



JMIH 2024

JOINT MEETING OF ICHTHYOLOGISTS AND HERPETOLOGISTS

10-14 July 2024 • Pittsburgh, PA

ABSTRACT BOOK



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Abstracts

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Abstract Book

4.5 | Fungal Microbiome Associated with the Puerto Rican Boa (*Chilabothrus inornatus*; Reinhardt, 1843)

Jacob Adam, Eneilis Oliveras, Gualberto Rodriguez, Alberto Puente-Rolon, Timothy Colston

419 Microbiomes found living on, or inside vertebrate hosts, are widely known to impact a suite of traits related to their host's fitness, such as immune response, development, reproduction, and host community assembly. Reptiles are among the least studied vertebrate groups regarding their associated microbes, resulting in very little knowledge of their fungal microbiome. The Puerto Rican Boa (*Chilabothrus inornatus*) is listed as an Endangered Species under the Endangered Species Act of 1973 and an iconic Puerto Rican endemic. We characterized the fungal microbiome of the Puerto Rican Boa (via culture and molecular techniques using samples collected from caves in Arecibo, Isabela, Cabo Rojo, Aguadilla and Hatillo s. By cataloging the fungal microbiome of the species, we can begin to understand the diversity of the microbiome of this endangered species and survey the distribution of invasive fungal pathogens, such as *Ophidiomyces ophidiicola*, the causal agent of Snake Fungal Disease (SFD). Snake Fungal Disease has recently been detected on the island of Puerto Rico and could pose another major threat to the already small population of *C. inornatus* found on the island and for the populations associated with caves. This study includes targeted sequencing of fungal isolates, and metabarcoding of skin and soil communities for both fungal and bacterial identification.

P2.43 | Alligator Snapping Turtle eDNA Detectability Across a Temporal Scale

Cory Adams, James Childress, William Lutterschmidt, Daniel Saenz, Christopher Schalk, Kyra Woytek

130 The alligator snapping turtle (*Macrochelys temminckii*) is a large freshwater turtle native to the southeastern United States and, due to declining populations, it is being proposed for federal listing as Threatened under the Endangered Species Act. Current information on the status, distribution, and abundance of alligator snapping turtles is lacking, making the development of a comprehensive conservation plan difficult. Development of management actions is dependent on reliable methodologies that can quantify the presence of alligator snapping turtles. Recent work has shown that alligator snapping turtles can be detected using environmental DNA (eDNA). However, variation in detection outcomes has made the reliability of this method unclear. We sought to evaluate the temporal variation of detecting alligator snapping turtle eDNA across lentic and lotic aquatic systems. To test this, we surveyed 10 sites of known occupancy (5 lentic and 5 lotic), monthly, by collecting 3L of water per site to test for eDNA. We also collected environmental variables of water quality at each sample location which included dissolved oxygen, water temperature, pH, conductivity, total dissolved solids, turbidity, salinity and flow rate. Preliminary results indicate that alligator snapping turtle eDNA is more likely to be detected in lotic systems. Further, the probability of detecting snapping turtle eDNA may be affected by environmental variables and vary annually. Continued work is necessary to refine this technique before it can become a useful tool for natural resource managers.

25.10 | Monitoring egg fertility, embryonic morbidity, and mortality in an oviparous elasmobranch using ultrasound

Lance Adams, Jennifer Wyffels, Brittney Goodwin, Rachel Munson, Kevin Feldheim, Kady Lyons

505 Ultrasound has been used to estimate fecundity in both viviparous and oviparous species, negating the need for lethal sampling which is problematic for those of conservation concern. Currently, a multi-institutional effort is underway to re-wild the endangered Zebra Shark (*Stegostoma tigrinum*) to locations where this species has been previously extirpated by leveraging aquarium collections as a source of brood stock. However, while Zebra Sharks are fecund, a large percentage of yolked eggs degrade or spoil within the first few weeks post-oviposition. Therefore, ultrasonography represents a

potential tool that could be used to both accurately distinguish fertile from non-fertile eggs and to diagnose changes in early embryonic development predictive of poor outcomes. Freshly laid eggs from four female Zebra Sharks were collected by aquarists daily from two enclosures at Aquarium of the Pacific. Eggs were incubated undisturbed for two or three weeks at 23.8 – 25 °C and then underwent weekly exams via ultrasound to monitor embryo development. Eggs were evaluated for: yolk integrity, egg case fluid homogeneity and embryo morphology. Abnormalities were observed in the majority of samples ($n = 69$, 67%) as early as 16 days to 93 days post-oviposition. Common abnormalities included: bent or curled tails, anechoic fluid pockets forming at the attachment of the yolk stalk to the yolk, and sluggish movement. Ultrasonography was found to be an effective and non-invasive method to determine egg fertility, identify embryos with developmental abnormalities and track growth rates.

