turtles in the northern Lower Peninsula of Michigan. Our objectives were to document nesting, emergence, habitat use, dispersal rates, residency time of neonates in natal openings, and annual survival using radio telemetry. Nest emergence timing varied considerably in different years but no neonates dispersed more than 50 m beyond the boundary of their natal forest opening before onset of winter. Dispersal (distance from nest to overwintering site) was extremely limited in the first activity season, and by 1 June of their second activity season, all neonates were still

present in or within 50 m of their natal opening, but all vacated openings by 1 July. Survival was 50% until overwintering, after which it dropped considerably, and no neonates survived beyond 335 days post hatching. Predation and exposure to suboptimal environmental conditions were the main sources of mortality. Our results have implications for turtle demography and habitat management, as prescribed burning, used to maintain open canopy habitats necessary for nesting, may negatively affect neonate survival.

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**442 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Kevin Moore<sup>1</sup>, Chris Brooks<sup>1</sup>, Chuck Knapp<sup>2</sup> and Mark Welch<sup>1</sup>

<sup>1</sup>Mississippi State University, Starkville, MS, USA. <sup>2</sup>Shedd Aquarium, Chicago, IL, USA

**Rock Iguanas and Their Ticks: Predicting The Infestation Bias of Nonspecific Herptophile Ticks in the Bahamas.**

The faunal community of the Caribbean region is unique from most mainland communities in that the largest endemic vertebrates are reptiles, specifically rock iguanas: *Cyclura*. For this reason, the majority of locally adapted parasites specialize on reptilian and avian taxa instead of mammalian hosts. Parasite life history is concomitant with the ecology of potential hosts, and although *Cyclura* ecology is well studied, the prevalence of and susceptibility to parasitic infestation within and among populations has been a subject of little research. Ticks of the genus *Amblyomma* will infest any large-bodied reptile and are common in the Caribbean. Despite not being host-specific, ticks may infest species at biased rates. *Amblyomma* leave their hosts infrequently to oviposit and molt. I hypothesize that the territoriality and larger body size of *Cyclura* lead to ticks reinfesting their previous, or infest neighboring iguana hosts. Larval ticks would encounter a similar suite of hosts unless ticks disperse great distances to oviposit. I predict that these factors will result in an infestation bias of iguanids over any other reptilian host. To investigate these questions, I will simulate parasite load of three models of infestation bias: no biased infestation, iguana biased infestation, and biased infestation of non-iguanas. The empirical data of actual parasite load can then be fit to the best likelihood surface. The product of these simulations will contribute to our understanding of how parasites infest hosts; additionally, identify populations at risk of vector borne diseases, augmenting the conservation and management of a critically endangered reptile.

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**54 ASIH STOYE GENERAL ICHTHYOLOGY IV, Highland E., Friday 13 July 2018**

Thomas Morgan<sup>1</sup>, Stuart Willis<sup>2</sup>, Izeni Farias<sup>3</sup>, Raphael Covain<sup>4</sup>, Jan Mol<sup>5</sup>, David Portnoy<sup>6</sup> and Hernán López-Fernández<sup>7</sup>

<sup>1</sup>University of Toronto, Toronto, Ontario, Canada. <sup>2</sup>California Academy of Sciences, San Francisco, California, USA. <sup>3</sup>Federal University of Amazonas, Manaus, Brazil. <sup>4</sup>Natural History Museum of Geneva, Geneva, Switzerland. <sup>5</sup>Anton de Kom University of Suriname, Paramaribo, Suriname. <sup>6</sup>Texas A&M University at Corpus Christi, Corpus Christi, Texas, USA. <sup>7</sup>University of Michigan, Ann Arbor, Michigan, USA

## **The Biogeography and Phylogenomics of *Geophagus* (Subfamily: Cichlinae) in the Guiana Shield.**

The Guiana Shield region of South America is characterized by high levels of fish diversity and endemism. However, the processes that contributed to the formation of these unique fish assemblages have not been resolved. The modern fish diversity of the Guiana Shield likely originated from a combination of processes including invasion via river capture events and subsequent diversification, marine incursion, and the persistence of more ancient relictual species; however, how each of these processes has contributed to extant assemblages is not known. In order to elucidate drivers of endemism and patterns of diversity in the Guiana Shield fishes, we looked at 136 individuals from the genus *Geophagus* (subfamily: Cichlinae), collected from the Guiana Shield, Orinoco and Amazonian regions, representing 14 described species and several populations of unclear taxonomic identity. Using a ddRADseq approach we sequenced >15,000 loci to characterize *Geophagus* genetic diversity and phylogenetic relationships. Our results revealed monophyly of Guiana Shield endemics and phylogenetic relationships indicating that hydrological basins contain distinct and possibly isolated populations. Phylogenetic analyses identified 19 well resolved clades within *Geophagus* corresponding to described species as well as putatively undescribed taxa. Our results, as do previous unpublished analyses, also indicate that the currently distinct taxa *G. surinamensis* and *G. brokopondo* are likely one species. Broadly, phylogenetic patterns suggest a single evolutionary origin for endemic Guiana Shield *Geophagus*. These results suggest that diversification of Guiana Shield endemic *Geophagus* was likely *in situ*, and that this process has led to the high levels of observed endemism.

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### **534 Ichthyology Ecology and Ethology, Highland E, Sunday 15 July 2018**

Nathan Morris<sup>1,2</sup>, Janet Long<sup>2</sup> and Elizabeth Alter<sup>1,2,3</sup>

<sup>1</sup>CUNY Graduate Center, New York, NY, USA. <sup>2</sup>York College, Jamaica, NY, USA. <sup>3</sup>Sackler Institute for Comparative Genomics at AMNH, New York, NY, USA

### **“Characterization of the Gut Microbiome of Mummichog, *Fundulus heteroclitus*, Living in Polluted Urban Waterways”**

Fish gut microbiome research, while still relatively new, has already begun to provide insights into the overall health, immune function, and digestive processes of host species. While the relationship between gut microbiome composition and physiology is not completely understood, it is known that gut microbiota are responsible for metabolizing foods that their

hosts could not otherwise digest, and for influencing immune functions. Fish guts are also likely inundated with microorganisms from the water and food in their immediate surroundings. It has been shown that habitat and diet affect gut microbiome composition, but the exact relationship has yet to be demonstrated. *Fundulus heteroclitus*, or the mummichog, is a species of fish known to live in diverse environments, feed on a wide variety of foods, and survive in severely polluted waters. The gut microbiome of mummichog living in polluted urban waterways has not been well explored. Here we present results characterizing the gut microbiomes of mummichog from various New York City waterways using 16S ribosomal RNA gene sequencing. Sampling sites include the Gowanus Canal (a superfund site), Jamaica Bay, and Long Island. Both the Gowanus Canal and Jamaica Bay are known for their long history of pollution from industrial waste and combined sewer overflows. We examine alpha and beta diversity, and the taxonomic composition of the microbial communities found in fish gut. By characterizing the gut microbiome of the mummichog, we hope to contribute to further understanding of the mechanisms that enable this species to persist in such challenging environments.

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## 74 Herpetology Biogeography I, Highland B, Saturday 14 July 2018

Cherie Mosher<sup>1</sup>, Brent Murray<sup>1</sup>, Chris Johnson<sup>1</sup> and Stephen Spear<sup>2</sup>

<sup>1</sup>UNBC, Prince George, BC, Canada. <sup>2</sup>The Wilds, Cumberland, Ohio, USA

### **The Curious Case of the Coastal Tailed Frog: A Phylogeographic Study Using Multiple Methods**

The coastal tailed frog (*Ascaphus truei*) is an indicator species for the health of its habitats in the Coastal and Cascade Mountains of the Pacific Northwest of North America. This ancient species, unique among and a sister species to all extant frogs, is associated with cool, fast-flowing, mountain streams. We compared the within region genetic diversity of populations near the northern extent of the coastal tailed frog's range (British Columbia, Canada) to four other regions (two in British Columbia, Canada and two in Washington, USA), moving towards the core of the range in Washington, USA. We used two genetic techniques - microsatellite (9 loci) and next-generation sequencing (4,249 loci) - to explore broad-scale genetic diversification. Sampled regions (N=5) separated into 4 genetic clusters with the two most northern regions clustering together, all marker systems being consistent. The allelic richness and heterozygosity reduced substantially as the latitude increased. Though northernmost populations are often characterized by lower genetic variability, we discovered an extreme case of reduction in a large portion of the coastal tailed frog range. This study showed a strong correlation between microsatellite and "big data" analyses. Additionally, our discovery of reduced diversity may have important conservation and management implications regarding population connectivity and response to climate change. This talk will detail our intriguing results and showcase insight into *A. truei*'s unique evolutionary lineage in British Columbia.

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## 380 ASIH STOYE ECOLOGY & ETHOLOGY II, Highland C, Thursday 12 July 2018

Jeanette B. Moss<sup>1</sup>, Glenn P. Gerber<sup>2</sup>, Aumbriel Schwirian<sup>1</sup>, Anna C. Jackson<sup>1</sup> and Mark E. Welch<sup>1</sup>

<sup>1</sup>Mississippi State University, Mississippi State, MS, USA. <sup>2</sup>San Diego Zoo Institute for Conservation Research, Escondido, CA, USA

### **The sex life of a Caribbean lizard: sexual conflict, evolutionary constraint, and inbreeding avoidance in a small, insular population**

In natural populations susceptible to inbreeding depression, behaviors such as female promiscuity and negative assortative mating may enhance the production of outbred progeny. However, the majority of empirical tests of such hypotheses have been undertaken in breeding systems where female choice is known to play a large role. We carried out pedigree reconstructions of 50 clutches of critically endangered *Cyclura nubila caymanensis* (Sauria: Iguanidae) to investigate the prevalence and efficacy of inbreeding avoidance behaviors. We found no evidence for negative assortative mating or female preference for outbred males, but successful sires were larger-than-average. We detected multiple-paternity in 36.2% of clutches, with reduced rates of 20% occurring in a human-modified habitat with high local densities compared to 40.5% for the remainder of the island. This finding implies that females paradoxically have fewer mates when more males are present. However, multiply sired clutches exhibited higher allelic diversity and lower rates of inbreeding than single sire clutches suggesting that there could be benefits to mating multiply. Our data imply that while female mating behaviors have the potential to confer adaptive benefits in this small population, the trajectory of mating system evolution may be largely constrained by sexual conflict.

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## 181 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018

Cy Mott<sup>1</sup> and Emily Croteau<sup>2</sup>

<sup>1</sup>Eastern Kentucky University, Richmond, KY, USA. <sup>2</sup>University of Kentucky, Lexington, KY, USA

### **Testing the abundant center distribution hypothesis in North American anurans using a citizen science program**

The abundant center distribution hypothesis (ACH) predicts decreasing population densities as a species' geographic range edge is approached, a pattern that is considered to underlie spatial variation in ecological and evolutionary processes occurring in ecologically marginal habitats. However, the extent to which abundant center distributions represent a biogeographical rule is unclear, as such patterns occur in less than half of all species examined, and most ACH studies have focused on plants or endothermic vertebrates. Using call count

data from a citizen science program, the North American Amphibian Monitoring Program, we examined range-wide abundance estimates for 13 anuran species across 16 transects spanning the eastern and central United States. Based on call-count density estimates for nearly 750 populations, we observed that 75% (12/16) of species-transects exhibited distributions fitting the ACH. In addition, ~88% (14/16) of species-transects exhibited decreases in abundance towards the range edge based on two other estimates of abundance. In contrast to previous studies of the ACH, our results indicate that anurans largely adhere to its predictions, potentially due to such factors as reduced vagility and increased sensitivity to local environmental conditions relative to other vertebrate groups. These results also speak to the value of citizen science programs in providing data that can address large-scale ecological and evolutionary questions, but that are difficult to address through traditional research methods.

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### **431 ASIH STOYE GENETICS, DEVELOPMENT, & MORPHOLOGY III, Highland C, Friday 13 July 2018**

Kevin P Mulder<sup>1,2</sup>, André Lourenço<sup>2</sup>, Rayna C. Bell<sup>1</sup>, Ivan Gomez-Mestre<sup>3</sup> and Guillermo Velo-Antón<sup>2</sup>

<sup>1</sup>National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

<sup>2</sup>CIBIO, Vairão, Porto, Portugal. <sup>3</sup>EBD-CSIC, Sevilla, Andalusia, Spain

### **RNAseq analyses across two independent transitions within *Salamandra salamandra* highlight candidate genes important in the shift from larviparity to viviparity**

Shifts in reproductive mode occur across the tree of life and are key adaptations with profound effects on species' life histories and evolutionary trajectories. Understanding the proximate and ultimate causes of these shifts can be challenging due to concurrent neutral and adaptive changes that can arise alongside a shift in reproductive mode. *Salamandra salamandra* is an amphibian that exhibits intra-specific variation in reproductive mode allowing us to investigate both larviparity and viviparity in the same species. Although it yields fewer offspring, viviparity is an adaptive innovation that allows individuals to exploit ecological habitats with no available water bodies, and bypass the high predation pressure of the larval stage. *S. salamandra* is larviparous across the majority of its range but viviparity evolved during the Pleistocene within *S. s. bernardezi* populations of northern Spain and separately during the Holocene on the land-bridge islands of *S. s. gallaica* in northwestern Spain. We compared the gene expression profiles of the uterus and oviduct of pregnant females across both transition zones to detect candidate genes that are important in explaining the difference in reproductive mode. We identified differentially expressed genes specific to either transition zone as well as genes that appear important for both transition zones. We discuss the potential mechanisms that can explain the phenotypic differentiation based on what is known about the molecular function of the candidate genes.

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**110 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: CONSERVATION & MANAGEMENT, Empire Hall South – JF Rochester Riverside Convention Center, Friday 13 July 2018**

Damien Mullin<sup>1</sup>, Rachel White<sup>1</sup>, Andrew Lentini<sup>2</sup>, Jory Mullen<sup>1</sup>, Ronald Brooks<sup>3</sup> and Jacqueline Litzgus<sup>1</sup>

<sup>1</sup>Laurentian University, SUDBURY, Ontario, Canada. <sup>2</sup>Toronto Zoo, Toronto, Ontario, Canada. <sup>3</sup>University of Guelph, Guelph, Ontario, Canada

**Evaluating Assumptions of Headstarting for Turtle Conservation**

Headstarting is a conservation tool which assumes that raising turtles in captivity to a larger body size increases their survivorship compared to wild non-headstarted turtles. Our goal was to quantitatively test this fundamental assumption by comparing three groups of turtles with varying degrees of headstarting: (1) 15 turtles headstarted for 2-years (2yHS), (2) 15 turtles headstarted for 1-year (1yHS), and (3) 15 turtles hatched in captivity then released (i.e. no headstarting; 0yHS). We measured somatic growth rates of headstarted turtles while in captivity, and then all three cohorts of turtles were radio-tracked weekly during the active season and monthly during the winter to monitor behaviour, growth, and survivorship in the wild post-release. 2yHS and 1yHS were tracked for one year, from June 2016 until June 2017. 0yHS hatched in late July 2016, were released on 2 August 2016, and tracked for one month. All cohorts exhibited positive growth post-release from captivity. 0yHS had 73% confirmed survivorship one-month post-release, and three of these turtles were confirmed to have survived the winter. 2yHS had greater survivorship (73%) than 1yHS (40%) during the 12-months post-release ( $p=0.070$ ). Our results support the fundamental assumption that bigger turtles have greater survivorship, and suggest that headstarting for 2 years increases post-release survival of turtles. Given the growing number of turtle headstarting projects globally, our study provides data that can aid in establishing best practices.

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**109 SSAR SEIBERT CONSERVATION II, Highland B, Thursday 12 July 2018**

Damien Mullin<sup>1</sup>, Rachel White<sup>1</sup>, Andrew Lentini<sup>2</sup>, Jory Mullen<sup>1</sup>, Ronald Brooks<sup>3</sup> and Jacqueline Litzgus<sup>1</sup>

<sup>1</sup>Laurentian University, Sudbury, Ontario, Canada. <sup>2</sup>Toronto Zoo, Toronto, Ontario, Canada. <sup>3</sup>University of Guelph, Guelph, Ontario, Canada

**Evaluating the Effectiveness of Headstarting for Wood Turtle (*Glyptemys insculpta*) Recovery from a Suspected Poaching Event**

A population of endangered Wood Turtles (*Glyptemys insculpta*) was studied extensively beginning in 1988. By the mid-1990s, a suspected poaching event resulted in the removal of approximately 70% of the population. A population viability analysis determined that

extirpation was inevitable if no intervention was undertaken and so a headstarting project was initiated in 2003 and the first cohort was released in 2005. Our objective is to quantitatively assess the effectiveness of the 14-year headstarting program by modeling population demographic parameters to evaluate recovery efforts to date, and determine the next phase of recovery. To date, a total of 537 headstarted turtles have been released back into their maternal streams. At present, the population bears the hallmarks of a heavily managed system: headstarted turtles constitute a larger proportion of the population than non-headstarted wild turtles (149:25), and sexually immature juveniles outnumber sexually mature adults (139:35). The persistence of the population will likely require a demographic shift to a more natural situation in which the population is made up mostly of reproducing adults. Headstarted turtles from the first release groups are just now beginning to reproduce, indicating that the population may become self-sustaining. Modeling suggests population recovery has been slow, even with intensive management. Modeling population recovery scenarios with comprehensive long-term data is essential for evaluating the effectiveness of headstarting projects, while continuously improving recovery efforts.

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## **651 General Herpetology I, Highland B, Sunday 15 July 2018**

Eric Munscher<sup>1</sup>, Andrew Walde<sup>2</sup>, Daren Riedle<sup>3</sup>, Stephen Ross<sup>4</sup>, Nicole Salvatico<sup>5</sup>, Chris Collins<sup>6</sup>, Mike Farris<sup>7</sup>, Brian Butterfield<sup>8</sup>, Brian Hauge<sup>9</sup> and Michael Skibsted<sup>10</sup>

<sup>1</sup>SWCA, Houston, Texas, USA. <sup>2</sup>Walde Research & Environmental Consulting, Atascadero, California, USA. <sup>3</sup>Kansas Department of Wildlife, Parks, and Tourism, Pratt, Kansas, USA. <sup>4</sup>Power Engineers, Inc., Houston, Texas, USA. <sup>5</sup>Florida Department of Health, Tavares, Florida, USA. <sup>6</sup>SWCA, San Antonio, Texas, USA. <sup>7</sup>NAFTRG, Houston, Texas, USA. <sup>8</sup>Freed-Hardeman University, Henderson, Tennessee, USA. <sup>9</sup>Peninsula College, Port Angeles, Washington, USA. <sup>10</sup>Aliso Creek Turtle Rescue, Ladera Ranch, California, USA

## **Lots of Turtles, Lots of Work: An Overview of the North American Freshwater Turtle Research Group's Research at Comal Springs**

Comal Springs in New Braunfels, Texas, is the largest freshwater spring west of the Mississippi. The spring is within the Edwards Plateau Savanna Ecoregion of the Southeastern United States Turtle Priority Area (TPA). Because Comal Springs is in a TPA, it is ecologically important and may be impacted by recreational use; it is important to assess baseline population levels for the turtle community residing in this spring habitat. From February 2012 to February 2017, we captured nearly 5,000 turtles. Of these 5,000, we caught nearly 3,000 *Sternotherus odoratus*, 1,600 *Pseudemys texana*, 300 *Trachemys scripta*, and 20 *Chelydra serpentina serpentina*. The population of *Sternotherus* at Comal is one of the largest across the species range. Current estimates put the overall population at up to 14,000 individuals. The *Chelydra* at Comal all seem to be suffering from an unknown virus/disease that is causing ulcerations on the head and carapacial pitting. A unique aspect of the Comal Springs study is its incorporation of citizen scientists. Through this, the load of work accomplished is greatly enhanced. The data collected at Comal Springs can be used in future regulations on the spring concerning recreational use. The data collected

also acts as a catalog of species that can be used in other studies looking at specific aspects of specific species. This talk will cover an overview of the project, providing data collected on species and the results of our work so far.

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## **55 SSAR SEIBERT SYSTEMATICS & EVOLUTION II, Highland B, Friday 13 July 2018**

Matthew Murdoch<sup>1</sup>, Lee Grismer<sup>2</sup>, Perry Wood<sup>3</sup>, Neang Thy<sup>4</sup>, Nikolay Poyarkov<sup>5</sup>, Ngo Van Tri<sup>6</sup>, Roman Nazarov<sup>5</sup>, Anchalee Aowphol<sup>7</sup>, Olivier Pauwels<sup>8</sup> and Jesse Grismer<sup>9</sup>

<sup>1</sup>Villanova University, Villanova, PA, USA. <sup>2</sup>La Sierra University, Riverside, CA, USA. <sup>3</sup>University of Kansas, Lawrence, KS, USA. <sup>4</sup>Department of National Parks, Ministry of the Environment, Phnom Penh, Cambodia. <sup>5</sup>Moscow State University, Moscow, Russian Federation. <sup>6</sup>Institutes of Tropical Biology, Vietnamese Academy of Sciences and Technology, Hochiminh City, Vietnam. <sup>7</sup>Kasetsart University, Bangkok, Thailand. <sup>8</sup>Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium. <sup>9</sup>University of California, Los Angeles, CA, USA

### **Six new species of *Cyrtodactylus* Gray (Squamata: Gekkonidae) *intermedius* complex from the Cardamom Mountains and associated highlands of Southeast Asia.**

An integrative taxonomic analysis using color pattern, morphology, and 1449 base pairs of the ND2 mitochondrial gene and its five flanking tRNAs demonstrate that eight species-level lineages occur within the *Cyrtodactylus intermedius* complex (*Cyrtodactylus intermedius sensu stricto*, *C. phuquocensis* and related populations) of the Cardamom mountains and associated highlands of Cambodia, Thailand, and Vietnam that have a sequence divergence ranging 3.4-8.9%. Additionally, each lineage is discretely diagnosable from one another based on morphology and color pattern and most may be endemic to specific geographic regions (upland areas, karst formations or islands) that prevent or greatly restrict interpopulation gene flow. Six of these lineages were masquerading under the nomen *C. intermedius* and are described from the following locations: Phnom Aural, the highest mountain in Cambodia; Bokor Plateau; central Cardamom mountains; Phnom Dalai, the northernmost peak of the Cardamom mountains; Phnom Laang karst formation; and the Bả y Núi Hills of southwest Vietnam.

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## **61 ASIH: If Salamanders Could Speak Symposium, Grand Lilac Ballroom North, Saturday 14 July 2018**

Henry Mushinsky, Earl McCoy, Adam Emerick, Brad Hauch and Nick Osman

*University of South Florida, Tampa, FL, USA*

### **Successful Translocation of the Florida Sand Skink**

The Florida Sand Skink, *Plestiodon reynoldsi*, is precinctive to the high-elevation ridges of central Florida. Its preferred habitat has been, and continues to be subjected to numerous human

perturbations. Because of the immense pressure put on the skink by development, we used what we consider a last resort to protect the species. We translocated more than 500 individuals out of harm's way and monitored them for several years post-translocation. Our ultimate goal was to establish a viable population on land protected from future development and determine if translocation was an option for imperiled populations. We were interested in achieving two benchmarks: initial survival and reproduction and completion of the life cycle through subsequent recruitment of offspring. Individuals were released into enclosures at the recipient site in the same densities as found at the donor site. We modified the environments within enclosures to include specific conditions that we thought would promote survival and reproduction. We documented survival and reproduction of the individuals released into the enclosures, and the likely reproduction of individuals born in the enclosures. In spite of its small size and delicate appearance, the Florida Sand Skink is a resilient species that can survive and reproduce under apparently adverse conditions.

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### **392 Lightning Talks III, Highland B, Sunday 15 July 2018**

Edward Myers and Frank Burbrink

*American Museum of Natural History, New York, NY, USA*

#### **Population Genomics and Species Delimitation of *Coluber constrictor***

The North American racer (*Coluber constrictor*) is a wide-spread, phenotypically diverse taxon that has been shown to be composed of multiple divergent mtDNA lineages. While previous studies have suggested that species level diversity is under-represented, no process oriented species delimitation analyses have been conducted. Herein, we examine the phylogeographic history of the *C. constrictor* using 1,000's of loci, assessing population structure across North America while also estimating the timing of lineage divergence and quantifying gene flow among these lineages. Using coalescent species delimitation analyses, we explicitly test if these lineages represent species level diversity. Our results demonstrate that lineage divergence within *C. constrictor* is associated with several well-known biogeographic barriers in North America and that the taxonomy of this group is in need of revision.

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### **82 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Emily Nall, Brant Faircloth, William Ludt and Prosanta Chakrabarty

*Louisiana State University, Baton Rouge, LA, USA*

#### **Is Peter Wainwright Right?**

Maybe not? In Wainwright and Longo (2017) the success of Acanthomorpha is attributed to the development of eight characteristics: jaw protrusion, advanced fin-spines, pharyngognathy, endothermy, intramandibular joints, antifreeze proteins, air-breathing, and bioluminescence. Most of these characteristics are either also known outside of acanthomorphs or are only within a subset of the group. We think the success of this clade of 16,000 species

cannot be solely attributed to these features - even in combination. We hypothesize that features that were more likely to lead to the success of Acanthomorpha include a unique mix of bright coloration (including biofluorescence, bioluminescence, and conspicuous pigmentation) aided by sexual selection. We will map these characteristics on to the latest acanthomorph phylogeny to test our hypothesis.

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## **530 Amphibian Ecology I, Grand Lilac Ballroom North, Friday 13 July 2018**

Megan Napoli

*Mohonk Preserve, New Paltz, NY, USA*

### **Amphibian Phenological Shifts in Southeastern NY: Understanding the Local Effects of Climate Change through Analysis of a Unique Long-term Dataset**

As springtime temperatures progressively become warmer earlier in the season, environmental time sensitive events such as amphibian over-wintering emergence and breeding have been shifting to occur at earlier dates than previously observed. By studying these phenological relationships valuable insight is gained to truly understand the local effects of climate change. This case study investigates the usefulness of a unique long-term dataset of vernal pool phenological activity from 1955 to 2018 on the Mohonk Preserve, NY. The goal for this study was to determine if calling and egg-laying dates in spring had shifted to earlier dates over time in a localized area due to increasing annual springtime temperatures and changes in precipitation levels. We analyzed anuran calling phenology in two species, wood frog (*Lithobates sylvaticus*) and northern spring peeper (*Pseudacris crucifer*), and egg-laying phenology in two species, wood frog and spotted salamander (*Ambystoma maculatum*). To perform time series analyses, calling/egg-laying dates were grouped into three time period categories of pre, during, and post-anthropogenic emergence. All records prior to 1989 were carefully digitized from notecard observations into a database containing the other subsequent phenological observations. As predicted, our preliminary results indicate a shift in both calling and egg-laying to earlier dates. Although these results show promise that our dataset can be valuable at determining local phenological changes, more robust analyses with other variables are necessary to fully understand complete impacts on regional phenological events. Next analyzation steps include correlating calling and egg-laying dates with average springtime temperatures and precipitation over time.

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## **515 Ichthyology Systematics I, Grand Lilac Ballroom South, Saturday 14 July 2018**

Thomas Near<sup>1</sup>, Daniel MacGuigan<sup>2</sup> and Alex Dornburg<sup>3</sup>

<sup>1</sup>*Yale University and Peabody Museum of Natural History, New Haven, CT, USA.* <sup>2</sup>*Yale University, New Haven, CT, USA.* <sup>3</sup>*North Carolina Museum of Natural Sciences, Raleigh, NC, USA*

### **The Utility of RADseq for Resolving Cenozoic Adaptive Radiations: A Case Study of Antarctic Notothenioid Fishes (Percomorpha: Perciformes)**

Notothenioids, a clade of ~120 marine species distributed in extreme south temperate near shore habitats and the Southern Ocean surrounding Antarctica. Over the past 25 years molecular and morphological approaches have redefined hypotheses of relationships among notothenioid lineages as well as their relationships within Percomorpha. These phylogenies provide a basis to investigate mechanisms of evolutionary diversification in the clade, including adaptive radiation. Despite extensive efforts there are many unresolved questions in the phylogenetics of notothenioids. In this study we deploy DNA sequences of ~100,000 loci obtained using ddRADseq to investigate the phylogenetic relationships of notothenioids and to assess the utility of RADseq loci for lineages that exhibit divergence times ranging from the early Cenozoic to the Quaternary. The notothenioid phylogenies inferred from the RADseq loci are well-resolved with strong node support for several key relationships including, 1) relationships among species of *Trematomus*, 2) resolution of *Indonotothenia cyanobrancha* as the sister lineage of *Trematomus*, 3) the deep paraphyly of Nototheniidae, 4) the paraphyly of *Lepidonotothen* s.l., 5) paraphyly of *Artedidraco*, and 6) the monophyly of the Bathydraconidae. Assessment of site rates demonstrates that RADseq loci are similar to mtDNA protein coding genes and RADseq loci exhibit peak phylogenetic informativeness at the time interval when the major Antarctic notothenioid lineages are hypothesized to have diversified. In addition to providing a well-resolved phylogenetic hypothesis for notothenioids, our analysis demonstrates the utility of RADseq loci for investigating phylogenetic relationships of lineages that diversified over the past 30 to 40 million years.

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**600 ASIH: If Salamanders Could Speak Symposium, Grand Lilac Ballroom North, Saturday 14 July 2018**

Lorin Neuman-Lee<sup>1</sup>, Edmund Brodie, Jr.<sup>2</sup> and Susannah French<sup>2</sup>

<sup>1</sup>Arkansas State University, Jonesboro, AR, USA. <sup>2</sup>Utah State University, Logan, UT, USA

**Examining the stress response in the gartersnake-newt-tetrodotoxin system**

The gartersnake-newt-tetrodotoxin (TTX) system has provided us with a wealth of evolutionary and genetic information. This provides us with the ideal system to study complex endocrine relationships. We examined the hypothalamic-pituitary-adrenal (HPA) axis, which is associated with the stress response, by conducting two experiments. In our first experiment, we examined the HPA axis of the Rough-skinned newt (*Taricha granulosa*) in relation to antipredator behavior and toxicity by manipulating different hormones within the HPA axis. In our second experiment, we tested the effects of TTX exposure on the Common Gartersnake (*Thamnophis sirtalis*) by injecting increasing concentrations of TTX into male, female, and juvenile snakes. In both experiments, we tested the concentration of corticosterone (CORT), the primary hormone released by the HPA axis in reptiles and amphibians. In the first experiment, we found that TTX is not related to antipredator behavior or to CORT. However, CORT may play a role in mediating antipredator behavior, but the relationship is complex. In the second experiment, we found that female gartersnakes activated the HPA axis when exposed to TTX, but males and juveniles did not. Both of these experiments illustrate the potential for using this system for further untangling complex endocrine relationships.

**411 CHS: Effects of Climate Change Symposium, Grand Lilac Ballroom North, Friday 13 July 2018**

Jennifer Neuwald<sup>1</sup> and Nicole Valenzuela<sup>2</sup>

<sup>1</sup>Colorado State University, Fort Collins, CO, USA. <sup>2</sup>Iowa State University, Ames, IA, USA

## **Increasing Thermal Variance due to Climate Change Alters the Sexual Development of Temperature-Dependent Sex Determined Turtles**

Temperature-dependent sex determination (TSD) is a mechanism used by several reptilian lineages, including the majority of turtles. In an age when climate change is warming atmospheric temperatures and increasing thermal fluctuations globally, those species that rely on TSD may experience challenges to maintaining balanced sex ratios. Here, we examine how increased thermal variance around typical male-producing and female-producing temperatures in the painted turtle, *Chrysemys picta*, results in sex reversal and increased embryonic mortality – the combination of which can lead to biased sex ratios. These data are then considered in light of the genetic architecture underlying sex determination in *C. picta*. Specifically, we consider the degree of genetic variance in genes correlated to sexual development and discuss the potential for adaptive evolution in response to a changing environment.

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155 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: ECOLOGY, NATURAL HISTORY, DISTRIBUTION & BEHAVIOR, Empire Hall South - JF  
**Rochester Riverside Convention Center, Friday 13 July 2018**

Thomas Nhu<sup>1</sup>, Paul Maier<sup>1</sup>, Gennese Garcia<sup>1</sup>, Sebastian Gonzales<sup>1</sup>, Mallory Harmel<sup>1</sup>, Miguel Jimenez<sup>2</sup>, Katie King<sup>1</sup>, John Thomas Nolan<sup>1</sup>, James Whelan<sup>1</sup>, Hayley Layne Crowell<sup>1</sup> and Emily Taylor<sup>1</sup>

<sup>1</sup>California Polytechnic State University, San Luis Obispo, CA, USA. <sup>2</sup>Hancock College, Santa Maria, CA, USA

## **Inglorious Baskers: Comparative Behavior of Pacific Rattlesnakes in Coastal and Inland Populations**

The Pacific rattlesnake (*Crotalus oreganus*) is a moderate-sized, generalist pit viper species found throughout central California. These snakes live in a myriad of habitat types from coastal chaparral and rocky cliffs to the vast, inland plains of the Central Valley. Because this species is found over such a wide range of habitats, we hypothesized that different populations exhibit different thermoregulatory behavioral strategies in order to survive in their respective climates. The purpose of this study was to compare these behaviors of inland and coastal *C. oreganus*. To conduct this study, male rattlesnakes from two inland sites (Chimineas Ranch N = 5, Sedgwick Reserve N = 8) and two coastal sites (Vandenberg Air Force Base N = 7, Montaña de Oro State Park N = 8) were tracked throughout their active season (April-October). Environmental and behavioral data were recorded 4-5 times a week for individual snakes. Preliminary analysis showed that body temperatures of coastal and inland snakes were not significantly different. Inland sites had higher variability in air temperature than coastal sites, with higher midday temperatures. This suggests that inland and coastal snakes may have different behavioral activity throughout the day to maintain similar field-active body temperatures. We will present

data on the differences in their activity, posture, refugia type, and exposure time. These differences will indicate plasticity of behavior for maintenance of similar field-active body temperatures despite climate differences.

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## **206 General Herpetology I, Highland B, Sunday 15 July 2018**

Max Nickerson and Joseph Mitchell

*Florida Museum of Natural History, Gainesville, FL, USA*

### **Turtle Communities for Remnant Wetland Restoration in the Upper Mississippi River Embayment**

A century ago, almost half of the commercial harvest for freshwater turtles in the U.S. came from the forested wetlands of the Upper Mississippi Embayment (UME) region. Most of the habitat for freshwater turtles was eliminated, with only a few remnants remaining. Nearly 4,000,000 ha were destroyed 1955–1985. In 1983, we conducted a mark/recapture study of turtles in Allred Lake, Butler Co., MO, in one of those remnants now protected as Allred Lake State Park to ascertain which species remained and if the information could inform restoration efforts. The 6,154 trap-hour study in two sessions produced an assemblage of 359 turtles/ha and a standing crop biomass of 163 kg/ha. The two most abundant species were *Trachemys scripta elegans* (280 individuals/ha and 128.2 kg/ha) and *Sternotherus odoratus* (50 individuals/ha and 6.4 kg/ha). *Trachemys scripta* and *Chelydra serpentina* contributed the most biomass based on the techniques we used. The other turtles captured were, *Apalone spinifera*, *Chrysemys dorsalis*, and *Kinosternon subrubrum*. Two other species, *Deirochelys reticularia* and *Macrochelys temminckii*, were not captured but are known to occur in the UME. Comparisons with assemblages in a pond 96 km to the east and ponds in a U.S. Fish and Wildlife Service refuge 265 km to the southwest, both within the embayment, showed that at least 8 species occur throughout the UME. Focusing on the habitat needs and life histories of these species will guide construction and remediation efforts.

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## **32 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Stuart V. Nielsen<sup>1</sup>, Jai L. Banks<sup>1</sup>, Raul E. Diaz Jr.<sup>2,3</sup>, Paul A. Trainor<sup>4,5</sup> and Tony Gamble<sup>1,6,7</sup>

<sup>1</sup>Marquette University, Milwaukee, WI, USA. <sup>2</sup>Southeastern Louisiana University, Hammond, LA, USA. <sup>3</sup>Natural History Museum of Los Angeles County, Los Angeles, CA, USA. <sup>4</sup>Stowers Institute for Medical Research, Kansas City, MO, USA. <sup>5</sup>University of Kansas Medical Center, Kansas City, KS, USA. <sup>6</sup>Bell Museum of Natural History, Saint Paul, MN, USA. <sup>7</sup>Milwaukee Public Museum, Milwaukee, WI, USA

### **Dynamic Sex Chromosomes in Old World Chameleons (Squamata: Chamaeleonidae)**

Our current state of knowledge concerning sex chromosome evolution is based on a handful of ‘exceptional’ taxa with heteromorphic sex chromosomes. However, cataloging sex chromosome

systems of additional species lacking easily identifiable, heteromorphic sex chromosomes is indispensable if we wish to fully understand the evolutionary patterns and processes affecting the genesis, degeneration, and turnover of vertebrate sex chromosomes. Squamate reptiles are a potential model clade for studying sex chromosome evolution as they exhibit a suite of sex determining modes yet most species lack heteromorphic sex chromosomes. Only 3 (of 203) chameleon species have identified sex chromosome systems (all with female heterogamety, ZZ/ZW). This study uses a recently developed method to identify sex-specific genetic markers from restriction site-associated DNA sequence (RADseq) data, which enables the identification of sex chromosome systems in species lacking heteromorphic sex chromosomes. We used RADseq and subsequent PCR validation to identify an XX/XY sex chromosome system in the veiled chameleon (*Chamaeleo calyptratus*), revealing a novel transition in sex chromosome systems within the Chamaeleonidae. The sex-specific genetic markers identified here will be useful in embryology, particularly for studying the development of sexually dimorphic phenotypes, and further promotes *C. calyptratus*' utility as an emerging model organism.

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### 33 Herpetology Genetics II, Highland D, Sunday 15 July 2018

Stuart V. Nielsen<sup>1</sup>, Juan D. Daza<sup>2</sup>, Brendan J. Pinto<sup>1</sup> and Tony Gamble<sup>1,3,4</sup>

<sup>1</sup>Marquette University, Milwaukee, WI, USA. <sup>2</sup>Sam Houston State University, Huntsville, TX, USA. <sup>3</sup>Bell Museum of Natural History, University of Minnesota, Saint Paul, MN, USA.

<sup>4</sup>Milwaukee Public Museum, Milwaukee, WI, USA

### Independently Derived ZZ/ZW Sex Chromosomes in the Puerto Rican Leaf-toed Gecko (*Phyllodactylus wirshingi*) are Homologous with the Avian Z

Investigating the evolutionary processes influencing the origin, evolution, and turnover of vertebrate sex chromosomes requires the classification of sex chromosome systems in a great diversity of species. Among amniotes, squamates – and geckos in particular – are worthy of additional study. Geckos possess all major vertebrate sex determining systems, as well as multiple transitions among them, yet we still lack data on the sex-determining systems for the vast majority of species. We here utilize restriction-site associated DNA sequencing (RADseq) to identify the sex chromosome system of the Puerto Rican endemic leaf-toed gecko (Phyllodactylidae: *Phyllodactylus wirshingi*), in order to confirm a ZZ/ZW sex chromosome system within the genus, as well as to better categorize the diversity within this poorly characterized family. RADseq has proven an effective alternative to cytogenetic methods for determining whether a species has an XX/XY or ZZ/ZW sex chromosome system – particularly in taxa with non-differentiated sex chromosomes – but can also be used to identify which chromosomes in the genome are the sex chromosomes. We here identify a ZZ/ZW sex chromosome system in *P. wirshingi*. Furthermore, we show that four of the female-specific markers contain fragments of genes found on the avian Z and discuss homology with *P. wirshingi* sex chromosomes.

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### 565 Herpetology Biogeography II, Highland B, Saturday 14 July 2018

Zachary Nikolakis and Brian Crother

*Southeastern Louisiana University, Hammond, Louisiana, USA*

### **Phylogenomics of the Eastern Pinesnake Complex (*Pituophis melanoleucus*)**

The Eastern Pinesnake (*Pituophis melanoleucus*) is a polytypic wide ranging species comprised of three sub-specific taxa that occupy much of eastern North America with several disjunct populations. All three of these sub-specific taxa have distinguishing color patterns and are of taxonomic interest due to conservation concerns stemming from habitat degradation, fragmentation, and declining prey communities (e.g., Southeastern Pocket Gopher decline & longleaf pine degradation). Previous molecular phylogenetic studies have attempted to resolve evolutionary relationships within this complex utilizing single locus approaches. Here we use a sequence capture approach in the form of ultra-conserved elements (UCEs) to (1) infer the evolutionary relationships within this complex and determine if these molecular markers are viable for this type of study and (2) test the taxonomic validity of the current recognized nomenclature and describe any unrecognized diversity within the group. We also utilize population clustering analyses to determine levels of admixture across the range and quantify gene-flow across previously recognized southeastern biogeographic barriers.