6.6 | Finding Nemo in the Pelagic Realm: A Novel Fish-Anemone Association Lost in Open Waters

Gabriel Afonso, G. Johnson, Richard Collins, Murilo Pastana

261 The movie Finding Nemo popularized the complex relationship between the Clownfish and sea anemones and brought attention to the association between these species. Up to date, six other percid fish families (i.e., Apogonidae, Labridae, Cirrhitidae, Chaetodontidae, Clinidae, Hexagrammidae) also associate with benthic anemones for sheltering and protection. Blackwater Diving, famous for its astonishing photographs in social medias, brought attention to the association between fishes and invertebrates in its first life stages, previously hidden in plain sight in the water column. The visual records of this still obscure micro universe of small drifting creatures can provide scientists with new information about the early life history of marine species, difficult to reach with conventional collection and preservation methods. Here, we describe the first recorded association between fishes and anemones in open epipelagic waters, extending the relationship between members of these groups previously known only to the benthos. In situ observations and photographs of juvenile fishes of the families Ariommatidae, Bramidae, and Carangidae document their association with the pelagic phase of the anemones of the subclasses Ceriantharia and Hexacorallia. We illustrate and describe the differences in behavior of each fish family associated with the anemones and the implications of its morphology to the association. The association may increase the chances of survival of fish specimens at the open epipelagic waters while presenting limited locomotion and defense mechanisms. This finding highlights the importance of community science in advancing our knowledge of the life history of marine species.

12.1 | Movement of Amphibians in a Habitat Mosaic of Agriculture Landscape

Waseem Ahmed, Muhammad Rais, Ayesha Akram, Muhammad Saeed

302 Information on responses of amphibian species to short term changes or disturbance in their habitats, such as agricultural activities is scarce. We conducted the present study to see if the movement of amphibians differ in accordance with snout-vent length, seasons (pre-harvesting, post-harvesting and during harvest) and availability of other nearby habitats (open space, wetlands, forest) around croplands. Of the studied two toad species, *Duttaphrynus stomaticus* (0-86 m, 6.02 ± 0.93 m) showed highest movement followed by *D. bengalensis* (0-65, 4.34 ± 0.75). Among frog species, *Minervarya pierrei* showed highest movement (3-20, 9.18 ± 1.13), *Euphlyctis* spp. (0-7.5, 1.25 ± 0.20), and *Microhyla nilphamariensis* (0-9, 3 ± 0.68). Our data on movement (pooled for seasons and habitats) revealed that the movements in the studied species were statistically alike. We found statistically significant difference in the distance covered by *D. bengalensis*, *D. stomaticus*, and *Euphlyctis* spp. among the studied habitats. Our results showed statistically significant difference in the distance covered by *D. stomaticus* during the three seasons with higher movement during the harvesting season. We found statistically significant effect of season on the movement of *D. stomaticus*, of habitats on *D. bengalensis* movement and of snout-vent length on *Euphlyctis* spp.

movement while none of the studied variable had any effect on the movement of *M. pierrei* and *M. nilphamariensis*. Our findings show that anuran species from these families move to different nearby habitats, such as uncultivated land, forest patch, and wetlands, within the landscape in response to any disturbance or degradation such as harvesting of the crops.

P1.73 | Speculate Land Use and Land Cover Changes for Eco Mozaic Region of Pakistan Using QGIS MOLUSCE Plugin.

Waseem Ahmed, Muhammad Rais

308 Remote sensing and GIS tools are essential for understanding environmental dynamics and fostering sustainable urban development for biodiversity conservation. This study employed Landsat satellite imagery from 2005 and 2022, with a 17-year interval, alongside a CA-ANN approach within the MOLUSCE plugin of QGIS, to model spatiotemporal land use and land cover (LULC) changes in Rawalpindi and Islamabad. In 2005, barren land dominated, followed by vegetation cover, urban land, and water, with road networks observed to decrease. By 2022, there was a notable shift with an increase in water and urban land and a decrease in vegetation and barren land, along with an expansion of road networks due to increased development. Over the 17-year period, water area, urban land, and vegetation increased, while barren land decreased. The accuracy of LULC maps for 2005 and 2022 was 80% and 60% respectively, with substantial Kappa statistics. The study identified five sites hosting endemic, rare, and common anuran species, noting that road network expansion by 2022 caused severe habitat fragmentation, impacting amphibian habitats. Using CA-ANN, future LULC for 2030 was predicted, showing a decrease in barren land and increases in water, vegetation, and urban land, with validation indicating accurate model performance. The projection for 2030 highlighted further road network expansion, exacerbating habitat fragmentation and posing a significant threat to local amphibian populations. This study underscores the role of remote sensing and GIS in monitoring and predicting environmental changes, crucial for urban planning and biodiversity conservation. Urgent sustainable development strategies are needed to mitigate habitat fragmentation and protect vulnerable species in rapidly urbanizing areas like Rawalpindi and Islamabad.