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### **146 ASIH STORER HERPETOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Emmeleia Nix, Luis Burgos, Megan Corn, Averil E. Royal, Kiley A. Rucker, Sunny Vansdadia and Emily Taylor

*California Polytechnic State University, San Luis Obispo, CA, USA*

### **Size Still Matters: Comparing Brain and Cloacal Heating Rates in the Western Fence Lizard (*Sceloporus occidentalis*)**

A previous study from our laboratory found that larger individuals of Western Fence Lizards (*Sceloporus occidentalis*) had lower upper thermal tolerance limits (defined as critical thermal maximum, CT<sub>max</sub>) than smaller individuals. When studying thermal tolerance, we measure cloacal temperature. However, brain temperature may be more germane to CT<sub>max</sub> than cloacal temperature, since high temperatures are thought to impact the central nervous system. Higher thermal inertia of larger lizards could mean that brain-cloaca temperature differentials are impacted by body size. To test whether the brain and cloaca heat at different rates, sixteen individuals were captured and tested. Lizards were anesthetized using isoflurane, and flexible thermocouples were inserted into both brain and cloaca. Brain and cloacal heating rates were measured as lizards were heated in a controlled environment at a constant rate until they surpassed their upper lethal temperature. We found that brain temperatures were consistently lower than cloacal temperatures. Smaller lizards had larger brain-cloaca temperature differences than larger lizards, potentially because cloacas of larger lizards heated more slowly than those of smaller lizards due to thermal inertia. The bodies were allowed to cool and we re-ran the heating trial on the dead lizards. Dead lizards had lower brain-cloaca temperature differences than live lizards, regardless of size, indicating that living lizards actively maintain lower brain temperatures via physiological regulation. Our data allow us to create an equation to calculate brain temperature from cloacal temperature for a lizard of a given size, so that we can examine the factors affecting CT<sub>max</sub> more accurately.

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**211 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

José Luís Novaes<sup>1</sup>, Danielle Peretti<sup>2</sup>, Rodrigo Costa<sup>1</sup> and David Hoeninghaus<sup>3</sup>

<sup>1</sup>Federal University of Semiárid, Mossoro, RN, Brazil. <sup>2</sup>Rio Grande do Norte State University, Mossoro, RN, Brazil. <sup>3</sup>University of North Texas, Denton, TX, USA

**Longitudinal Gradients in the Fish Assemblages of Small Reservoirs in Intermittent River Basins of the Brazilian Semiárid Region**

Reservoirs are often characterized by fluvial, transition and lacustrine zones occurring from the upstream extent towards the dam, with concomitant structuring in biological assemblages. However, the aforementioned gradient in physical conditions is not persistent in reservoirs of intermittent river basins, which have flowing conditions during only part of the year. This study tested for longitudinal gradients in fish assemblage structure in reservoirs of the Brazilian semiárid region and for effects of season (i.e. flowing and non-flowing conditions) on fish assemblage structure. Field research was conducted quarterly from 2010 to 2014 in three differently-sized reservoirs in Northeast Brazil. Standardized gill-net sampling was conducted at multiple sites along the lacustrine-fluvial gradient in each reservoir. Species richness was calculated for each site and differences were evaluated using ANOVA for each reservoir in both seasons. Community structure (composition and relative abundances in CPUE) was summarized using nMDS. Differences were tested with PERMANOVA for each reservoir in both rainy and dry seasons. Species richness decreased from fluvial to lacustrine in both rainy and dry seasons in the larger Santa Cruz Reservoir ( $p < 0.05$ ), whereas the Pau dos Ferros and Umari Reservoirs did not present any longitudinal patterns in either rainy or dry seasons. Similarly, nMDS showed separation between fluvial sites and other sites in Santa Cruz Reservoir in both rainy and dry seasons ( $p < 0.05$ ). In this study, a longitudinal gradient in fish diversity and assemblage structure was observed only in the largest reservoir, Santa Cruz Reservoir, and that gradient was persistent between seasons.

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**399 Herpetology Conservation II, Highland C, Sunday 15 July 2018**

Katherine O'Donnell<sup>1</sup>, William Barichivich<sup>1</sup>, Kurt Buhlmann<sup>2</sup>, Jonathan Chandler<sup>3</sup>, Kevin Enge<sup>4</sup>, Anna Farmer<sup>4</sup>, Thomas Gorman<sup>5</sup>, Carola Haas<sup>6</sup>, Pierson Hill<sup>4</sup>, John Jensen<sup>7</sup>, Mark Mandica<sup>8</sup>, Jana Mott<sup>9</sup>, John Palis<sup>10</sup>, Lora Smith<sup>11</sup> and Susan Walls<sup>1</sup>

<sup>1</sup>U.S. Geological Survey, Gainesville, FL, USA. <sup>2</sup>Savannah River Ecology Laboratory, Aiken, GA, USA. <sup>3</sup>U.S. Fish and Wildlife Service, St. Marks, FL, USA. <sup>4</sup>Florida Fish and Wildlife Conservation Commission, Gainesville, FL, USA. <sup>5</sup>Washington Department of Natural Resources, Olympia, WA, USA. <sup>6</sup>Virginia Tech, Blacksburg, VA, USA. <sup>7</sup>Georgia Department of Natural Resources, Forsyth, GA, USA. <sup>8</sup>The Amphibian Foundation, Atlanta, GA, USA. <sup>9</sup>The Nature Conservancy, Bristol, FL, USA. <sup>10</sup>Palis Environmental Consulting, Jonesboro, IL, USA. <sup>11</sup>Joseph W. Jones Ecological Research Center, Newton, GA, USA

**Range-wide Occupancy Status of Federally-listed Flatwoods Salamanders**

Flatwoods salamanders (*Ambystoma cingulatum*, *A. bishopi*) are federally-listed pond-breeding salamanders native to the southeastern United States. Both species breed in wetlands embedded in pine-wiregrass ecosystems and have likely declined because of widespread habitat loss and degradation. It is critical to have a thorough understanding of remaining populations to inform recovery planning. In 2013, we initiated a multi-partner effort to survey known and potential flatwoods salamander ponds across the combined range of the two species. These species typically breed in late fall (October–December); surveys targeted larval salamanders approximately 2–3 months after breeding events (January–March). All partners incorporated repeated sampling into survey efforts, enabling us to analyze resulting data in an occupancy-based framework. We fit Bayesian models that account for nested sampling design (i.e., multiple wetlands within multiple geographically distinct survey areas; Miller & Grant 2015). Through this 4-year effort, we discovered several previously unknown breeding wetlands; however, we also failed to detect salamanders at many historical breeding sites. We surveyed over 500 unique wetlands; 19% of wetlands were occupied in at least one season. St Marks National Wildlife Refuge (FL) and Apalachicola National Forest (FL) contain the majority of active *A. cingulatum* ponds, whereas Eglin Air Force Base (FL) harbors the best population of *A. bishopi*. Populations in South Carolina, Georgia, and north-central Florida have been extirpated or are very small. Understanding the current status of these species provides the foundation for making key decisions about species recovery, including where to prioritize salvage efforts and potential reintroduction efforts.

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#### **461 Herpetology Conservation III, Highland C, Sunday 15 July 2018**

Mizraim Olivares and Sean Rovito

LANGEBIO - CINVESTAV, Irapuato, Guanajuato, Mexico

#### **The Role of Fungal Pathogens in Declines of an Obligate Cave-Dwelling Salamander from Eastern Mexico**

*Chiropterotriton magnipes* is the only obligately cave-dwelling salamander known from the Neotropics and is known from a small region of the Sierra Madre Oriental of Mexico. This species was abundant in the decade following its description in 1965, but records decreased in subsequent years to the point where it disappeared from several localities where it was common and it is now classified as Critically Endangered. Its decline is coincident with that of other populations of Neotropical salamanders associated with the arrival of the fungal pathogen *Batrachochytrium dendrobatidis* (Bd). We hypothesized that the arrival of Bd played a key role in the declines of *C. magnipes*. We used a noninvasive sampling technique and qPCR assay to detect Bd in the skin of museum specimens of *C. magnipes* collected in from 1952 to 2012. We also examined the prevalence of the fungus in extant populations of *C. magnipes* and other sympatric species of amphibians. We obtain the earliest positive record of the fungus to date in Mexico, providing additional historical evidence for the “Bd epidemic wave” hypothesis. Our results provide an important historical baseline for actions to preserve the few known remaining populations of *Chiropterotriton magnipes*.

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#### **301 Ichthyology Ecology and Ethology, Highland E, Sunday 15 July 2018**

Daniel Oliveira<sup>1</sup> and Sarah Fitzpatrick<sup>2</sup>

<sup>1</sup>Clark University, Worcester, Massachusetts, USA. <sup>2</sup>Michigan State University, East Lansing, Michigan, USA

### **Phenotypic Differentiation matches Environmental Variation: a Potential Case for Local Adaptation in Rainbow Darters**

Populations of species inhabiting different environments often display phenotypic differentiation associated with local conditions. Many well-known examples of local adaptation exist from freshwater fish populations occupying varying environments. However, population-level differentiation has rarely been documented in darters, one of the most species-rich groups of fish in North America. This study assessed fine-scale intraspecific variation in a suite of phenotypic traits across local populations of *Etheostoma caeruleum* (rainbow darters). Individuals were collected from five sites in Southwest Michigan, including from one of the few documented lake populations of rainbow darters. Variation in thermal tolerance and body shape was quantified per population, in addition to the collection of site-specific environmental variables (temperature and flow). Preliminary results indicate a positive trend between water temperature and thermal tolerance. Lake individuals differed significantly from stream populations across all traits, but some phenotypic differences were also found between stream populations. This is the first observation that we know of showing phenotypic differentiation among lake versus stream populations of darters. Next-generation sequencing data will identify intra and inter-population genetic diversity and patterns of gene flow in this landscape. Genomic information will provide an understanding of the contribution of gene flow to phenotypic variation as well as determining if underlying genetic variation correlates with phenotypic differentiation among populations.

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**609 Ichthyology Morphology/Collections/Fisheries, Grand Lilac Ballroom South, Sunday 15 July 2018**

Aaron Olsen and Elizabeth Brainerd

*Brown University, Providence, RI, USA*

### **An Ancient Throat Expansion Mechanism Functions as an 11-Bar Linkage in Channel Catfish**

The throat expansion mechanism used by ray-finned fishes and chondrichthyans likely evolved at the origin of the jawed vertebrates. This ancient mechanism couples pectoral girdle retraction with hyoid depression and suspensorial abduction, enabling the axial (body) muscles to power throat expansion by simply pulling back on the shoulder. Previous studies have imaged the motion of this mechanism using lateral-view X-rays (two-dimensional kinematics) and concluded that the mechanism can be accurately modeled as a planar 4-bar linkage. However, it is clear from anatomy and live observation that the system is more complex than a 4-bar and likely exhibits significant non-planar motion. How this mechanism functions in three dimensions is unknown. To answer this question we collected 3D *in vivo* kinematics of six cranial skeletal elements in channel catfish (*Ictalurus punctatus*) during suction feeding using X-ray Reconstruction of Moving Morphology (XRMM). We then fit joint and linkage models of varying degrees of freedom (DoFs) to the *in vivo* motion. We find that the hyoid-pectoral girdle mechanism functions as an 11-bar linkage comprised of four bilaterally paired elements and

three unpaired elements. Despite having 11 bodies, the closed-chain nature of this linkage reduces the DoFs of motion to around six. In addition, only around four of these DoFs vary *in vivo*. Thus, in channel catfish a complex system with many parts actually functions and moves in a relatively simple manner, possibly a consequence of the coarse axial muscle control that powers this mechanism. Funding: NSF 1612230, 1655756.

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## **65 CHS: Effects of Climate Change Symposium, Grand Lilac Ballroom North, Friday 13 July 2018**

Deanna Olson<sup>1</sup>, Meryl Mims<sup>2</sup>, Carmen Harjoe<sup>3</sup>, Gisselle Xie<sup>3</sup>, Andrew Blaustein<sup>3</sup>, David Pilliod<sup>4</sup> and Jason Dunham<sup>5</sup>

<sup>1</sup>US Forest Service Pacific Northwest Research Station, Corvallis, OR, USA. <sup>2</sup>Virginia Tech, Blacksburg, VA, USA. <sup>3</sup>Oregon State University Department of Integrative Biology, Corvallis, OR, USA. <sup>4</sup>US Geological Survey, Boise, ID, USA. <sup>5</sup>US Geological Survey, Corvallis, OR, USA

### **Climate Niches and High-latitude Herpetofauna Risk: Multi-taxa Climate Sensitivity Modeling**

Climate-smart management for species persistence includes consideration of species' climate sensitivity, exposure to changing conditions, and adaptive capacity. With all species potentially exposed to changing conditions, rapid multi-species systematic assessments are needed. Northern latitudes are particularly important for ectotherms relative to climate change because many species reach their northward extents here, and climate affects habitat suitability and aspects of physiological ecology. Three case studies illustrate different aspects of multi-taxa vulnerabilities to climate change. First, we evaluated the intrinsic risk to climate change for 114 reptiles, amphibians, and freshwater fishes in the US Pacific Northwest by combining geographic rarity and traits-based approaches. We found: 1) 17% of reptiles and 23% of amphibians had very high climate sensitivity; and 2) rarity and life history data provided complementary information on risk to climate change. Second, for northwestern-US reptiles, we examined climate niches and climate change projections. Both reduction and expansion of ranges were projected for different species, with reductions aiding identification of climate-smart refuges for land-management prioritization. Third, in addition to examining climate futures for herpetofauna, climate niches of species posing potential threats to amphibians and reptiles are important considerations. Using world data of amphibian chytrid fungal (*Batrachochytrium dendrobatidis*, *Bd*) infections, we projected the future *Bd* distribution with climate change scenarios. An expanded high-latitude range is expected. Initial sampling has detected *Bd* and a second pathogen, Ranavirus, in coastal Alaskan wetland ecosystems where a monitoring plan is under development to assess amphibians subject to changes in both climate and pathogen exposure.

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## **18 Lightning Talks I, Grand Lilac Ballroom North, Thursday 12 July 2018**

Abiodun Onadeko

University of Lagos, Nigeria, Lagos, Lagos State, Nigeria

## **Tackling the Paucity of Information (Knowledge) of Anuran diversity and studies on Nigerian Landscapes: Platform for Research Collaboration.**

Nigeria is rich in anuran diversity with biodiverse natural landscapes. As expected, being a tropical country, its climatic conditions and vegetation favour the thriving conditions of the anurans. The diversity of landscapes results in a corresponding diversity of anuran species. A few ecosystems where herpetological surveys have been carried out include; 1) high altitude plateau (Obudu Ranch), 2) lowland and montane rainforests (Cross River National Park) and 3) freshwater wetlands (Niger Delta). Prominent anuran species observed in these ecosystems were respectively: 1) *Cardioglossa pulchra*, *Leptopelis modestus*, *Phrynobatrachus werneri* and *Astylosterus montanus*; 2) *Scotobleps gabonicus*, *Amietophrynus tuberosus*, *Werneria mertensiana* and *Tichobatrachus robustus*; and 3) *Hylarana albolabris*, *Phlyctimantis boulengeri*, *Hymenochirus* sp and *Leptopelis boulengeri*. However appreciating the diversity of ecosystems, anurans have been understudied in Nigeria. Novel species, no doubt, do exist. Anuran decline compounded by emerging diseases (caused by the oomycete *Saprolegnia* and the fungus *Batrachochytrium*) needs to be studied and well documented. There is a paucity of information regarding the dynamics of anuran population on the various landscapes. Appreciating the importance of anurans in our environment and the fast and unprecedented rate of its decline, one cannot overemphasize the need for more research emphasis on anuran study. It is against this background which strongly suggests that there is need for international collaboration research work to harness more revelation on these beautiful jewels in Nigeria.

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**276 SSAR SEIBERT ECOLOGY I, Highland A, Friday 13 July 2018**

Xochitl Ortiz Ross<sup>1</sup>, Michelle E. Thompson<sup>2</sup> and Maureen A. Donnelly<sup>2</sup>

<sup>1</sup>College of the Atlantic, Bar Harbor, ME, USA. <sup>2</sup>Florida International University, Miami, FL, USA

### **Oviposition Site Selection in Three Glass Frog Species**

Oviposition site selection is an important behavior that can, directly and indirectly, affect hatching success and larval survivorship in oviparous organisms. Although we should expect strong selection pressure for the ability to recognize and select a favorable habitat, active selection for oviposition sites is not well supported for many species of anurans. We investigate oviposition site selection in three species of glass frogs – *Hyalinobatrachium valerioi*, *Espadarana prosoblepon* and *Teratohyla spinosa* – in northeastern Costa Rica. We conducted nocturnal visual encounter surveys to estimate glass frog egg mass abundance and characterize oviposition site features at nine different sites and across three different habitats (pasture, secondary growth forest, and old growth forest). We then characterized habitat availability with habitat surveys at the same sites. Our results show differential active oviposition site selection in all three species based both on stream and vegetation features, such as water velocity, leaf substrate type, and leaf size. *Espadarana prosoblepon* was the only species influenced by habitat type, preferring old growth forests. However, the large variation in egg mass abundance at different sites that is not explained by habitat type suggests that microhabitat features may play a larger role in oviposition site selection than habitat type. Therefore, pastures and other de-forested areas can still sustain glass frog populations so long as the appropriate riparian microhabitat is maintained. Our results offer new insights into the ecology, distribution and habitat use of glass frogs and have important implications for conservation practices and habitat restoration efforts.

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**407 Ichthyology Genetics, Reproduction, and Development, Highland E., Friday 13 July 2018**

Megan Osborne<sup>1</sup>, Alyssa Sanchez<sup>1</sup>, Thomas Dowling<sup>2</sup> and Thomas Turner<sup>1</sup>

<sup>1</sup>University of New Mexico, Albuquerque, New Mexico, USA. <sup>2</sup>Wayne State University, Detroit, Michigan, USA

**Gender equality: large variance in reproductive success is driven by environmental factors not mating system in Bonytail.**

Studying the reproductive ecology of aggregate broadcast spawning fishes is difficult because it generally is not feasible to sample all potential parents and unambiguously assign their offspring. We used molecular-based parentage analysis to gain insights into the reproductive ecology of the endangered Bonytail (*Gila elegans*) and to evaluate whether protected off-channel ponds could be used as an alternative to hatchery production. By genotyping adults and offspring stocked (n = 4130) into two experimental backwaters across three years, we determined that most adults (82-97%) contributed to progeny production across years and backwaters, with one exception. Both genders mated multiply and the number of mates and family size were positively correlated. There was also a positive correlation between adult size and metrics of reproductive success. Males and females made essentially equal contributions to the progeny pool within backwaters and years. There were strong interactions between sample years and backwaters suggesting that environmental factors are the primary driver of variance in reproductive success. Knowledge of mating systems and sources of variance in reproductive success is important for management of endangered fish because high variance in reproductive success leads to substantial losses of genetic variation when few individuals reproduce successfully. Although there was variation in reproductive success among Bonytail, high reproductive contribution of adults resulted in faithful transmission of genetic variation from parents to their progeny. These results suggest that use of predator-free but otherwise natural backwaters will be an important conservation tool for reintroducing Bonytail to its native habitat.

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**579 Ichthyology Biogeography, Grand Lilac Ballroom South, Saturday 14 July 2018**

Kenneth Oswald and Morgan Reich

Ohio Northern University, Ada, OH, USA

**Population Genetics and Phylogeography Inform Conservation and Management of Rare Tonguetied Minnow (*Exoglossum laurae*)**

Tonguetied minnow (*Exoglossum laurae*) is a rare species that maintains a fragmented distribution across a small geographic range, with individuals occurring only in the Upper Great Miami, Upper Allegheny, New, and Upper Genesee Rivers of the eastern United States. Populations currently face various anthropogenically-driven threats to persistence such as habitat destruction from alterations of native streams and interspecific hybridization resulting

from introductions of non-native cutlip minnow (*E. maxilllingua*). DNA sequences from one mitochondrial locus and three single-copy nuclear DNA loci were used to estimate intraspecific genetic variation, ascertain phyletic affinities among drainages, and assess levels of interspecific hybridization. A coalescent-based model of evolution based on a Teays River ancestry for the species assessed demographic parameters, including effective population sizes ( $N_e$ ) and times since divergence ( $t$ ) among populations. Management recommendations will be given which aim to maximize the persistence of tongue-tied minnow based on a holistic interpretation of these analyses.