Keywords: Habitat Fragmentation, Amphibians, Landsat, Remote sensing, GIS.

2.2 | Documenting Darter Diversity: Systematic Evaluation of *Etheostoma duryi*, Blackside Snubnose Darter, and *Etheostoma flavum*, Saffron Darter (Percidae)

Hannah Alloway, Benjamin Keck, Thomas Near, Rebecca Blanton

200 *Etheostoma duryi* occurs in streams across the Tennessee River. Its sister species, *E. flavum*, is largely restricted to the Cumberland River, but occupies several streams in the Tennessee River, where it may co-occur with *E. duryi*. Whether *E. duryi* and *E. flavum* are reciprocally monophyletic or hybridize in contact areas has not been tested. For both species, we assessed geographic variation in morphology using scale and fin-element counts and evaluated their monophyly and phylogeographic relationships using Cytochrome b and ddRAD sequencing. Each species was monophyletic with no evidence of interspecific hybridization. We recovered four geographically definable clades for *E. duryi*: (1) Shoal Creek, (2) Elk River + Duck River, (3) Sequatchie River + Emory River, and (4) all other Tennessee River systems; two clades were recovered for *E. flavum*: (1) Cumberland River and (2) Tennessee River#_msocom_2#_msocom_3. We found low levels of morphological variation among clades, but shifts in mean values were noted for some. The phylogeographic relationships observed for *E. duryi* are largely consistent with historical isolation of the upper, middle, and lower Tennessee River; while the sister relationship between Duck and Elk River *E. duryi* may be explained by headwater stream capture. Divergence in *E. flavum* is consistent with isolation across the Cumberland-Tennessee drainage divide. Our results suggest possible cryptic diversity in each species. However, additional species delimitation approaches and clade divergence time estimations are ongoing to better understand the taxonomic implications of our work and describe historical events that have shaped species diversification.

P1.65 | The Lateral-Line Canals of the Big Africa Catfish Clade: Amphiliidae, Auchenoglanididae, Claroteidae, Lacantuniidae, Malapteruridae, Mochokidae and Schilbeidae (Ostariophysi: Siluriformes)

Malu Almeida, Flávio Bockmann, Mark Sabaj

309 The mechanosensory lateral-line system plays a central role in the behavior of most fishes. Neuromasts, the functional units of the system, may be present inside canals (canal neuromasts) or on the skin surface (superficial neuromasts) on the head and trunk. The lateral-line canal system has proven to be a valuable source of characters for taxonomic and phylogenetic studies. However, the lateral-line canals of several fish groups, including some catfishes, are largely unknown. One of the poorly studied groups regarding this morphological complex is the so-called 'Big Africa clade', an assemblage composed of Amphiliidae, Auchenoglanididae, Claroteidae, Malapteruridae, Mochokidae and Schilbeidae, all endemic to Africa, plus Lacantuniidae, which is restricted to Central America. The general pattern of lateral-line canals in this clade was investigated in specimens of different preparations deposited in the fish collection of the Academy of Natural Sciences of Drexel University (ANSP). We described the lateral-line canals in members of the 'Big Africa clade', and discovered striking variation within: 1) number of canal segments in the frontal and mandibular portions of the supraorbital and preoperculo-mandibular canals, respectively; 2) presence of an interorbital connection; 3) presence of a membranal portion in the trunk canal; 4) presence of multiple tubes and pores. A well-conserved canal-bone association was found, with small variations in the presence of tubular ossifications of the supra- and subpreopercule, and in the presence of the extrascapular bone. All the information surveyed is being incorporated into a broader analysis that includes all catfish families.