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**623 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: PHYSIOLOGY & MORPHOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Dustin Owen, David Ensminger, Michael Sheriff and Tracy Langkilde

*Pennsylvania State University, University Park, PA, USA*

**Effects of Maternal Stress on Offspring of Lizards from High- and Low-stress Sites**

While it is well established that maternal stress hormones, glucocorticoids, can induce transgenerational phenotypic plasticity, there is much debate over the adaptive significance of such effects. While many studies have examined how maternal stress influences traits of offspring, few have compared these effects across populations with different transgenerational histories. We tested the hypothesis that the effects of experimentally elevating corticosterone (CORT) in gravid female eastern fence lizards (*Sceloporus undulatus*) on offspring traits would differ for lizards from high-stress sites (those invaded by predator fire ants, *Solenopsis invicta*) versus low-stress (fire ant free) sites. Maternal CORT-treatment increased snout-vent length and tail length in offspring from high stress, fire ant invaded sites but decreased snout-vent length and tail length in offspring from low-stress, uninvaded sites when compared to controls. Larger offspring for high-stress sites could help mitigate the impact of some predators, such as envenomation by fire ants. Conversely, smaller size in offspring of females from uninvaded sites could facilitate avoidance of other predators, such as birds. There was no difference in glucose levels between offspring of females from invaded and uninvaded sites. Maternal CORT could match the specific environmental stressor to the phenotypic change in the offspring, increasing the fitness of offspring within the environments into which they emerge. Future work should examine this possibility.

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**605 SSAR SEIBERT PHYSIOLOGY & MORPHOLOGY, Highland A, Thursday 12 July 2018**

Dustin Owen, Michael Sheriff and Tracy Langkilde

*Pennsylvania State University, University Park, PA, USA*

**Effects of Maternal Stress on Lizard Heart Rate**

Maternally-derived stress hormones, glucocorticoids, can induce phenotypic plasticity in many

vertebrate taxa, and have consequences for resulting offspring. We tested the hypothesis that increased physiological stress of female eastern fence lizards (*Sceloporus undulatus*) while gravid will elevate heart rates of mothers and their offspring. Increased heart rates may facilitate energy allocation to deal with the environmental stressors, and can also speed development of offspring and decrease the amount of time in the vulnerable hatchling stage. Gravid females were dosed daily with topical corticosterone (CORT) until laying. Heart rate was measured five days after laying for mothers, and five days after hatching for hatchlings. We found that hatchlings of glucocorticoid-treated mothers had higher heart rates compared to hatchlings of control mothers. However, mothers from CORT-treated and control treatments had similar heart rates. Maternal stress appears to alter the physiology of offspring at five days of age, potentially speeding rates of development and resulting in earlier sexual maturity and larger body size, which could have important fitness benefits. Future work should investigate the adaptive significance of these maternal stress-effect to determine whether these offspring have increased fitness within high-stress environments.

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## **190 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Austin Owens<sup>1</sup>, Renae Steinberger<sup>1</sup>, Catherine Triplett<sup>2</sup>, Howard Whiteman<sup>2</sup> and Cy Mott<sup>1</sup>

<sup>1</sup>Eastern Kentucky University, Richmond, KY, USA. <sup>2</sup>Murray State University, Murray, KY, USA

### **Trophic effects of intraspecific body size variation among exploitative and interference competitors**

Despite the importance of intraspecific variation to population ecology studies, community ecologists have historically modelled predator-prey interactions with an assumption of functional equivalence among members of a single species. To more accurately predict the outcomes of ecological interactions, recent theoretical approaches have incorporated aspects of intraspecific trait variation into community ecology, disregarding mean trait values and instead focusing on the importance of variation around the mean. In larval salamanders, intraspecific body size variation is considerable and may impact predator-prey dynamics through associated risks of cannibalism at high levels of size variation. We manipulated body size variation around a standardized mean body size in two apex predators (larval *Ambystoma talpoideum* and *A. maculatum*) to determine the effects of size variation on intraspecific aggression, microhabitat partitioning, and attacks on/consumption of zooplankton prey. Despite broad differences in competitive strategy among larval *A. talpoideum* (interference competitor) and *A. maculatum* (exploitative competitor), intraspecific body size variation did not influence any of our response variables. However, interspecific differences independent of the influence of body size variation were observed for the number of attacks on zooplankton prey and the amount of zooplankton captured, with the exploitative competitor (*A. maculatum*) exhibiting higher totals for both. Our results indicate that increased size variation did not promote increased cannibalism among larval salamanders or associated release from predation for zooplankton prey, though the short-term nature of our study may have limited longer-term ecological consequences of intraspecific body size variation.

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**145 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Hannah Owens and Edward Stanley

*University of Florida, Gainesville, Florida, USA*

**Anatomy of Sexual Parasitism in Triplewart Sea-Devils (*Cryptosaras couesii*)**

Ceratioid anglerfishes exhibit extreme sexual dimorphism; males are many times smaller than females, with enlarged nostrils and specialized jaw denticles to find and attach to females for mating. These attachments vary in permanence from facultative associations to putatively permanent obligate parasitism. In the case of obligate parasitism in the Triplewart Sea-Devil, epidermal and dermal tissues of the partners fuse. It is thought that males receive nutrients from mates via a merged circulatory system; however, investigation of the nature of these connections via traditional histological sections has been inconclusive. To elucidate the nature of sexual parasitism in the Triplewart Sea-Devil, we performed high-resolution microCT scans of two contrast-stained adult female Sea-Devils with attached males from the Florida Museum of Natural History. These scans allow unprecedented 3-dimensional digital models of the unusual anatomy of the Triplewart Sea-Devil, and provide important information regarding the nature of parasitic male attachment in this charismatic deep-sea fish.

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**266 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Juan Pacheco and Christopher Beachy

*Southeastern Louisiana University, Hammond, LA, USA*

**Effects of differential probiotic administration on *Ambystoma mexicanum*'s response to a skin incision before and after metamorphosis**

Amphibian populations all over the world are experiencing a decline, due to many environmental factors such as pollution and diseases; a lot of effort has been made to conserve species that may be endangered because of such factors and, many approaches have been taken to solve this problem. Diseases such as Chytridiomycosis, red leg disease and ranavirus are specially playing a role in the decline of amphibians. This investigation aims to test the effect of the administration of oral probiotics, identified from the gut of axolotls, in improving their response to a skin incision. The results of the study could provide an alternative choice for the prevention of the decline of amphibians threatened by skin diseases.

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**59 Lightning Talks I, Grand Lilac Ballroom North, Thursday 12 July 2018**

Robert Page<sup>1</sup>, Claire Conarroe<sup>2</sup>, Diana Quintanilla<sup>1</sup>, Andriela Palomo<sup>1</sup>, Joshua Solis<sup>1</sup> and

David Marsh<sup>2</sup>

<sup>1</sup>Texas A&M University--San Antonio, San Antonio, TX, USA. <sup>2</sup>Washington & Lee University, Lexington, VA, USA

### **Hybridization and Genetic Variation in the Range-restricted Peaks of Otter Salamander, *Plethodon hubrichti***

Climate change can alter the geographic ranges of species in ways that reshuffle the compositions of ecological communities, and one potential consequence of such reshuffling is increased hybridization between closely related species that were once reproductively isolated. Interspecific hybridization is recognized as a potential driver of extinction because it can lead to the production of less fit hybrids or the replacement of one or both species with hybrids. The Peaks of Otter Salamander (*Plethodon hubrichti*) is restricted to a ~ 19 km stretch of ridge in west-central Virginia. The area occupied by *P. hubrichti* is surrounded by the morphologically and ecologically similar Eastern Red-backed Salamander (*P. cinereus*). While hybridization among closely related plethodontids is well known, it is unclear whether *P. hubrichti* and *P. cinereus* are hybridizing. To assess this possibility, we used microsatellite markers to investigate whether there is evidence for admixture between *P. hubrichti* and *P. cinereus*. Preliminary results from our study suggest that hybridization between *P. hubrichti* and *P. cinereus* is rare. However, our results revealed that allelic richness and heterozygosity are substantially higher in *P. hubrichti* than they are in nearby *P. cinereus* populations. This suggests that *P. hubrichti* may have evolved *in situ* in this region for longer than *P. cinereus*, and that, despite its large geographic range, *P. cinereus* is a comparatively recent invader. We argue that additional work on the historical and contemporary demography of range-restricted plethodontids is needed in order to better understand their evolutionary histories and conservation statuses.

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**208 SSAR SEIBERT SYSTEMATICS & EVOLUTION I, Highland B, Friday 13 July 2018**

Daniel Paluh, Edward Stanley and David Blackburn

University of Florida, Gainesville, Florida, USA

### **Convergent Evolution and Function of Hyperossification in Frogs**

Within fossil and extant anuran amphibians, a reoccurring trend in skull morphological diversity is hyperossification, i.e. the increased mineralization and excessive ossification of a skeletal element that results in dorsal sculpturing and pitted ornamentation of dermal bones. There is little research on the evolution of anuran skull hyperossification, but a survey of skeletal diversity indicates that it has persisted or independently evolved in at least 23 lineages and 14 families of frogs in taxa ranging in size from 16 to 245 mm snout-vent length. Three disparate hypotheses exist on the function of hyperossification – water balance enhancement in arid environments, protection against predators during phragmotic behavior, and increased skull biomechanic capabilities related to feeding biology – but there have been no explicit tests whether there is an association between hyperossified skull shape and these different functions. We utilized high-resolution micro-computed tomography, 3-D geometric morphometric analyses, and phylogenetic comparative methods to determine if there is a significant difference in shape between hyperossified and non-hyperossified skulls across all families of frogs. We

then further tested if a predicted relationship exists between skull shape, the habitation of arid environments, the use of phragmotic defensive behavior, and a carnivorous diet. Overall, we found that hyperossification has independently evolved in phylogenetically, morphologically, and ecologically diverse frog lineages. An association was found between hyperossification and large body size, carnivorous feeding biology, and predator defense behaviors. No relationship was found between skull shape and climate or microhabitat parameters.

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## **45 General Ichthyology II, Grand Lilac Ballroom South, Sunday 15 July 2018**

Lynne Parenti<sup>1</sup>, Diane Pitassy<sup>1</sup>, Zeehan Jaafar<sup>2,1</sup>, Kirill Vinnikov<sup>3</sup> and Kathleen Cole<sup>3,1</sup>

<sup>1</sup>National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

<sup>2</sup>National University of Singapore, Singapore, Singapore. <sup>3</sup>University of Hawaii, Honolulu, HI, USA

## **The 2017 Smithsonian MarineGEO Assessment of the Fishes of Kaneohe Bay, Oahu, Hawaii**

In 2017, we conducted a survey of the fishes of Kaneohe Bay, Oahu, Hawaii as part of a broader Smithsonian Institution MarineGEO Hawaii biodiversity assessment: *Ola I ke Kai*, or Life Comes from the Sea. Kaneohe Bay was chosen for intensive study because of the long history (ca. 1,000 years) of use of its land and sea resources by Hawaiian peoples living in and around the Bay. Our knowledge of the fishes of the Hawaiian Islands is broad compared to that of other subtropical and tropical islands of the central Pacific. Yet, there have been few attempts to compile a comprehensive systematic inventory and assessment of the fish species of Kaneohe Bay, an ultimate goal of MarineGEO Hawaii. We surveyed fishes throughout the Bay using a variety of sampling methods (dipnets, pushnets, hook and line, and spears) without chemicals. We collected about 100 species representing the larger, visible reef species as well as some cryptic species. We documented the occurrence of each species with an archived voucher specimen or a verified field observation, genome-quality tissue samples, and a color photograph of a freshly dead specimen. We sequenced DNA barcodes for each species to confirm identification and to test our hypothesis that Hawaiian populations of species broadly distributed throughout the Indo-Pacific may be genetically distinct. We consider the taxonomic implications of these findings and how they may affect our understanding of Hawaiian endemism.

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## **375 ASIH STOYE GENERAL ICHTHYOLOGY I, Grand Lilac Ballroom South, Thursday 12 July 2018**

Elyse Parker<sup>1</sup>, Alex Dornburg<sup>2</sup>, Daniel J. MacGuigan<sup>1</sup>, Edgar Benavides<sup>1</sup> and Thomas J. Near<sup>1,3</sup>

<sup>1</sup>Yale University, New Haven, CT, USA. <sup>2</sup>North Carolina Museum of Natural Sciences, Raleigh, NC, USA. <sup>3</sup>Peabody Museum of Natural History, Yale University, New Haven, CT, USA

## **Phylogenomic species delimitation and the reduction of species diversity in Antarctic Plunderfishes (Notothenioidei: Artedidraconidae)**

Explaining the factors that underlie the uneven distribution of species-richness across the Tree of Life has been a core topic in evolutionary biology for over a century. However, the impact of taxonomic uncertainty on estimates of lineage origination and turnover is rarely considered in macroevolutionary studies. The notothenioids, a clade of percomorph fishes that dominates the ichthyofauna of the Antarctic continental shelf, provide an ideal case study for understanding the impact of taxonomic uncertainty on inferences of diversification patterns. Like many lineages of ray-finned fishes, notothenioid species diversity undergoes continuous revision based on morphological and molecular data. Uncertainty in species level diversity is especially evident in the Antarctic Plunderfish (Artedidraconidae) lineage *Pogonophryne*. This lineage comprises 29 valid species, 11 of which were described since 2000. Many of these species descriptions are based solely on variation in ornamentation of the mental barbel, a structure that is highly plastic within species, and are known only from holotype specimens. Extensive intraspecific variation in mental barbel morphology warrants renewed examination of species delimitation in the clade. Bayesian species delimitation approaches using both genome-wide SNP data and mtDNA data support a reduction in recognized diversity within *Pogonophryne* to no fewer than five species. This conclusion is supported by extensive overlap among *Pogonophryne* species in morphometric and meristic traits. Given that Artedidraconidae were previously hypothesized to exhibit an exceptionally high diversification rate relative to other notothenioid clades, we demonstrate how the dramatic reduction of species diversity within *Pogonophryne* necessitates a reinterpretation of adaptive radiation in notothenioids.

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**313 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

M. Rockwell Parker<sup>1</sup>, Bryan G. Falk<sup>2</sup>, Amy A. Yackel Adams<sup>3</sup> and Robert N. Reed<sup>3</sup>

<sup>1</sup>James Madison University, Harrisonburg, VA, USA. <sup>2</sup>U.S. Geological Survey, Homestead, FL, USA. <sup>3</sup>U.S. Geological Survey, Ft. Collins, CO, USA

## **A modified Judas approach for enhancing detection of Burmese pythons in Florida**

The successful management of invasive species, especially vertebrates, depends on the development of techniques that increase detection and removal of individuals from the invasive range. Also, once an invasive species has become established, some tools maintain their utility in detecting early stage invasions/expansions of species into novel habitats. Burmese pythons (*Python bivittatus*) are an established invasive species that has contributed significantly to swift ecological changes in southern Florida. Detectability of pythons is a central problem for managers that necessitated the adaptation of existing tools as well as the evolution of new

approaches. Currently, we are integrating a standard technique in invasive vertebrate management, the Judas approach, with a novel technique, hormone manipulation. Sex steroid hormones are powerful regulators of pheromone production in snakes, and males can be feminized in their pheromone expression via estradiol treatment. We are using radiotelemetry to track male Burmese pythons (n=8) in Big Cypress National Preserve in southern Florida. Half of these males were given control surgery (SHAM), and half received silastic implants containing 17  $\beta$ -estradiol, the latter of which we predict will be attractive to other males in the field. Blood samples will reveal male sex hormone concentrations during the breeding season in Florida and validate the estradiol implants. In June, we will extract the skin lipids from these snakes and identify compounds specifically upregulated in the skin as a result of estradiol treatment. If effective, our modified Judas approach may enhance existing detection probabilities for Burmese pythons in Florida.

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### **308 Herpetology Reproduction, Highland C, Sunday 15 July 2018**

M. Rockwell Parker, Shannon A. Richard, Holly R. Rucker and Sydney E. Ashton

*James Madison University, Harrisonburg, VA, USA*

#### **How to make a sexy snake, part deux: dose-specific feminization of males via estradiol**

Many sexual signals in vertebrates are dynamically controlled by sex hormones, such as testosterone and estradiol. The sex-specific nature of these reproductive signals is also highly seasonal, with fluctuations in circulating steroids often matching the quality and complexity of the signals. In red-sided garter snakes (*Thamnophis sirtalis parietalis*), females elicit courtship from males by producing a potent sex pheromone, and the quality of this sex pheromone varies annually and maximized during the spring breeding season. Estradiol is the principle female sex steroid that activates pheromone production in garter snakes, and males can be stimulated to produce the pheromone via estradiol treatment. In this study, we gave males varying doses of estradiol and found that while all males became attractive, we saw a gradient of behavioral responses from wild males in the den. The lower the dose of estradiol, the less potent the male's pheromone was in bioassays as evidenced by the length of time wild males would court the manipulated male. We therefore propose that estradiol signaling manifests a gradient of phenotypic change via sex pheromones in garter snakes that can be assessed by males during the breeding season.

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### **580 SSAR: Coloration in Fish, Amphibians, & Reptiles Symposium, Grand Lilac Ballroom North, Sunday 15 July 2018**

Larissa Patterson<sup>1</sup> and David Parichy<sup>2</sup>

<sup>1</sup>Rhode Island College, Providence, RI, USA. <sup>2</sup>University of Virginia, Charlottesville, VA, USA

## **Stripes, Spots, Bars and More: Pigment Pattern Development and Evolution in *Danio* Fishes**

Teleost fishes boast colorful and dramatic pigment patterns. Adult pigment patterns of fishes in the genus *Danio* include horizontal stripes, spots, vertical bars and uniform patterns. The diversity of patterns within this genus, presents an opportunity to identify the genetic and cellular mechanisms underlying variation in a neural crest-derived trait. Armed with an understanding of stripe development in zebrafish, we can generate testable hypotheses about pattern evolution within this genus. In zebrafish, iridescent iridophores differentiate prior to other adult pigment cell types, establishing the location and orientation of adult stripes. In contrast, the barred pattern of *D. aesculapii* and the uniform pattern of *D. aff. albolineatus*, are initiated by the differentiation of precocious xanthophores, not iridophores. In both species, widespread, early xanthophore development is associated with elevated expression of *colony-stimulating factor-1*. Csf1-signaling was experimentally manipulated in all three species to determine its effect on pattern formation. Together, these results provide insight into the cellular and molecular mechanisms underlying pattern diversification within this genus.

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**103 Herpetology Behavior, Grand Lilac Ballroom South, Friday 13 July 2018**

Mark Paulissen

*Northeastern State University, Tahlequah, OK, USA*

## **Does the Little Brown Skink, *Scincella lateralis*, Use Positional Cues for Spatial Learning?**

Many small lizards escape from predators by rapidly running under a retreat. Lizards that have previously learned the location of such retreats through spatial learning should be better able to escape than lizards that run in a non-specific way in hopes of locating retreat before they are caught. Previous work has shown that LBSs learn to escape to retreats with vertical striped local cues significantly better than those with horizontal striped local cues. One hypothesis is that LBSs regard vertical stripes as positional cues to orient toward retreats (similar to orienting using tree trunks in nature). I tested this hypothesis with a series of trials in which LBSs were trained to escape to one of two retreats positioned on either side of a vertical positional cue. Fifteen trials were run on each LBS; those that escaped to the correct retreat in five consecutive trials were scored as having learned which of the two retreats was “correct” based on its position relative to the positional cue. Of the 16 LBSs tested, only 2 (12.5%) met the learning criterion, significantly fewer than had met the learning criterion in the earlier study using the vertical striped cue. This suggests that LBSs do not use positional cues for spatial learning of the location of escape retreats and that the reason they are better able to learn using a vertical striped local cue versus a horizontal striped one lies in some other aspect the sensory or cognitive biology of this species.