P1.77 | Populations Genetics of Connecticut's Mudpuppy, *Necturus maculosus*

Sarah Anacleto, Dennis Quinn, Michelle Kraczkowski

367 The Mudpuppy, *Necturus maculosus*, is a fully aquatic salamander distributed from the southeast United States, north to Quebec and west to North Dakota, with evidence of two dominant lineages present east and west of the Mississippi River. It was believed to be introduced in locations in southern New England, but little work has been done to study its origins in the state of Connecticut. Due to its rare habitat dependency and uncertainty of its origins, the state lists it as a Species of Special Concern. A determination of the origins of this salamander for the two watersheds it inhabits in the state was warranted. Our study sampled across the Connecticut and Housatonic watersheds for a total of 55 specimens examined. Analyses have found genetically distant populations with significant morphological difference in mass(g)/length(cm). When compared to data from outside of the state, most Connecticut specimens showed genetic similarities matching Mudpuppies west of the Mississippi, with multiple human-caused introductions likely. However, the Connecticut River also contained the eastern dominant lineage, leading to continued uncertainty of "introduced vs native" designation in that watershed. These results may be helpful for assessment of this and other species' listing status, which may help direct decision-making and resources appropriately.

11.9 | Preliminary Analysis of Blacknose Shark (*Carcharhinus acronotus*) Age, Growth, and Maturity in the Northern Gulf of Mexico

Alena Anderson, John Carlson, Ashley Dawdy, Danielle McAree, J Drymon

103 The blacknose shark, *Carcharhinus acronotus*, is a small coastal shark found in the western Atlantic Ocean from Virginia to Brazil, including the Gulf of Mexico (GoM). Like other coastal sharks in the western Atlantic, blacknose sharks experienced historic overfishing throughout the 1970s and 1980s. The GoM blacknose shark stock status is currently unknown; however, studies have observed that GoM blacknose sharks have not shown signs of recovery, primarily due to susceptibility as bycatch. Although studies have evaluated the age, growth, and maturity of blacknose sharks throughout their range, the most recent study in the GoM used samples collected two decades

ago, and updated data are needed to better understand the current population dynamics of the stock. Therefore, the objectives of this study are to 1) determine the sex-specific and overall growth parameters of GoM blacknose sharks and 2) determine the size and age at maturity of GoM blacknose sharks. From 2000 to 2023, blacknose sharks ($n = 182$) were collected from the northern GoM via bottom longline and gillnet surveys. A section of vertebrae was extracted from each fish for aging. Blacknose sharks ranged in size from 36-114 cm fork length, with females significantly larger than males ($p = 0.005$). The male-to-female ratio was 1.3:1 and did not significantly differ from a 1:1 ratio ($X^2 = 3.147$, $df = 1$, $p = 0.076$). This study is necessary for evaluating the health of the GoM blacknose shark stock and informing effective management measures that ensure population sustainability.

11.4 | Assessment of predator-prey interactions using technology: a case study on calling anurans and raccoons

Thomas Anderson, Kasey Nowell

190 In situ observations of predation events on many amphibians are complicated by their nocturnal activity periods and relatively small size, with most evidence coming from anecdotal observations. Technological advances have increased our ability to monitor wildlife, including herpetofauna. These improved methods may increase our ability to infer and understand species interactions, albeit indirectly, by examining periods of spatiotemporal overlap. We tested whether raccoon (*Procyon lotor*) activity at two constructed wetlands increased with higher levels of anuran calling intensity. We paired wildlife trail cameras to monitor mammal activity with automated recording devices (Audiomoths) over the course of the entire 2022 breeding season. Trail camera photographs were identified and catalogued using the Wildlife Insights platform, while Audiomoth recordings (seven 2-min recordings per day between 20:00 and 02:00) were manually listened to by observers. Calling indices for each frog species were tabulated to qualitatively assess breeding chorus size. Overall, we found limited relationships between the number of raccoons photographed and the calling indices across all frog species, using either hourly data or daily data. Future work is investigating raccoon activity around specific-specific patterns of calling, in case these predators target only certain anuran species more than others.