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## 592 Herpetology Conservation II, Highland C, Sunday 15 July 2018

Gregory Pauly

*Natural History Museum of Los Angeles County, Los Angeles, California, USA*

### **The Nursery Trade as an Introduction Pathway for Nonnative Reptiles and Amphibians in California**

The nursery trade is one of the primary pathways through which nonnative reptiles and amphibians are introduced around the globe. Here, I use a combination of citizen science approaches and traditional methodologies to document the arrival and spread of nonnative reptiles and amphibians in Southern California that are being transported via the nursery trade. These efforts have revealed four nonnative species now established in the state and another five species that are frequent hitchhikers on nursery shipments but are not yet established. Through a unique collaboration with a local wholesale nursery, we have documented one native frog species and seven nonnative frog and gecko species as hitchhikers on nursery shipments at just this one facility. More broadly throughout Southern California, Brown Anoles and Green Anoles are now established in and around multiple nurseries, and surveys suggest that both species are displacing native lizards in urban neighborhoods. These efforts are also documenting the rapid spread of Brahminy Blindsnakes in Southern California. Efforts to assess the role of the nursery trade, and other pathways, as sources of introductions are currently hampered by underreporting and failure to secure museum specimens and photo vouchers that document the transportation of hitchhikers. Citizen science databases can be an important tool in improving documentation of nonnative species transport.

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## 223 NIA BEST STUDENT PAPER, Highland E., Friday 13 July 2018

Holden Paz, Malorie Hayes and Jonathan Armbruster

*Auburn University, Auburn, Alabama, USA*

### **Phylogenetic Placement of a New Species of *Trichomycterus* from the Pakaraima Mountains in Guyana**

*Trichomycterus* (Trichomycteridae: Siluriformes) is a genus of catfishes found throughout South American waters that is experiencing a growth in the number of described species. The genus has recently been shown to be paraphyletic with geography as a major factor determining relatedness. True *Trichomycterus* are believed to be those found in rivers draining to the Atlantic Ocean. Specimens of putative *T. guianensis* as well as undescribed species were collected from the upper Kuribrong, Potaro, and Ireng Rivers in Guyana. These rivers originate in the Pakaraima Mountains of the northwest Guiana Shield, and flow to the Atlantic Ocean, making

them members of true *Trichomycterus* according to a recent phylogenetic paper, although the species differ significantly in their interopercular and opercular odontode patterns from other *Trichomycterus*. The Pakaraima Mountains are a region of high endemism and have been the recent focus of biodiversity inventories. Using three mitochondrial (16S, COI, and cytb) and two nuclear markers (myh6 and RAG2), we determined the phylogenetic placement of these taxa within *Trichomycterus*. Our results suggest that there are multiple undescribed species of *Trichomycterus* in the highlands of Guyana, and we provide clarification of the identification of *T. guianensis* and *T. conradi*.

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**425 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: CONSERVATION & MANAGEMENT, Empire Hall South – JF Rochester Riverside Convention Center, Friday 13 July 2018**

Kenzie Pereira<sup>1</sup>, Damien Wilburn<sup>2</sup> and Sarah Woodley<sup>1</sup>

<sup>1</sup>Duquesne University, Pittsburgh, PA, USA. <sup>2</sup>University of Washington, Seattle, WA, USA

**Skin Peptides of Three-toed Amphiuma (*A. tridactylum*) Inhibit Growth of Chytrid Fungal Pathogens Linked to Worldwide Amphibian Decline**

Amphibian skin is unique among vertebrate classes, containing a large number of multicellular exocrine glands. The secretions of these glands, particularly granular glands, vary among species and include a repertoire of bioactive compounds including a rich array of antimicrobial peptides (AMPs). AMPs are important for amphibian innate immune responses and may protect some species from chytridiomycosis, a lethal skin disease caused by the chytrid fungal pathogens, *Batrachochytrium dendrobatidis* (Bd) and *B. salamandrivorans* (Bsal). Susceptibility to chytrid fungi is species-specific and related to AMP bioactivity. While AMP bioactivity against Bd has been measured for a number of amphibian taxa using in-vitro assays, similar studies are lacking for Bsal, a chytrid fungus which is especially pathogenic for salamanders. We studied the skin secretions of the fully aquatic salamander, Three-toed Amphiuma (*Amphiuma tridactylum*) to test for anti-chytrid properties. AMPs purified from the crude skin secretions of captive adult salamanders were analyzed by RP-HPLC and tested against the growth of Bd and Bsal using in-vitro assays. We found that secreted peptides were similar among male and female salamanders and inhibited the growth of Bd (minimum inhibitory concentration (MIC): 85.18  $\mu\text{g mL}^{-1}$ ) and Bsal (MIC: 147.5  $\mu\text{g mL}^{-1}$ ). Thus, AMPs that protect against Bd may also provide protection against Bsal.

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**558 Herpetology Conservation III, Highland C, Sunday 15 July 2018**

John Peterson and Tyler Sternbach

University of Wisconsin-Platteville, Platteville, WI, USA

## **Environmental correlates and anuran abundance in a community including state-endangered Blanchard's Cricket Frogs.**

The influence of environmental variables on the occurrence of amphibian vocalizations is species specific; however, few studies have observed the influence of environmental variables on relative abundance of amphibians. Automated recording devices were used to record frog vocalizations for one minute each hour during peak nightly calling across the breeding seasons of Gray Treefrogs (*Hyla versicolor*), Green Frogs (*Lithobates clamitans*), and state-endangered Blanchard's Cricket Frogs (*Acris blanchardi*) in Southwest Wisconsin. Relative abundance was determined using the standard amphibian calling index. Calling indices were assessed for each hour during peak calling and average nightly abundance was determined. Average nightly water and air temperature and relative humidity were determined via environmental data loggers. Similarly to previous studies of occurrence, relative abundance was influenced by environmental variables in a species specific fashion. Species responded to different variables depending on whether the early, middle, or late calling season was analyzed. Both *A. blanchardi* and *L. clamitans* were influenced more by date and water temperature, while *H. versicolor* was influenced more by air temperature and their relative abundances were more variable.

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### **465 Herpetology Morphology I, Highland D, Sunday 15 July 2018**

Jackson Phillips and Kurt Schwenk

*University of Connecticut, Storrs Mansfield, Connecticut, USA*

#### **The Mechanics of Air-Breathing in Tree Frog Tadpoles.**

Air-breathing in tadpoles is a well-known, yet under-appreciated facet of anuran biology. The physiology of tadpole air-breathing has been well studied in a small number of well-known taxa, and previous authors have shown the physiological importance of air-breathing as a source of oxygen for larval frogs. However, the biomechanics of air-breathing has never been fully investigated in any species of tadpole, nor has the functional morphology of the organs associated with air-breathing. We use a combination of high-speed videography, gross dissection, and paraffin histology to describe the functional morphology and mechanics of air-breathing in gray tree frog (*Hyla versicolor*) tadpoles. We raised tadpoles in the lab until metamorphosis, and characterized the kinematics of air-breathing throughout ontogeny. During the course of these observations, we documented a novel form of air-breathing, previously undescribed in any other vertebrate, termed 'bubble-sucking'. During bubble-sucking, tadpoles attach their mouth parts to the under-surface of the water and pull the surface into the pharynx, creating a bubble. Most *H. versicolor* tadpoles perform a specialized 'double-suck', where the tadpole sucks in an initial bubble and empties the lungs, then after releasing the first bubble sucks in a second bubble. The second bubble is pinched off, compressed by the pharynx and forced into the lungs, with remaining air released from the mouth. Younger tadpoles, however, often use a single-suck behavior, which appears to be

unrelated to lung ventilation. It is possible that some air-breathing behavior is related to ventilation of the gills rather than the lungs.

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**430 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Josh Pierce<sup>1</sup>, Craig Rudolph<sup>1</sup>, Steve Reichling<sup>2</sup> and Emlyn Smith<sup>3</sup>

<sup>1</sup>USDA Forest Service, Southern Research Station, Nacogdoches, TX, USA. <sup>2</sup>Memphis Zoo, Memphis, TN, USA. <sup>3</sup>USDA Forest Service, Catahoula District, Kisatchie National Forest, Bentley, LA, USA

**Returning the Louisiana Pinesnake (*Pituophis ruthveni*) to Restored Habitat**

Ongoing surveys suggest that populations of the Louisiana Pinesnake (*Pituophis ruthveni*) are limited to a few small blocks of degraded and highly fragmented habitat. Research indicates that the species requires frequently burned sites with a well-developed herbaceous understory capable of supporting populations of its primary prey, Baird's Pocket Gopher (*Geomys breviceps*). Recent changes in management practices on U. S. Forest Service lands have resulted in restoration of substantial blocks of suitable habitat, which are now available for reintroduction. A captive population consisting has been established from wild-caught snakes from Bienville Parish, LA. The reintroduction site is located on the Catahoula District of the Kisatchie National Forest. Ninety-one individuals have been released to date, and 3 snakes are currently being head-started to be released in April 2018. The current protocol is to release 50% of available animals as neonates immediately following post-natal shed, while the remaining snakes will be head-started and released the following April. Currently, automated pit tag readers and trapping are the primary monitoring techniques. To date, 20 snakes have been detected the year following release, or later. Five of those snakes have been detected 4 years following release. Louisiana Pinesnakes across 20+ zoos have been consolidated into 4 dedicated and successful facilities, which should increase the production of hatchlings in the future. Production of neonates and release of young will be repeated annually until a viable population is established or it is concluded that further releases are not likely to result in establishment of a population.

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**87 SSAR SEIBERT SYSTEMATICS & EVOLUTION II, Highland B, Friday 13 July 2018**

Todd Pierson<sup>1</sup>, Benjamin Fitzpatrick<sup>1</sup>, Kenneth Kozak<sup>2</sup> and Carlos Camp<sup>3</sup>

<sup>1</sup>University of Tennessee, Knoxville, TN, USA. <sup>2</sup>University of Minnesota, Saint Paul, MN, USA. <sup>3</sup>Piedmont College, Demorest, GA, USA

## Historic hybridization and modern reproductive isolation in the two-lined salamander (*Eurycea bislineata*) species complex

Reticulate evolutionary histories provide useful systems for exploring the role of hybridization in evolution, and modern-day contact zones allow a closer examination of the mechanisms regulating gene flow. The biogeography of plethodontid salamanders is generally characterized by the allopatry of closely-related species, with aquatic and semi-aquatic species' distributions often explained by ancient and modern river drainage boundaries. One such example, distributed throughout the eastern United States, is the two-lined salamander (*Eurycea bislineata*) species complex. Here, we use low-coverage 3RAD data from 120 individuals representing all major mtDNA lineages of the *Eurycea bislineata* species complex and high-coverage RADcap data of a subset of these individuals to reconstruct the evolutionary history of the group. We use a suite of complementary methods to reveal instances of historical hybridization, and we demonstrate the bias these events have on the maximum likelihood phylogenetic inference, focusing in particular on putative hybridization events following major river drainage reorganization events. Next, to further explore mechanisms regulating gene flow at a modern-day contact zone, we sampled individuals from four replicate contact zones between two members of this species complex – *Eurycea cirrigera* and *Eurycea* cf. *wilderae* – in the foothills of the Appalachians. We generated RADcap data for 330 individuals and recovered no evidence for ongoing gene flow. Instead, we show a strong pattern of fine-scale segregation within an ecological mosaic, potentially driven by nest-site selection. Together, these studies highlight the importance of both large-scale, biogeographic factors and fine-scale, ecological factors in structuring gene flow across evolutionary time.

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### 357 Ichthyology Systematics I, Grand Lilac Ballroom South, Saturday 14 July 2018

Kyle Piller<sup>1</sup>, Elyse Parker<sup>1,2</sup>, Alan Lemmon<sup>3</sup> and Emily Moriarty-Lemmon<sup>3</sup>

<sup>1</sup>*Southeastern Louisiana University, Hammond, LA, USA.* <sup>2</sup>*Yale University, New Haven, CT, USA.* <sup>3</sup>*Florida State University, Tallahassee, FL, USA*

### Assessing relationships within the Goodeidae using Anchored Hybrid Phylogenomics

The Goodeidae (Cyprinodontiformes) has a limited distribution in the Great Basin of Southwestern United States and the Mesa Central of Mexico. The family consists of two subfamilies, the oviparous Empetrichthyinae and the viviparous Goodeinae. Despite much interest, previous attempts to investigate the evolutionary relationships among species in the family have been incongruent and primarily based on mitochondrial data. The lack of a comprehensive, multilocus nuclear DNA phylogeny for the entire family has hampered our ability to understand the evolutionary relationships. Therefore, we conducted the first phylogenomic study of the family to examine the relationships among taxa in the family using anchored hybrid enrichment, a targeted next generation sequencing approach. Sequence data were generated from more than 350 nuclear loci and nearly 75 goodeids from across the range.

Phylogenetic analyses were conducted using the concatenated data set and a locus partitioned RaxML analysis. The relationships among the species of goodeids within each of the Tribes were similar to previous studies, but the relationships among the Tribes differed, thereby challenging previous hypotheses. This study is the first phylogenomic study of the Goodeidae and provides an historical template that can be used to address a multitude of macroevolutionary questions focusing on the biogeography and the tempo and mode of diversification of the entire family.

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## **66 SSAR SEIBERT SYSTEMATICS & EVOLUTION II, Highland B, Friday 13 July 2018**

Brendan Pinto<sup>1</sup>, Juan Daza<sup>2</sup>, James Titus-McQuillan<sup>3</sup> and Tony Gamble<sup>1</sup>

<sup>1</sup>Marquette University, Milwaukee, WI, USA. <sup>2</sup>Sam Houston State University, Huntsville, TX, USA. <sup>3</sup>University of Texas at Arlington, Arlington, TX, USA

### **The rapid evolution of post-zygotic isolating barriers and identification of the first stable hybrid zone in geckos**

Investigating the processes that lead to the generation of new species, or speciation, is a cornerstone investigation in ecology and evolutionary biology. The process of speciation is mediated by the evolution of genetic incompatibilities that lead to reproductive isolation between divergent populations. We study and observe the speciation process in geographic regions where two species meet and interbreed, or hybrid zones. Gecko lizards are a species-rich group of vertebrate animals (>1,700 species), for which, hybridization is poorly represented in the literature, we characterize the first reported stable hybrid zone within geckos (infraorder Gekkota). Thirty-five years ago, *Sphaerodactylus* hybridization was reported between two Puerto Rican species, *Sphaerodactylus nicholsi* and *Sphaerodactylus townsendi*. We revisited this putative hybrid zone and confirmed its presence and geographic stability using modern molecular genetic methods and investigated the climatic disparity between these two species' niche breadths to determine that these two species may have been released from fierce competition by anthropogenically-mediated disturbances. This system provides us with the means to examine the iterative processes of reproductive isolation and speciation in gecko lizards for the first time.

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## **322 Herpetology Habitat & Environment, Highland A, Saturday 14 July 2018**

Jessica Pita-Aquino, Christopher Thawley, Noah Gilbert and Jason Kolbe

University of Rhode Island, Kingston, Rhode Island, USA

### **The Effect of Substrate Diameter and Limb Morphology on Locomotor Performance in Brown Anoles (*Anolis sagrei*)**

In lizards, locomotor performance is affected by both substrate diameter and limb morphology. For example, *Anolis* species with longer limbs run faster on broad substrates, whereas short-limbed species are more adept at moving on narrow diameters. For the brown anole (*A. sagrei*), previous studies have identified a positive relationship between perch diameter and hindlimb

length across populations. This is consistent with natural selection favoring hindlimb lengths appropriate for different microhabitats. Also, limb kinematics studies have demonstrated a trade-off between speed and stability, which is mediated by substrate diameter. However, no study so far has measured the combined effects of substrate diameter and limb morphology on locomotor performance within an anole species. We examined the sprinting abilities of brown anoles from urban and natural habitats in southern Florida. We recorded lizard performance on six inclined racetracks of varying diameters (1.0–8.9 cm), and on a flat surface. We used Tracker® to measure maximum velocity for 10 cm and 25 cm distances as well as number of pauses, slips and falls during each run. To quantify effects of morphology on performance, we x-rayed lizards to measure limb lengths and counted the number of lamellae to measure toepad size. By generating performance curves, we will describe the relationships between maximal sprinting ability, locomotor stability, lizard morphology and surface diameter. Lizard sprint speed should decrease on narrower surfaces and with shorter limbs. We discuss our results in relation to within population morphological variation as well as differences between urban and natural habitats.

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## **116 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Sinlan Poo<sup>1</sup>, Kristin Hinkson<sup>1</sup> and Maud Ferrari<sup>2</sup>

<sup>1</sup>Memphis Zoo, Memphis, TN, USA. <sup>2</sup>University of Saskatchewan, Saskatoon, Saskatchewan, Canada

### **Life-skills training: Antipredator behavior in captive-bred tadpoles**

As one of the most endangered group of species, amphibians are threatened by rapid anthropogenic changes to their environment. In response to these threats, breeding programs have been established in many zoos to prevent extinctions by providing a safe harbor for amphibians, with the goal of releasing captive-bred individuals into wild. A key issue that determines the success of release programs, however, is whether captive-reared animals are able to exhibit ecologically-relevant behavior in response to dangers in their natural environment. The idea of training captive animals to survive in the wild is well-established in mammals, birds, and fishes, but has yet to be developed in amphibians. To fill this gap in scientific knowledge and conservation practice, we present the first attempt at increasing amphibian survival by “teaching” captive-bred tadpoles to recognize and respond to potential predators (life-skill training). For predator recognition training, we exposed *Anaxyrus fowleri* tadpoles to predator cues at two different stages (7 days of conditioning, starting at 3 or 13 days post hatching). We then assessed tadpole behavior at three different stages of development (10, 20, or 30 days post hatching). We found antipredator behavior increased with age, but did not differ between conditioned and non-conditioned tadpoles. Results indicated an innate ability of captive-bred tadpoles to respond to predator cues regardless of previous experience or exposure. These findings will help inform management of captive release programs and form the basis of future studies into the effects of captive breeding and rearing environments on predator recognition in amphibians.

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Sinlan Poo<sup>1</sup>, Kristin Hinkson<sup>1</sup>, Edward Stege<sup>2</sup> and Kimberly Terrell<sup>3</sup>

<sup>1</sup>Memphis Zoo, Memphis, TN, USA. <sup>2</sup>USFWS, Leadville, CO, USA. <sup>3</sup>Smithsonian Conservation Biology Institute, Washington, DC, USA

### **Sperm Output and Body Condition are Maintained Independent of Hibernation in an Endangered Temperate Amphibian**

Hibernation is an integral part of the life history of species living in seasonal environments. However, our knowledge on the link between hibernation and reproductive success in amphibians is limited, and such information is critically needed to inform conservation efforts, as amphibians are disproportionately threatened with extinction. Therefore, we experimentally quantified the effects of *ex situ* hibernation on sperm quality, sperm quantity, and body condition in a federally-endangered anuran, the Wyoming toad (*Anaxyrus baxteri*). We tested the hypothesis that hibernation is essential for optimal reproductive output, but is detrimental to body condition. Captive-bred, male toads were exposed to 0, 30, or 60 days of low temperature, and sperm output (total number of cells, concentration, motility, and viability) and body condition were evaluated. Contrary to our hypotheses, no differences were observed in sperm metrics or in body condition across treatment groups. These unexpected findings suggest that hibernation is not an essential process for spermiation in *A. baxteri* and illustrates the potential of temperate amphibians to adapt to varying environmental conditions during winter months. Further research on reproductive behavior and possible multiyear effects of hibernation are needed to elucidate the overall significance of hibernation on the reproductive success in anurans.

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**17 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: ECOLOGY, NATURAL HISTORY, DISTRIBUTION & BEHAVIOR, Empire Hall South – JF Rochester Riverside Convention Center, Friday 13 July 2018**

Andrew Powers and Tim J. Karels

California State University, Northridge, Northridge, CA, USA

### **Habitat Fragmentation and Snakes in Southern California**

Los Angeles is one of the largest urban areas in the world, and this rapid urban sprawl has created many scattered habitat fragments. These habitat fragments can have negative consequences on wildlife diversity and dispersal. Studies of habitat fragmentation have focused on lizards, mammals and birds, but rarely snakes. Many of these groups, such as lizards, have been chosen for their high visibility and conspicuous nature. Studies have shown that in areas of high fragmentation and urbanization, lizard diversity becomes lower than in unfragmented areas. However, this trend might not carry across all reptile groups. Snakes are an ecologically important group as primary predators on rodents and nesting birds in areas that other predators cannot reach. They are long-lived, habitat specific, and are vulnerable to human interference. I will explore the relationship between snake diversity and habitat fragmentation in Thousand Oaks, California. I will capture snakes, identify species, and will record mass, length and sex in order to quantify snake diversity and population composition in 25 large and small patches. I expect to find differences in snake composition between patch size

classes. Additionally, I expect large snake diversity and size will decrease as patch size decreases. I also hypothesize more recently fragmented patches will have higher diversity over older patches. My study will be the first to examine the indirect effects of habitat fragmentation on snake diversity in Southern California, and will help to better understand the challenges local wildlife are faced with through urbanization.

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**526 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Worth Pugh and Phillip Harris

*The University of Alabama, Tuscaloosa, AL, USA*

**Update on the Integration of the Geological Survey of Alabama and the University of Alabama Ichthyology Collections**

Natural history collections have served as the foundation for the studies of ecology, evolutionary biology, systematics and conservation biology. Despite the importance of these collections many robust examples remain largely hidden due to lack of publicly available electronic data. The Geological Survey of Alabama Ichthyology Collection was created in the late 1970s as part of the enactment of the GSA's state-wide biological inventory assessments. In 2014, the GSA began to turn over their holdings to the University of Alabama Ichthyology Collection as part of an acquisition funded by the NSF Collections in Support of Biological Research program. Our goals are to incorporate this collection into the UAIC and then make all associated data available online (i.e., GBIF, VertNet, iDigBio). Thus far we have cataloged >13,000 lots from the GSA collection and estimate that we are only ~60% finished assimilating all lots. Preliminary results of the project show strong numbers of a variety of freshwater taxa from nearly every major tributary in the state of Alabama as well as some surrounding states with shared watersheds. While the sheer volume of specimens is astounding and likely fills many gaps in geographic distribution, the true significance of this collection lies in the data represented in the collection which were collected using standardized survey methods and includes environmental data across an extended spatial scale (1979-2010s). Future studies utilizing the GSA collection could examine many research topics related to shifts in fish species diversity in response to land-use change, water-quality, and climate change.

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**523 Ichthyology Conservation, Grand Lilac Ballroom South, Saturday 14 July 2018**

Worth Pugh<sup>1</sup>, Gary Pandolfi<sup>2</sup> and Michael Gangloff<sup>3</sup>

<sup>1</sup>*The University of Alabama, Tuscaloosa, AL, USA.* <sup>2</sup>*United State Fish and Wildlife Service, Austin, TX, USA.* <sup>3</sup>*Appalachian State University, Boone, NC, USA*

## Impacts of Land-Use, Catchment Size and In-Stream Habitat on Lotic Communities of the Upper New River Drainage in North Carolina

Land-use impacts local water quality by influencing hydroperiod, nutrient cycling, and substrate composition in freshwater systems. Deforestation and pollution generally have negative consequences on freshwater systems as well as animal communities that inhabit them. The New River originates in Watauga Co. NC and is home to several endemic aquatic fauna including several fishes, one crayfish and one snail. We examined how land-use and in-stream habitat parameters influence species diversity and distribution of sensitive aquatic taxa in the upper New River. Our data demonstrate negative relationships between forest cover and concentrations of fine sediments at the riparian and catchment scales. We also found that upstream forest cover shares a positive relationship with fish diversity and is an adequate predictor of New River Crayfish and hellbender salamander site occupancy. Moreover, our study finds that catchment size influences in-stream habitat which, in turn, impacts fish species diversity and community structure. Although reducing development while increasing reforestation within the entire catchment would be ideal, it may be more plausible to target catchments of headwater tributaries which would have positive cascading effects on main-stem tributaries. Future monitoring efforts in the New River are imperative to understand how further land conversion will affect these endemic communities as increases in urban development and water-use in headwater regions pose significant threats to sensitive stream fauna and water-quality.

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547 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018

Andrea Quattrini<sup>1</sup>, Dominique Cheb Terrab<sup>2</sup> and Katriina Ilves<sup>2,3</sup>

<sup>1</sup>Harvey Mudd College, Claremont, CA, USA. <sup>2</sup>Pace University, New York, NY, USA.

<sup>3</sup>Academy of Natural Sciences of Philadelphia, Philadelphia, PA, USA

## Genetic and Morphometric Evidence for a New Species of Deep-Sea Anguilliform Eel (Congridae: *Conger*) from the Gulf of Mexico.

Biotic surveys in the deep-sea reveal there is still much biodiversity remaining to be discovered. Here we report evidence for a new species of anguilliform eel of the genus *Conger*, based on species tree analyses of mitochondrial and nuclear loci with additional support from morphometric characters. Five specimens were collected in the northern Gulf of Mexico from ~300 m depth using chevron traps deployed in deep-coral reef areas. Specimens were originally identified as *C. oceanicus*, yet are genetically distinct (e.g., >8% COI divergence) from putative conspecifics and other congeners from the region. Morphometric analyses are ongoing. Comments are made on possible speciation scenarios in *Conger* and deep-sea fishes more generally. This study highlights the utility of using DNA barcoding as a starting point for biodiversity studies, particularly of deep-sea biota. Further, results emphasize the importance of

museum collections for housing not only tissue samples, but also voucher specimens and the expertise that accompanies these collections.

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**63 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Aleta Quinn

*University of Idaho, Moscow, ID, USA. National Museum of Natural History, Washington, DC, USA*

**Teaching philosophy of biology**

I teach “environmental philosophy”, “philosophy of biology” and related undergraduate courses. In this poster I reflect on what is/are the purpose(s) of teaching these courses, and in turn how I should teach. My goal is to collect feedback from individuals with broad backgrounds in molecular or organismal biology and wildlife management, both to improve my own class and to contribute to pedagogical literature. Challenges include students’ belief that empirical studies will straightforwardly solve conceptual problems, colleagues’ views about the relative value of different sub-fields of biology, and administrators’ demand that pedagogy narrowly fit career objectives. Additionally, the things that interest me as a philosopher and a hobby herper differ from the things that would be of interest and value to my students. I recently argued successfully for my courses to earn credit towards biology degrees, and I expect to contribute to graduate students’ research. What issues and skills, broadly considered “conceptual”, do you wish that you and/or your students had an opportunity to study? My poster is an invitation to collaborate across disciplines to improve scientific literacy in the general population, but especially to help develop strong conceptual foundations for future biologists.

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**62 Ichthyology Systematics I, Grand Lilac Ballroom South, Saturday 14 July 2018**

Aleta Quinn

*University of Idaho, Moscow, ID, USA. National Museum of Natural History, Washington, DC, USA*

**When is a cladist not a cladist?**

The term “cladist” has distinct meanings in distinct contexts. Communication between philosophers, historians, and biologists has been hindered by different understandings of the term in various contexts. In this paper I trace historical and conceptual connections between several broadly distinct senses of the term “cladist”. I propose seven specific definitions that

capture distinct contemporary uses. This serves to disambiguate some cases where the meaning is unclear, and will help resolve apparent disagreements that in fact result from conflicting understandings of the term.

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## **642 Herpetology Behavior, Grand Lilac Ballroom South, Friday 13 July 2018**

Alison Davis Rabosky, Talia Moore, Erin Westeen, Joanna Larson and Ciara Sanchez Paredes

*University of Michigan, Ann Arbor, MI, USA*

### **Convergence or Divergence? 3-D Quantification and Characterization of Snake Anti-predator Behavior in the Peruvian Amazon**

Coral snakes have bright color patterns and distinctive behavioral displays that honestly signal their venomous bite to potential predators. While the coloration of coral snakes and their many harmless mimics has been well studied, the behavioral repertoires that these snakes, and other cryptically colored species within the same ecological community, has not received the same level of attention. Tropical snake behavior is challenging to study due to changes in behavior in artificial settings, environmental hazards to electrical equipment, and difficulty capturing sufficient sample sizes with taxonomic breadth. By constructing wireless, waterproof, and portable data collection buckets with high definition video cameras, we captured the anti-predator behavior of snakes at the moment of collection from four sites in the Amazonian rainforests of Peru. We also constructed a pop-up kinematics lab to run a series of behavioral assays in semi-controlled conditions in the field. Over three month-long expeditions, we collected 1352 behavioral trials from 161 individuals across 51 species, including venomous models, harmless mimics, and non-mimicking snake species. We used qualitative analyses to characterize behavioral motifs and quantitative biomechanical analyses to characterize snake motions in three dimensional space. By placing these data in a phylogenetic context, we will test hypotheses regarding the evolution of behavioral mimicry, including quantifying the degree of mimetic convergence relative to sympatric cryptic species.

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## **433 ASIH STOYE PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY, Highland D, Friday 13 July 2018**

Andrea Racic<sup>1</sup>, Catherine Tylan<sup>2</sup> and Tracy Langkilde

<sup>1</sup>*Pennsylvania State University, University Park, Pennsylvania, USA.* <sup>2</sup>*Pennsylvania State University, University Park, Pennsylvania, USA*

### **Temperature Effects on Corticosterone in the Eastern Fence Lizard, *Sceloporus undulatus***

The physiological stress response is frequently used as an indicator of an animal's interactions with its environment. However, activity of the hypothalamic-pituitary-adrenal axis, the primary regulator of the glucocorticoid stress response in vertebrates, may be affected by body temperature. In endotherms, this does not pose a serious issue since they maintain body temperature within a narrow range. In contrast, ectotherm body temperature is more strongly influenced by ambient temperature, which may affect our ability to measure and interpret physiological stress. We tested the effects of temperature on plasma corticosterone in the eastern fence lizard (*Sceloporus undulatus*). We assigned lizards to one of four temperature treatments within the range naturally experienced: 22°C, 29°C, 33°C, or 36°C. After four hours, body temperature was measured and blood taken to obtain baseline plasma corticosterone concentrations. The lizards were then exposed to a standardized stressor (placed in a cloth bag) and returned to their treatment temperature. After 30 minutes, we re-measured body temperature and obtained a second blood sample to measure stress-induced corticosterone. Both baseline and stress-induced corticosterone were elevated in lizards held at higher temperatures, indicating that the physiological activity of the hypothalamic-pituitary-adrenal axis is enhanced at higher temperatures. These results suggest environmental temperature can significantly affect plasma corticosterone concentrations by increasing body temperature in reptiles. Field biologists are encouraged to measure body temperature at time of sampling, as this could explain variation in their data. Similarly, investigators should consider the temperatures at which they run lab studies as this may affect their results.

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**112 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: PHYSIOLOGY & MORPHOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Howard Rainey<sup>1</sup>, Todd Pierson<sup>2</sup> and Jennifer Deitloff<sup>1</sup>

<sup>1</sup>Lock Haven University, Lock Haven, Pennsylvania, USA. <sup>2</sup>University of Tennessee, Knoxville, Tennessee, USA

**Distinguishing Morphological Differences in the Head Shape of Male *Eurycea wilderae* (Blue-Ridge Two-Lined Salamander)**

Morphology can be correlated with behaviors that impact a male's ability to obtain reproductive success when facing competition for mates. In addition, sexual selection can influence differences in morphological traits between males and females leading to sexual dimorphism. *Eurycea* salamanders display polymorphism in head shape among males as well as between the sexes. Males of *Eurycea wilderae* exhibit two different suites of correlated morphological traits often described as cirriferous and Morph A. Cirriferous males possess cirri that extend down from the nasolabial grooves, and they lack enlarged jaw musculature. Morph A males have enlarged jaw musculature resulting in broader heads than the cirriferous morphology, and they lack cirri, mental glands, and protruding premaxillary teeth. The ventral and lateral head morphology of *E. wilderae* was investigated in this study by using geometric morphometrics. We tested the hypothesis that males with and without cirri would be

statistically different in overall head shape. We also tested the hypothesis that *E. wilderae* exhibit sexual dimorphism in head shape. We found support for the first hypothesis, and head shape of Morph A males were different than head shape of females. However, cirriferous males did not differ significantly from females in overall head shape even though the males possessed cirri and the females did not. Based on this and previous research, future studies should determine whether these two head morphologies of male *E. wilderae* (cirriferous and Morph A) demonstrate evolutionary adaptive characteristics that increase reproductive opportunities.

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### **339 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday, 13 July 2018**

Muhammad Rais, Waseem Ahmed, Muhammad Saeed, Ayesha Akram, Imtiaz Ahmed Khan, Maqsood Anwar and Sidra Ikram

*Department of Wildlife Management, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Rawalpindi, Punjab, Pakistan*

#### **Occupancy and Detection Probability of Endemic Murree Hills Frog (*Nanorana vicina*) in Natural and Urban Areas of Murree, Pakistan**

The modeling of species occupancy and determination of factors influencing its detection probability help formulate appropriate survey and monitoring programs. We studied if the occupancy of Murree Hills Frog (*Nanorana vicina*) differed in natural and urban areas and that certain survey covariates influenced its detection probability. The best fit model predicted occupancy ( $\psi$ ) of the species as 48% while detection probability ( $p$ ) as 25%. The best fit model predicted occupancy as a function of water velocity and salinity while habitat type (natural/urban areas) did not contribute. None of the water quality and environmental variables measured from natural and urban areas during the study period differ significantly ( $P > 0.05$ ). The species occupied sites occurring at an elevation above 900 m. The species was recorded from sub-tropical pine forest and moist temperate forest. The frog frequented fast flowing ( $> 10$  m/s) natural freshwater springs/streams with associated pools of stagnant water having low water temperature.

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### **338 Herpetology Conservation II, Highland C, Sunday 15 July 2018**

Muhammad Rais<sup>1</sup>, Imtiaz Ahmed Khan<sup>1</sup>, Aneesa Islam<sup>2</sup>, Waseem Ahmed<sup>1</sup>, Muhammad Saeed<sup>1</sup>, Syeda Maria Ali<sup>2</sup> and Ayesha Akram<sup>1</sup>

<sup>1</sup>Wildlife Management, PMAS-Arid Agriculture University Rawalpindi, Rawalpindi, Punjab, Pakistan. <sup>2</sup>Department of Environmental Sciences, Faculty of Basic and Applied Studies, International Islamic University, Islamabad, ICT, Pakistan

## Quantification of Herpetofauna Habitat and Assessment of Land Use Change in Rawalpindi and Islamabad Areas, Pakistan

The conversion of wildlife habitat into urban settings is a ubiquitous threat to herpetofauna globally. We assessed land use land cover change of District Rawalpindi and Islamabad area through satellite images for the year 2006, 2011 and 2016. We gathered presence only data of herpetofauna species using standard survey technique-visual encounter method (VES) from October, 2016 to June, 2017. We recorded ten amphibian and 25 reptilian species. We observed increase in urban/ built up area in Islamabad (20%); Rawalpindi (21%), Murree (46%), Kotli Sattian (33%), Kallar Syedan (25%), Gujar Khan (24%) and Kahuta (24%) tehils of District Rawalpindi. We recorded decrease in other habitats of areas of Islamabad (30% open space); Rawalpindi (17% open space), Murree (44% croplands), Kotli Sattian (47% croplands, 46% forest), Kallar Syedan (33% croplands), Gujar Khan (41% open space), Taxila (4% forest) and Kahuta (37% croplands) tehils, District Rawalpindi from 2006 to 2016. The increase in urban area could cause change in species composition favoring the spread of nuisance and invasive species as Indus Valley Toad (*Duttaphrynus stomaticus*), Bull Frog (*Hoplobatrachus tigerinus*), Indian Flapshell Turtle (*Lissemys punctata andersoni*), Common Tree Lizard (*Calotes versicolor*), Wall lizards (*Hemidactylus spp.*), Bengal Monitor Lizard (*Varanus bengalensis*) while reduction in wetlands, forest, open space and cropland areas may put threatened/ uncommon and endemic species such as Ballon Frog (*Uperdon systoma*), Burrowing Frog (*Sphaerotheca breviceps*), Murree Hills Frog (*Nanorana vicina*), Hazara Torrent Frog (*Allopaa hazarensis*), Indian Soft-shell Turtle (*Nilssonia gangetica*) and Indus Valley Spiny-tailed Lizard (*Saara hardwickii*) in danger.

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### 96 Herpetology Morphology I, Highland D, Sunday 15 July 2018

Deran Reddy, Cassidy Kuiper and Stephanie Schoeman

University of the Witwatersrand, Johannesburg, Gauteng, South Africa

#### **A Light Microscopic Documentation of the Morphogenesis of the Lung of the Nile Crocodile (*Crocodylus niloticus niloticus*).**

It is an established and well understood fact that the lung of the Nile crocodile is a heterogeneous organ. However, no documentation of the structural composition of the cells/tissues that create this unique architecture has been done. Understanding this is vital to understanding the crocodile's storage mechanism of air, its unidirectional air flow mechanism and lung compliance which all have an effect on progression of development and behaviour. For all age groups, it was found that the subdivision of the lung decreased in a cranio-caudal direction with all of the ventral regions of the lung being more subdivided than their dorsal counterparts. This level of heterogeneity became more marked with an increase in age of individuals. The younger age group crocodiles illustrated thinner septa (relative to older crocodiles) dividing the lumen into faveoli (terminal gas exchange units). In most instances the collagen fibre cores (septa) varied in thickness, elasticity (varying elastic fibre density), vascularity, levels of bifurcation and often eventually terminated in smooth muscle plates or

knobs. Cilia was observed throughout the lung and decreased in density in a cranio-caudal direction. Also, the density of the cilia was higher in the younger crocodiles than the older ones. Similarly, the density of cartilage present in older individuals was higher with it being most prevalent in the ventral middle regions of the lung. By manipulation of these structural parameters individually or in combination, the respiratory cycle of the crocodile can be manipulated to suit its ontogenetic stage.

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## 169 Reptile Ecology I, Highland A, Sunday 15 July 2018

Jeanine Refsnider<sup>1</sup>, Henry Streby<sup>1</sup>, Song Qian<sup>1</sup>, Sarah Carter<sup>1</sup>, Ian Clifton<sup>1</sup>, Gunnar Kramer<sup>1</sup>, Adam Siefker<sup>2</sup> and Tyara Vazquez<sup>1</sup>

<sup>1</sup>University of Toledo, Toledo, Ohio, USA. <sup>2</sup>University of Toledo, Toledo, Ohio, USA

### **Does environmental heterogeneity predict degree of specialization? Testing the “jack-of-all-trades, master of none” hypothesis in a specialist lizard, *Phrynosoma hernandesi***

Niche width is often correlated with environmental heterogeneity, with generalists evolving in heterogeneous environments and specialists evolving in environments that vary less over space and time. Generalists are hypothesized to be better able to contend with rapid environmental change, and to persist longer in degraded habitat, than specialists. We used *Phrynosoma* horned lizards, a taxon considered to be highly specialized, to test the hypothesis that populations in a more heterogeneous environment were generalists compared to populations in a more homogeneous environment. We compared selection of prey items, microhabitat, light-environment, and spatial ecology between two populations that differed in elevation and environmental heterogeneity. Temperatures at the high-elevation site were more variable, and there was a greater diversity of microhabitats and associated light-environments at the high-elevation site, than at the low-elevation site. In contrast, available prey items were more diverse at the low-elevation site than the high-elevation site. Horned lizards selected for a wider range of prey items at the high-elevation site compared to the low-elevation site, and they showed similar selection for microhabitat types and had similar home ranges and daily travel distances at both sites. They showed specialization for light-environment use in opposing directions depending on elevation: low-elevation lizards spent more time buried underground and less time basking in full sun, while high-elevation lizards spent less time buried underground and more time basking in full sun. Our results demonstrate that environmental heterogeneity of a particular resource does not predict the degree to which organisms specialize on that resource.

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## 429 Lightning Talks III, Highland B, Sunday 15 July 2018

Brendan Reid and Sarah Fitzpatrick

W. K. Kellogg Biological Station, Michigan State University, Hickory Corners, MI, USA

### **Don't fear the Rapture: efficient and inexpensive generation of genomic data for the Arkansas darter (*Etheostoma cragini*)**

Next-generation sequencing approaches that combine restriction site-associated DNA (RAD) and sequence capture methods provide a highly efficient and inexpensive means of generating massive amounts of sequence data from a large number of targeted loci distributed throughout the genome. These approaches may be especially useful for resolving population processes at fine geographic scales using genetic data, for which large numbers of individuals and loci are both useful. We applied an existing hybrid RAD-capture approach (Rapture) to the Arkansas darter, (*Etheostoma cragini*), a species of conservation concern found in the Arkansas River and its tributaries. Using a pilot RAD dataset assembled to a draft genome for the orangethroat darter (*Etheostoma spectabile*), we first identified a set of 4,966 bait sequences targeting 2,121 loci distributed throughout the genome, including 29 loci potentially under selection. We then used dual-indexed RAD library preparation followed by bait capture to multiplex 384 individuals for sequencing in a single Illumina sequencing lane. Applying the Rapture method to our existing tissue collection ( $n > 2000$  individuals) will enable us to estimate fine-scale population structure, levels of inbreeding, and contemporary population sizes throughout the range as well as provide evidence-based recommendations for management that take into account neutral genetic structure as well as potential adaptations to local environmental conditions.

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### **221 ASIH STOYE ECOLOGY & ETHOLOGY II, Highland C, Thursday 12 July 2018**

Kelsey E. Reider and Maureen A. Donnelly

Florida International University, Miami, FL, USA

### **Survival at the Summits: Anuran Responses to Rapid Deglaciation in the High Andes of Southern Perú**

Understanding biological responses to climate change is a top concern in conservation biology. Tropical high-elevation aquatic ecosystems are particularly sensitive to precipitation changes. Glaciers, which provide the only other water source, are rapidly disappearing. In the Cordillera Vilcanota in southern Perú, frogs including *Pleurodema marmoratum* and *Telmatobius marmoratus* have colonized new aquatic habitat inside the recently deglaciated zone. Their 150-200 meter upward shift represents one of the largest elevational range expansions observed for any vertebrate. We studied pond availability, water sources, and frog reproductive phenology over three hydrologic years at the upper limit of the biosphere. We used amphibian surveys and repeat photography to document occupancy, breeding activity, and pond hydroperiod variation. We determined d-excess and  $\delta^{18}\text{O}$  values from the stable isotopes of water to distinguish amphibian breeding ponds fed by glacial runoff and ponds fed only by precipitation. Reproductive phenology in *Pleurodema marmoratum*, a terrestrial frog with aquatic larvae, was strongly linked to precipitation seasonality, whereas fully-aquatic *Telmatobius*

*marmoratus* tadpoles were present year-round but only in permanent ponds. Divergent strategies for dealing with variable and extreme conditions in high mountain environments leave each species vulnerable to different threats. El Niño caused a delay in the 2015 wet season and shortened the *P. marmoratum* breeding period in ephemeral ponds. *Telmatobius marmoratus* persistence is threatened by the loss of permanent ponds from ongoing glacial retreat. Our study shows that hydrologic alterations from the loss of glacial meltwater, changing precipitation patterns, and El Niño threaten some of the highest-known amphibians on Earth.

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## **541 ASIH: If Salamanders Could Speak Symposium, Grand Lilac Ballroom North, Saturday 14 July 2018**

Jessica Reimche<sup>1</sup>, Robert del Carlo<sup>2</sup>, Amber Stokes<sup>3</sup>, Erica Ely<sup>4</sup>, Joshua Hallas<sup>1</sup>, Edmund Brodie III<sup>5</sup>, Michael Pfrender<sup>6</sup>, Edmund Brodie Jr.<sup>7</sup>, Normand Leblanc<sup>1</sup> and Chris Feldman<sup>1</sup>

<sup>1</sup>University of Nevada Reno, Reno, NV, USA. <sup>2</sup>University of Nevada, Reno, NV, USA.

<sup>3</sup>California State University Bakersfield, Bakersfield, CA, USA. <sup>4</sup>California Academy of Sciences, San Francisco, CA, USA. <sup>5</sup>University of Virginia, Charlottesville, VA, USA.

<sup>6</sup>University of Notre Dame, Notre Dame, IN, USA. <sup>7</sup>Utah State University, Logan, UT, USA

### **Is the Sierra Garter Snake the exception to the rule? TTX-resistance in *Thamnophis couchii* is not explained by molecular phenotype**

The convergent evolution of tetrodotoxin (TTX) resistance in garter snakes (*Thamnophis*) has shown remarkable predictability. Patterns at both the phenotypic and genetic level have been consistent across multiple *Thamnophis* species, implying that there may be strong molecular constraints involved in this adaptive trait. TTX, a powerful neurotoxin found in Pacific newts (*Taricha*), binds to voltage-gated sodium channels in muscles (Na<sub>v</sub>1.4) and nerves (Na<sub>v</sub>1.6, 1.7), paralyzing these tissues and killing nearly all would-be predators. Despite this defense, three *Thamnophis* species have evolved similar structural changes in Na<sub>v</sub>1.4 that allow them to prey on sympatric newts. To further investigate the predictability of TTX-resistance, we examined geographic patterns of phenotypic resistance in the Sierra Garter Snake (*Thamnophis couchii*). We characterized both snake resistance and newt toxicity across their sympatric range. We then characterized functional genetic variation in three Na<sub>v</sub> genes expressed in snake muscles and nerves, and measured expression levels of Na<sub>v</sub>1.4. We found that *T. couchii* demonstrate high geographic variation in TTX-resistance at the whole animal, and this variation correlates strongly with prey toxicity. However, *T. couchii* shows no variation in amino acid sequences in all three Na<sub>v</sub> genes across its distribution and shows no significant changes in gene expression across populations. Thus, in *T. couchii*, resistance cannot be explained by a relationship between Na<sub>v</sub> genotype and whole animal phenotype, suggesting that there are additional genetic mechanisms involved in TTX-resistance in *T. couchii*, and this feeding adaptation may not be as predictable as previously thought.

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## 81 Herpetology Biogeography II, Highland B, Saturday 14 July 2018

R. Graham Reynolds<sup>1</sup> and Alberto Puente-Rolon<sup>2</sup>

<sup>1</sup>University of North Carolina Asheville, Asheville, NC, USA. <sup>2</sup>UPR Mayaguez, Mayaguez, Puerto Rico, Puerto Rico

### Ecology and Evolution of Boas in the West Indies

West Indian boid snakes in the genus *Chilabothrus* comprise an exclusively insular monophyletic lineage dating to a Miocene colonization of the proto-Antilles from South America. These nocturnal boas occupy habitats ranging from xeric scrub to montane rainforest and have maximum adult body sizes spanning a range from <1 m to nearly 4 m. As recently as 2013, only nine species were recognized, though substantial work in the last few years has revealed an additional four species. This includes the recognition of cryptic species such as the Virgin Islands Boa, the re-discovery of the Crooked-Acklins Boa, and the dramatic discovery of the Silver Boa, a new species found in 2015. Despite a modest number of species, this genus has undergone remarkable morphological evolution. Two morphotypes have been recognized: large-bodied generalists (five species) and small-bodied specialists (eight species). Both large and small species are distributed across the West Indies, though no single island has more than one large species, and small species frequently co-occur with large species (with the exception of the Bahamas banks). Further, this determinism in body size and ecological evolution has been arrived at via different evolutionary pathways, notably, via accelerated rates of head shape (trophic morphology) evolution as small-bodied species evolved from larger ancestors. I will discuss our current understanding of the ecology and evolution of these boas, including the application of multivariate morphological analysis, statistical historical biogeography, molecular phylogenetics, and phylogenetic comparative methods that have served to greatly increase our understanding of these lineages.

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### 317 Poster Session I, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018

Shannon A. Richard<sup>1</sup>, Sanjiv Jayamohan<sup>1</sup>, Eric A. Tillman<sup>2</sup>, Michael L. Avery<sup>2</sup> and M. Rockwell Parker<sup>1</sup>

<sup>1</sup>James Madison University, Harrisonburg, VA, USA. <sup>2</sup>USDA National Wildlife Research Center, Gainesville, FL, USA

### Preliminary analysis of scent trailing behavior in Argentine tegus from Florida

Invasive species can accelerate ecological dysfunction, and a key, aggressive invasive reptile, the Argentine black and white tegu (*Tupinambis merrianae*), has spread rapidly from west-central Florida into Everglades National Park and exacerbated local faunal declines. Because of their voracious, omnivorous diet and promiscuous occupation of burrows for habitat, tegus have

potential to be a significant, multiplicative invasion. The Argentine tegu produces large clutches and has established brumation sites throughout its invasive range indicating that the population has substantial potential to expand. Chemical signals are powerful cues used by conspecifics to locate potential mates in complex environments. For invasive species, mate searching is a key process that enables the reproduction and establishment of populations in novel habitats, and reptiles rely heavily on chemical signals for tracking mates. Our project is examining the trailing behaviors of male Argentine tegus ( $n=7$ ) as they follow conspecific scent in a Y-maze. Males were tested in three scenarios: male trail only, female trail only, and male vs. female trails. We conducted these tests both within (April-May) and outside (August) the predicted mating season for Argentine tegus in central Florida. If males show sex-specific preferences and behaviors across these trial types and seasons, it will establish a foundation for future management research on this invasive predator.

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## **297 Herpetology Behavior, Grand Lilac Ballroom South, Friday 13 July 2018**

Shannon A. Richard<sup>1</sup>, Eric A. Tillman<sup>2</sup>, Michael L. Avery<sup>2</sup> and M. Rockwell Parker<sup>1</sup>

<sup>1</sup>James Madison University, Harrisonburg, VA, USA. <sup>2</sup>USDA National Wildlife Research Center, Gainesville, FL, USA

### **Scent trailing behavior in male Burmese pythons**

Invasive species impacts have been abated through reproduction-focused interventions. The Burmese python (*Python bivittatus*) is an invasive predator in southern Florida that is accelerating the decrease in native vertebrate abundance. To reproduce, snakes use chemical signals to facilitate mate identification and location, especially via scent trailing. Little is known about this aspect of Burmese python biology in its invasive range, and the goal of this research is to investigate chemical communication in pythons at the behavioral level. Scent trails created by female and male Burmese pythons were tested in a Y-maze with wild-caught male pythons ( $N=6$  for female-only scent trials,  $N=5$  for male-only and male vs. female scent trials). Males consistently followed female scent trails when presented alone but did not follow male trails. Surprisingly, males did not select female scent trails when presented simultaneously with those of males, and male performance was worse in this trial (more exploration of the non-target arm). Chemosensory sampling (tongue-flick rate) was higher in female-only trails compared to the others, indicating discriminatory ability. Males also showed an array of behaviors in the Y-maze that we analyzed independently and with an ethogram. In general, behaviors were more frequent and complex when female scent was present compared to male. Because males follow female scent trails efficiently in isolation but not when the trailing environment becomes complex, strategies using mixtures of conspecific odors could be implemented to aid in management of this invasive predator.

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## **511 Lightning Talks III, Highland B, Sunday 15 July 2018**

Eric Rittmeyer and Sara Ruane

*Rutgers University - Newark, Newark, NJ, USA*

### **Biodiversity of Northern Isolate Squamate Populations in the New Jersey Pine Barrens**

The Pine Barrens of southern New Jersey is an unusual ecosystem, dominated by sandy-soiled pine and pine-oak forests, and acidic cedar swamps. These habitats have allowed numerous species distributed throughout the southeastern US to reach their northern distributional limit as isolated populations in this area. These include both habitat specialists and generalists, and species with diverse ecologies. We examine the degree of sandy habitat specialization in seven squamate species with this distribution by calculating the proportion of localities in sandy habitats and comparing this to a null distribution of availability for each species. We then use species distributional modeling to examine the potential distributions of each species and project these models onto paleoclimate layers to examine how distributions and connectivity may have changed over time. Finally, we also project these models onto future climate predictions to examine how distributions may have changed over time. We find that while all species were collected more frequently in sandy habitats, some species are found almost exclusively in these habitats, while others are found in sandy habitats no more frequently than random. Distributional models suggest species expanded rapidly northward over the past several thousand years, and that species are likely to continue expanding northward, but may retreat substantially in the southern portion of their range. These results emphasize the diversity of taxa that reach their northern limits in the Pine Barrens, as well as the need for increased conservation and monitoring to identify expanding populations in the north, and declining populations in the south.

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### **545 Herpetology Habitat & Environment, Highland A, Saturday 14 July 2018**

Nelson Rivera<sup>1</sup> and Brian Folt<sup>2</sup>

<sup>1</sup>*John Carroll University, University Heights, OH, USA.* <sup>2</sup>*Auburn University, Auburn, AL, USA*

### **Community assembly of glass frogs (Centrolenidae) in a Neotropical wet forest: a test of the river zonation hypothesis**

The river zonation hypothesis predicts that abiotic and biotic conditions along riparian gradients drive variation in animal communities. Glass frogs are a diverse group of Neotropical anurans that use riparian habitats exclusively for oviposition and larval development, but little is known about how glass frog communities are distributed across riparian gradients. Here, we measured glass frog community assembly across a gradient of riparian habitats from first- to fifth-order streams at La Selva Biological Station, Costa Rica. We performed repeated nocturnal frog calling surveys and built occupancy and *N*-mixture abundance models to test for varying

patterns of species occupancy, community assembly, species richness ( $\alpha$ -diversity) and species turnover ( $\beta$ -diversity). We observed significant differences in patterns of species occupancy and community assembly across a stream-order gradient: occupancy of two species increased with stream order (*Teratohyla pulverata*, *Hyalinobatrachium fleischmanni*), one species decreased (*Teratohyla spinosa*), and one species did not vary (*Espadarana prosoblepon*). We evaluated four a priori hypotheses describing how  $\alpha$ - and  $\beta$ -diversity of centrolenids are shaped across the riparian gradient; our data were most consistent with a pattern of nested assemblages and increasing species richness along the riparian gradient. Species-specific patterns of occupancy and abundance resulted in assemblage-level differences consistent with theoretical predictions for highly aquatic organisms along riparian gradients.

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**349 ASIH STOYE GENETICS, DEVELOPMENT, & MORPHOLOGY II, Highland C, Friday 13 July 2018**

Pedro Rizzato<sup>1</sup>, Flávio Bockmann<sup>1</sup> and Eric Hilton<sup>2</sup>

<sup>1</sup>Universidade de São Paulo/FFCLRP, Ribeirão Preto, SP, USA. <sup>2</sup>Virginia Institute of Marine Sciences, College of William & Mary, Gloucester Point, VA, USA

**Development of bones associated with lateral-line canals in *Acipenser fulvescens* and *Polyodon spathula* (Actinopterygii: Chondrostei: Acipenseriformes)**

In order to investigate the interrelationship between lateral-line canal and bone formation in Actinopterygii, we analyzed the development of bones associated with lateral line canals in representatives of the two extant families of Acipenseriformes (Actinopterygii: Chondrostei), the Lake Sturgeon, *Acipenser fulvescens* (Acipenseridae), and the North American Paddlefish, *Polyodon spathula* (Polyodontidae). Despite the morphological disparity between these families, we identified similarities in the characteristics of the lateral line and in the pattern of formation of bones associated with lateral-line canals. Both species share a high number of canal neuromasts and a very long infraorbital canal associated with the allometric elongation of the rostrum. We identified for the first time in *P. spathula* the lateral rostral canal bone, already known among sturgeons, hypothesized to be homologous to the antorbital of other actinopterygians. As in *A. fulvescens* and other acipenserids, the lateral rostral canal bone is among the first bones to form in the development of *Polyodon*. Finally, both species (especially *P. spathula*) are characterized by reduction of the skeleton, which is accompanied by a disassociation of the lateral-line canals from the dermal bones of the skull with which they are usually associated in actinopterygians. The condition of the lateral-line ossifications in acipenseriforms, therefore, provides support for the hypothesis of a two-component pattern of canal-bone morphogenesis in fishes.

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**350 ASIH STORER ICHTHYOLOGY, Empire Hall South – JF Rochester Riverside Convention Center, Friday 13 July 2018**

Pedro Rizzato<sup>1</sup>, Eric Hilton<sup>2</sup> and Flávio Bockmann<sup>1</sup>

<sup>1</sup>*Universidade de São Paulo/FFCLRP, Ribeirão Preto, SP, Brazil.* <sup>2</sup>*Virginia Institute of Marine Sciences, College of William & Mary, Gloucester Point, VA, USA*

## **A review on the lateral-line system of polypterids (Actinopterygii: Cladistii: Polypteriformes)**

The Polypteridae includes the African bichirs (*Polypterus* spp.) and the Ropefish (*Calamoichthys calabaricus*), fossils of the Upper Cretaceous of South America and Africa, and the Triassic 'scanilepiforms', recently interpreted as stem polypterids. The group is hypothesized to be the earliest diverging member of Actinopterygii, occupying a key phylogenetic position for understanding the evolution of bony fishes. A detailed and comprehensive understanding of their anatomy is, therefore, fundamental for the investigation of the anatomy and early evolutionary history of Osteichthyes. As part of a revisionary study of the anatomy of Polypteridae, we redescribe the laterosensory system of extant polypterids, including the number, distribution, and innervation of canal neuromasts (CNs) and lines of superficial neuromasts (SNs) in the head and trunk, the course of lateral-line canals, and the association of CNs with cranial bones. There are six lateral-line canals, identified according to their innervation by preotic and postotic lateral line nerves. The lateral line in the trunk is represented by three rows of lines of SNs innervated by branches of the posterior lateral-line nerve. The supraorbital line passes between the anterior and posterior nasal openings, a condition typical of non-teleostean actinopterygians, and there is a secondary connection with the infraorbital canal medial to the contralateral nares. The ethmoid commissure, another plesiomorphic feature of the lateral-line system of actinopterygians, is also present. The lateral line of polypterids is therefore characterized by the presence of many plesiomorphies and can be viewed as representative of a generalized ancestral condition of the lateral-line system of actinopterygians.

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**20 Ichthyology Biogeography, Grand Lilac Ballroom South, Saturday 14 July 2018**

D Ross Robertson

*Smithsonian Tropical Research Institute, Panama, Panama*

### **An Indo-Pacific damselfish in the Gulf of Mexico, 2018**

We present an overview of what is currently known about the Regal Demoiselle, *Neopomacentrus cyanomos*, which was first recorded in the southwest Gulf of Mexico (GoM) in 2013, and which is only the second alien, Indo-Pacific reef-fish to have become successfully established in the tropical northwest Atlantic. This overview includes information on its origin, mode and location of introduction; its current known distribution and what is known of the tempo of its spread in the GoM, the potential for spread beyond the GoM; its habitat usage on GoM coral and artificial reefs; the potential for adverse interactions with ecologically similar

native reef-fishes; and adult and larval-biology characteristics that may have contributed to its success in arriving, establishing and spreading.

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**347 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Elizabeth Rock, Jeffrey Bartman, Jamie Cornelius and Katherine Greenwald

*Eastern Michigan University, Ann Arbor, MI, USA*

**Effect of urbanization on stress response in Eastern Garter Snakes (*Thamnophis sirtalis*)**

Urbanization affects both abiotic and biotic components of the environment. Altering landscapes from natural states to urban states results in changes to microclimate, input of pollutants, and disruption of ecosystem function, all of which may increase stress on organisms persisting in these areas. Corticosterone (CORT) is a hormone produced in response to life history circumstances, daily demands, and stressful events. Chronic or long-term stress stimulus can alter the baseline status of CORT in the blood. This study will measure physiological stress response (CORT levels) and physical health metrics (body condition) in Eastern Garter Snakes (*Thamnophis sirtalis*) along an urban-rural gradient. *T. sirtalis* is a generalist species commonly found across the eastern United States in a variety of habitats, ranging from meadows to urban areas. We predict that snakes in urban areas will have increased CORT when compared to rural snakes through active seasons. We will also assess if the magnitude of this effect varies over time (e.g. decreased HPA axis sensitivity). We further predict that snakes in urban areas will have poorer body conditions than snakes in rural areas, as a reflection of this physiological response. Stress metrics of individual animals may be an indicator of how likely a population is to persist, which can inform our understanding of species living in urban environments.

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**309 Herpetology Conservation I, Grand Lilac Ballroom South, Friday 13 July 2018**

Maria Roe<sup>1</sup>, Jose Anadon<sup>1</sup> and Russell Burke<sup>2</sup>

<sup>1</sup>*Queens College, Flushing, NY, USA.* <sup>2</sup>*Hofstra University, Hempstead, NY, USA*

**Estimates of Adult Survival for Female Diamondback Terrapins in Adjacent Jamaica Bay Populations**

Jamaica Bay is inhabited by at least two populations of adult female Diamondback Terrapins (*Malaclemys terrapin*); one that nests at Ruler's Bar Hassock and another at John F. Kennedy airport, only 4.5km apart. Monitoring programs have been in place for years, but population

models are needed to support management programs. In addition, the effects of water quality, injuries, and climactic events like Hurricane Sandy (2012) need to be considered for this species which is vulnerable to urban development and climate change. We analyzed mark-recapture data using an age classified structure within the Cormack-Jolly-Seber model to account for transience. Apparent survival for resident females on Ruler's bar was high but declined from 0.951 to 0.869 over a 14-year period, while survival for JFK females was constant at an intermediate level. While the effect of water quality was not supported, the punctuated effect of Sandy showed support for a decline in survival in Ruler's Bar over a two-year period following the storm. Injuries were analyzed for Ruler's Bar using a multistratum approach to estimate survival and transition between minor and major injury states. Survival estimates for injury states were constant at 0.901 for individuals with minor injuries and 0.862 for major injuries. Results support a distinction in survival between the populations, and that individuals in Ruler's Bar exhibit lower survival after major injuries. Further investigation into environmental factors like marsh loss may be important in determining the cause of decline in survival in Ruler's Bar females and in promoting conservation measures.

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## **60 Amphibian Ecology I, Grand Lilac Ballroom North, Friday 13 July 2018**

Hilary B. Rollins and Michael F. Benard

*Case Western Reserve University, Cleveland, OH, USA*

### **Does shifting phenology early in ontogeny affect growth and development in subsequent stages?**

As global climate change alters environmental cues, phenological shifts early in ontogeny may alter timing and circumstances for all subsequent life history events. However, if organisms are able to compensate, an early shift may not affect later events. The energy to compensate for phenological shifts might require trade-offs between growth and development. Wood frogs (*Rana sylvatica*) have shifted their breeding two weeks earlier, on average, over the past century. To examine the effects of phenological shifts early in developmental on subsequent life events, we manipulated aquatic temperature to create egg masses that hatched early or late. At hatching, we transferred the larvae to mesocosms where we manipulated food availability to test for the effects of resources on developmental trade-offs. Eggs in the cool treatment hatched 6.5 days before eggs in the warm treatment. At metamorphosis, that difference had decreased to 0.5 days. Therefore, larvae from cooled egg masses had accelerated their developmental rate to "catch up" to warm egg masses by metamorphosis. Mass at metamorphosis was significantly affected by the interaction of egg temperature and larval resources such that frogs raised in the warm egg treatment with added larval food had the highest metamorphic mass. Our results suggest that larval wood frogs are able to compensate for delayed hatching. However, the aquatic temperature they experience as eggs and larval resource availability interact to affect size at metamorphosis. Organisms may be able to compensate for climate change induced phenological shifts early in development but those shifts may alter growth.

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**42 CHS: Effects of Climate Change Symposium, Grand Lilac Ballroom North, Friday  
13 July 2018**

Njal Rollinson<sup>1</sup>, Melanie Massey<sup>1</sup>, Jacqueline Litzgus<sup>2</sup> and Ronald Brooks<sup>3</sup>

<sup>1</sup>University of Toronto, Toronto, Ontario, Canada. <sup>2</sup>Laurentian University, Sudbury, Ontario, Canada. <sup>3</sup>University of Guelph, Guelph, Ontario, Canada

**Rapid Warming has Increased Growth, Development Rate, and Survival in  
Populations of Freshwater Turtles Near Their Northern Range Limit**

Southern Ontario is home to a diversity of Canada's turtle species. The region however is experiencing rapid warming, and few studies have investigated the long-term consequences of warming on turtle populations. Since the 1970s, we monitored populations of snapping turtles and painted turtles in Algonquin Park, Canada, near the northern range limit of each species. Our long-term data coupled with statistical models suggest advancement of spring reproductive phenology, faster rates of embryonic development in autumn, greater egg-hatching success, and faster juvenile growth rates. There have been no apparent changes in primary sex ratios, and no changes in the timing or duration of the thermosensitive period of embryonic development. Our data suggest that, so far, rapid warming has not had negative consequences on the turtles we studied, as growth and early-life survival have both increased in recent years.

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**37 Herpetology Conservation IV, Highland C, Sunday 15 July 2018**

Jonathan Rose, Michael Casazza, Glenn Wylie and Brian Halstead

USGS Western Ecological Research Center, Dixon, CA, USA

**Focusing Research and Conservation Through Modeling: Building a Demographic  
Model for the Giant Gartersnake, *Thamnophis gigas***

Demographic population models are valuable tools for studying life-history and targeting conservation efforts to sensitive life stages. Demographic vital rates are often size-dependent in reptiles, so Integral Projection Models (IPM), which allow vital rates to be continuous functions of a state variable, are well-suited to modeling reptile populations. We developed an IPM for the threatened Giant Gartersnake (*Thamnophis gigas*) and used elasticity analysis to identify vital rates and life-stage transitions that have a large effect on the population growth rate. We used data on the growth, survival, and reproduction of Giant Gartersnakes collected from several populations over more than 20 years to estimate continuous functions that describe how snake size affects these vital rates. We found the growth rate of Giant Gartersnake populations was most influenced by the survival and growth of adult females, and the size at which one year old

snakes recruit to the modeled population. The probability of snakes surviving their first year remains an important unknown, but is less influential on population growth than the size of surviving one year olds. Despite their large size, the life-history of Giant Gartersnakes is similar to many other gartersnake species, with rapid growth, early maturity, and relatively low adult survival. Linkages between key vital rates and environmental factors are largely unknown, and identifying actions to improve population growth will be key to this species' persistence. The model-building process itself was valuable because it focused our research priorities and highlighted important knowledge gaps for this threatened snake.

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### **373 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Zachary Ross<sup>1</sup>, Michael Jungen<sup>1</sup>, John Holloway<sup>2</sup>, Shane Welch<sup>1</sup> and Jayme Waldron<sup>1</sup>

<sup>1</sup>Marshall University, Huntington, WV, USA. <sup>2</sup>Marine Corps Recruit Depot Parris Island NREAO, Parris Island, SC, USA

#### **Maximizing the efficacy of eastern diamondback translocation to minimize human-snake interactions.**

The eastern diamondback rattlesnake (*Crotalus adamanteus*; EDB) is a large-bodied, venomous reptile that suffers from large-scale habitat loss and fragmentation. For herpetofauna, movement through anthropogenic habitats is typically reduced as costs of movement become prohibitive. Human-rattlesnake interactions that occur as EDBs move through anthropogenic landscapes often result in the snake's death due to inflated risk perception and misconceptions about EDBs. Translocation is the primary tool used to manage human-snake interactions; however, it is often performed without regard to the snake's home range. The post-translocation behavior of snakes is characterized as erratic, often increasing exposure to anthropogenic environments. Research indicates that these erratic post-translocation movements can be largely attributed to homing instincts within a novel landscape. Here, we examine how distance affects the efficacy of translocation regarding human-snake interaction. Rattlesnake response to two different scales of intra-installation translocation, intra- and extra-home range, was assessed using radio telemetry. Previous studies indicate that extra-home range translocations will result in a higher potential for human-snake interactions than intra-home range translocations. The potential for human-snake interaction is determined using a modification of cost distance analysis. The post-translocation movement patterns of free-ranging telemetered snakes are cross-referenced with a landscape classified for human use. Habitats likely to represent higher risk of human-snake interactions such as roads and mowed areas are assigned higher cost scores than low-risk areas. This study will provide a greater understanding of EDB movement ecology following translocations, a critical component to EDB conservation and maximizing the efficacy of translocation techniques.

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**598 Poster Session II, Empire Hall South – JF Rochester Riverside Convention Center, Saturday 14 July 2018**

John Rowe, Chelsea Martin, William Mulligan and Tyler Goerge

*Alma College, Alma, MI, USA*

**Spatial and Thermal Ecology of Snapping Turtles (*Chelydra serpentina*) in a Mid-Michigan Lake and its Associated Wetlands**

Over a three year period, we studied the spatial ecology of Snapping Turtles (*Chelydra serpentina*) in a dystrophic lake with northern wetland margins in central Michigan. Thermally-sensitive radio-transmitters were implanted in the body cavities of four male and two female individuals although one female died early in the study. Turtles remained in the lake throughout the summer months where they established multiple core areas along the littoral shelf. Remotely monitored hourly body temperatures ( $T_b$ ) cycled daily with the lowest values occurring during late morning (0900 – 1200 h) with a peak  $T_b$  during the evening (2000 – 2200 h). Turtles generally maintained their  $T_b$  throughout the day within a laboratory determined thermoregulatory set-point (21 – 26 °C). Operative temperatures measured by aluminum turtle replicas placed on the surrounding *Sphagnum* mat and by submerged thermal data loggers indicated that turtles likely remained mostly aquatic throughout the day, perhaps using warm surface water late in the day. Individual turtles showed strong fidelity to overwintering locations that were peripheral to the lake either in adjacent *Sphagnum* mounds or in a stream.

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**245 SSAR VICTOR HUTCHISON STUDENT POSTER AWARD: ECOLOGY, NATURAL HISTORY, DISTRIBUTION & BEHAVIOR, Empire Hall South – JF Rochester Riverside Convention Center, Friday 13 July 2018**

Ethan Royal<sup>1</sup>, John Willson<sup>1</sup> and Jessica Homyack<sup>2</sup>

<sup>1</sup>*University of Arkansas, Fayetteville, Arkansas, USA.* <sup>2</sup>*Weyerhaeuser Company, Tacoma, USA*

**Effects of forest management on habitat structure and upland pine-associated herpetofaunal communities**

Longleaf pine (*Pinus palustris*) savannah once covered much of the southeastern Coastal Plain and was characterized by open canopy, diverse herbaceous vegetation, and high amounts of bare soil. The unique structural and vegetative conditions of this habitat type support many endemic species, including several reptiles and amphibians. Managed pine (*Pinus* spp.) stands now occur throughout the southeastern U.S. and have replaced much of the historic longleaf pine savannah. These managed stands have been shown to provide suitable habitat conditions for some open canopy-associated wildlife species if certain structural characteristics are maintained. However, little work has examined herpetofaunal communities. Using repeated, low intensity herpetofauna surveys and vegetation surveys, we assessed the ability of managed pine stands in sandy soil regions of Northwestern Louisiana to support open pine-associated herpetofauna. We selected 81 sites across 7 management regimes: mechanically managed young and thinned mid-age loblolly pine (*P. taeda*) stands, fire-maintained young, mid-age and mature longleaf stands, and fire-maintained mid-age and mature loblolly stands. We deployed

coverboards and performed repeated visual encounter surveys at each site over two field seasons. We also quantified vegetation characteristics including canopy cover, overstory, midstory, understory, and groundcover. Preliminary results suggest that young stands and some mid-age fire-maintained sites most closely resembled open-canopy, fire-maintained mature pine stands in vegetation characteristics and herpetofaunal community composition. Some closed-canopy mature sites supported the most diverse herpetofauna communities, but lacked upland pine associated species. Our results provide insight into how forest management practices affect herpetofaunal communities and will help guide management strategies.

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## **88 Lightning Talks I, Grand Lilac Ballroom North, Thursday 12 July 2018**

Sara Ruane

*Rutgers University-Newark, Newark, NJ, USA*

### **Training YOUR Dog for Snake Detection!**

Dogs are frequently used for a variety of tasks that rely on their superior sense of smell, including bomb, drug, and cadaver detection. Wildlife detection dogs have become popular in many biological study systems, being used primarily to find animal scat but also for tracking and finding live animals. Within herpetology, turtle detecting dogs are somewhat well known, and snake dogs are becoming more popular, especially for indicating the presence of endangered species (e.g., Indigo snakes). Here, I explain and discuss the how-to of training a dog for snake detection, based on my experiences training my own dogs.

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## **619 Poster Session II, Empire Hall South - JF Rochester Riverside Convention Center, Saturday 14 July 2018**

Leah Rubin<sup>1</sup> and Elizabeth Sibert<sup>2</sup>

*<sup>1</sup>College of the Atlantic, Bar Harbor, ME, USA. <sup>2</sup>Harvard Society of Fellows and Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA*

### **Evidence for a Shark Extinction 20 Ma Using Morphometric Analysis of Dermal Denticles**

Sharks are an important part of marine ecosystems but are increasingly at risk of extinction due to anthropogenic stressors of global climate change and overfishing. The abundance and diversity of sharks has changed over their nearly 400 million year history. Recent work has revealed a decline of elasmobranch denticles preserved in open ocean marine sediments at approximately 20 million years ago (Ma), going from ~20% of all vertebrate microfossils to <1%. However, the nature of this decline is poorly understood, and does not correlate with any known major climatic changes, nor other mass extinction events. We examine the morphological diversity of sharks before and after this significant decline using microfossil dermal denticles extracted from a sediment core from the South Pacific Gyre. We developed a novel character coding scheme with 20 categories to quantify the morphological disparity of 550

individual denticles within the sediments, ranging in age from 1.4 to 41.5 Ma. Additionally, 124 modern shark species' denticles were coded to create a modern catalog of shark denticle diversity. Groupings were made broadly into geometric and linear denticles and analysis displays a dramatic decrease in the geometric type. These results expose a possible selective extinction which has yet to be described and could be the result of changing ocean conditions and thus an increase in competition with other large migratory predators. Our analysis highlights 20 Ma as a potential tipping point in open ocean ecology, and demonstrates the utility of the microfossil record in elucidating changes in deep time.

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### **302 ASIH STOYE PHYSIOLOGY & PHYSIOLOGICAL ECOLOGY, Highland D, Friday 13 July 2018**

Holly R. Rucker and M. Rockwell Parker

*James Madison University, Harrisonburg, VA, USA*

#### **Decrypting female mimicry in red-sided garter snakes**

Female sexual mimicry, the expression of female sexual signals by males, is a reproductive tactic that occurs in a wide range of species. Chemical cues, such as pheromones, are utilized by many species as sexual signals driving mate choice. There is only one example of chemical female mimicry in vertebrates: the red-sided garter snake, *Thamnophis sirtalis parietalis*. Female mimics in this species are males that produce female sex pheromones and are courted by other males. These female mimics have undetectable estradiol levels but elevated testosterone compared to normal males. Conversely, estradiol is necessary for females to produce the sex pheromone. Central to this is the link between estradiol and testosterone: testosterone is metabolized to estradiol via the enzyme aromatase. Female garter snake mimics are hypothesized to have higher expression of aromatase in their skin which would create estradiol locally to stimulate female pheromone production. Our project is the first empirical test of this hypothesis. Female mimics (n=20), males (n=20), and females (n=20) received injections of an aromatase inhibitor, fadrozole (FAD), or control injections (saline; SHAM) three times a week for three months. Skin lipids were extracted and fractionated from the shed skins of these snakes, and blood samples were collected to determine circulating hormone concentrations. We hypothesize that FAD treatment will prevent the production of female pheromone in the mimics and females, and if so will demonstrate that aromatase action is the key to female mimicry in garter snakes.

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### **321 SSAR SEIBERT CONSERVATION II, Highland B, Thursday 12 July 2018**

Lacy Rucker<sup>1</sup>, Thomas Pauley<sup>2</sup>, William Sutton<sup>3</sup> and Donald Brown<sup>1,4</sup>

<sup>1</sup>West Virginia University, Morgantown, WV, USA. <sup>2</sup>Marshall University, Huntington, WV, USA. <sup>3</sup>Tennessee State University, Nashville, TN, USA. <sup>4</sup>USFS Northern Research Station, Parsons, WV, USA

## **Occupancy Dynamics of Two Terrestrial Salamanders over 30 Years in Relation to Habitat Degradation and a Short Elevation Gradient**

Amphibians are declining globally and while many factors are contributing to this decline, climate change and habitat loss and degradation are among the most critical. In the Appalachian region, plethodontid salamanders are thought to be particularly vulnerable to environmental changes due to their low vagility, and for many species, restriction to high elevations. Further, interspecific competition at high elevations could increase as the climate warms and becomes more suitable for lower elevation species. This is a concern in West Virginia, where competitive interactions between the federally-threatened Cheat Mountain Salamander (*Plethodon nettingi*; CMS) and the Eastern Red-backed Salamander (*Plethodon cinereus*; ERB) could increase at high elevations. We investigated spatial and temporal patterns in occupancy of CMS and ERB along a habitat degradation (i.e., forest clearing) and short elevational (i.e., 1193-1251 m) gradient using 30 years of population survey data (i.e., 1986-2016) at 43 survey plots. For each species, we used dynamic occupancy models to identify and model influential covariates for initial occupancy, colonization, and extinction at sites, and for survey detection probability. Preliminary results indicate that colonization and extinction was not strongly related to elevation for either species. However, habitat degradation was positively correlated with extinction for CMS and ERB, with stronger impacts on CMS. Our results indicate that forest clearing in CMS habitat can negatively impact their occurrence in adjacent forested habitat.

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**502 ASIH STOYE GENERAL HERPETOLOGY, Highland C, Friday 13 July 2018**

Ariana Rupp and Brad Moon

*University of Louisiana Lafayette, Lafayette, LA, USA*

## **Prey Handling and Feeding Mechanisms in Mud Snakes (*Farancia abacura*)**

Feeding on elongate prey occurs in many vertebrates, including snakes. However, few publications have addressed the complexity of consuming elongate vertebrate prey. Some snakes can consume prey just as long, and sometimes longer, than themselves, although doing so takes considerable time and effort. Mud Snakes, *Farancia abacura*, are thought to be specialist feeders on elongate prey. This diet makes Mud Snakes a useful model for understanding how snakes consume elongate prey. Mud Snakes are widespread and abundant but secretive and difficult to find in large numbers for research, which has limited research on this species compared to other widespread snakes. We have recorded videos of Mud Snakes feeding on amphibians in order to describe and quantify the capture and consumption of elongate prey. From these video data, we have identified variation in prey handling in Mud Snakes of different

size classes and on different prey items. We have also studied retention of ingested prey to identify prey size limits for digestion. This research also includes the first quantitative data on feeding in hatchling Mud Snakes.

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## **516 ASIH STORER HERPETOLOGY, Empire Hall South - JF Rochester Riverside Convention Center, Friday 13 July 2018**

Ariana Rupp<sup>1</sup>, Dustin Siegel<sup>2</sup>, Stanley Trauth<sup>3</sup> and David Sever<sup>4</sup>

<sup>1</sup>University of Louisiana Lafayette, Lafayette, LA, USA. <sup>2</sup>Southeast Missouri State University, Cape Girardeau, MO, USA. <sup>3</sup>Arkansas State University, Jonesboro, AR, USA. <sup>4</sup>Southeastern Louisiana University, Hammond, LA, USA

### **Junk in the Trunk: Caudal Courtship Glands in Plethodontid Salamanders**

Salamanders in the family Plethodontidae exhibit a unique tail-straddle walk during courtship that can include the use of sexually dimorphic mental glands and caudal courtship glands. Mental glands are found in the skin of the lower jaw and have been extensively studied and caudal courtship glands are found in the skin of the dorsal base of the tail in some male plethodontids and remain comparatively understudied. Both are thought to increase female receptivity during courtship, although there is only published evidence for this in mental glands. Prior to this research, only the male morph A specimens of *Eurycea wilderae* were known to have caudal courtship glands without the presence of mental glands. We conducted a histological analysis of museum specimens from several genera not previously studied for presence or absence of these caudal courtship glands. We present novel data on the presence of caudal courtship glands in *Hemidactylium*, *Gyrinophilus*, *Pseudotriton*, *Stereochilus*, *Hydromantes*, *Bolitoglossa*, and *Pseudoeurycea*. Notably, we have also examined the dorsal base of the tail in *Rhyacotriton*, and have not detected the presence of caudal courtship glands, which may indicate that the tail-straddling behavior evolved in *Rhyacotritonidae*, prior to the seemingly universal presence of these glands in Plethodontidae. These morphological data indicate the importance of caudal courtship glands in Plethodontidae and may be useful in understanding potential reproductive isolation via pheromone evolution that might have aided in a radiation of plethodontids.

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## **571 Lightning Talks II, Highland A, Saturday 14 July 2018**

Trevor Ruppert and Robert Espinoza

California State University Northridge, Northridge, California, USA

### **Identifying the Physiological Limitations of Dispersal and Persistence of an Invasive Amphibian (*Xenopus laevis*) in Southern California**

Invasive species are detrimental to native ecosystems and, once established, are challenging and costly to manage. Modeling approaches are widely used preventative management tools for identifying potential habitat in uninvaded regions. However, most such models are limited by their correlative approaches. Recently, mechanistic (physiological) approaches have emerged as more effective management tools for defining niches of invasives. In Southern California, releases of the African Clawed Frog (*Xenopus laevis*) threaten native frogs across their invasive range. Once imported for use in human pregnancy tests, the advent of chemical tests resulted in the release of thousands of these aquatic frogs in the 1960s, which quickly spread throughout Southern California. These pond dwellers eat any animal they can swallow, including conspecifics, and are resistant to traditional methods of extermination (poisoning, habitat drying, prolonged starvation). Yet despite characterization as “perfect” invasive species, *Xenopus* have not achieved their anticipated invasive potential in California. In fact, some populations have gone extinct, or where they persist, occur in low numbers. The aim of our project is to determine which aspects of the biology of invasive populations of *Xenopus* have allowed some to persist, while others failed. Using the strong inference approach, we will inductively ascertain the physiological factors that limit the persistence and dispersal of *Xenopus* in Southern California. We hypothesize that a specific suite of biotic and abiotic variables (hydroperiod, predators, distance between habitat) limits this species from invading and establishing at new sites, and that lab-based physiological tests will provide confirmation of our field-based correlations.

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