17.4 | The Latin-American Aquariums' Perspective of the Sharks and Ray research-conservation programs

Federico Argemi

128 Chondrichthyan species are well-represented in marine and freshwater environments of Latin America, with over 400 known species. These species have cultural, ecological, social, and economic relevance given their role in ecosystem functioning and as key resources for fisheries, tourism, science, and other activities specific to each country. Still, just a few conservation programs are being conducted in the region. Not too far, the relations between science and aquariums presented a little disconnection, a large number of zoos and aquariums are represented by government institutions and they had the perspective they were being created just as institutions to show animals. ALPZA, AZA, and WAZA have contributed to changing this paradigm, generating the professionalization of the institutions and creating a conservation culture in the industry. The Latin-American Aquariums have just a few numbers of these species under professional care, the most well-known and common species like sand tiger, nurse sharks, bamboo, horn sharks, and broadnose seven gills, and orders like Myliobathis, Dasyatis, and Potamotrygon of ray/stingray, but with a huge potential. Today's research importance is understood and is involved daily in the aquarium operations, water quality, animal well-being, reproduction, and animal husbandry are some of our goals. Brazil and Argentina are leading the aquarium shark/ray research, and is very important to show the works on cryo-conservation, stress evaluation, and translocation projects. The governments, universities and the public in general must understand and support the aquarium's actions and let them think the aquariums are just a simple animal exploitation business.

P1.84 | Changes in Amphibian Biomass Production Associated with Pesticide Exposure and Community Structure

Ellie Armstrong

441 Ephemeral wetlands, which are dominated by amphibians, have been destroyed to make room for agriculture, which increases the risk of contamination from pesticide use. One of the most widely used insecticides in the US is the neonicotinoid, imidacloprid. While the direct effect of environmental concentrations of imidacloprid on amphibians appear to be sublethal, indirect negative effects may be conferred through disruptions in the food web. These effects may be dependent on the structure of the community, including the number of trophic levels. The objective of this study was to determine the effects of imidacloprid in communities with different numbers of trophic levels (communities without amphibians; communities with northern leopard frogs [*Lithobates pipiens*]; communities with northern leopard frogs and spotted salamanders [*Ambystoma maculatum*]) on the biomass and herbivore food chain efficiency of the aquatic community; additionally, the impact of the insecticide and number of trophic levels on amphibian metamorphosis will also be considered. This experiment was conducted in outdoor mesocosms located in Oxford, Ohio. Our study demonstrated that the trophic position of amphibians affected the impact of imidacloprid—negatively impacting salamanders, while having no or positive effects on anurans. Additionally, the herbivore efficiency and biomass differed across treatments and was impacted by insecticide exposure. This study demonstrates how the complexity of the food web can alter the impact of an insecticide on biomass produced and the movement of resources from the aquatic to terrestrial systems.

P1.46 | Tracking Ontogenetic Allometry of the skull during Metamorphosis in *Amphiprion bicinctus* (Pomacentridae)

Kaleigh Arnold, Kory Evans

45 This study aims to explore the early ontogenetic allometry of neurocranial and jaw structures in *Amphiprion bicinctus* (Pomacentridae) from hatch through to day 14 post-hatch, a critical period marked by significant life history events such as benthic hatching, a pelagic/planktonic larval stage, and settlement into reef habitats. This phase is characterized by dramatic environmental and functional changes, making it an ideal window for investigating early allometric processes. Utilizing micro-CT scans and 3D geometric morphometrics, this research seeks to measure and compare the allometric growth of specific skeletal structures, providing insights into the morphological adaptations that occur during this metamorphic stage. This study predicts that the rapid environmental transitions experienced by *A. bicinctus* larvae during metamorphosis might drive distinct allometric growth patterns in neurocranial and jaw structures, essential for their early predatory behaviors and dietary needs. The null hypothesis assumes isometric growth among these structures, while the alternative hypothesis suggests positive allometry, particularly in jaw components critical for feeding. This investigation sets the groundwork for comparative analyses within the genus and among different fish families, potentially uncovering conserved or divergent allometric patterns linked to ecological and life history variables. Through a comprehensive and innovative approach, this study aims to enhance our understanding of early ontogenetic allometry in reef fish, contributing to broader themes in evolutionary developmental biology and functional morphology.

8.3 | An Enigmatic Pelagic Fish with Internalized Red Muscle: A Future Regional Endotherm or Forever an Ectotherm?

Martin Arostegui, Michelle Shero, Lawrence Frank, Rachel Berquist, Camrin Braun

11 Ectothermy and endothermy in extant fishes are defined by distinct integrated suites of characters. Although only ~0.1% of fishes are known to have endothermic capacity, recent discoveries suggest that there may still be uncommon pelagic fish species with yet to be discovered endothermic traits. Among the most rarely encountered marine fishes, the louvar *Lugarus imperialis* is a remarkable example of adaptive evolution as the only extant pelagic species in the order Acanthuriformes (including surgeonfishes, tangs, unicornfishes and Moorish idol). Magnetic resonance imaging and gross necropsy did

not yield evidence of cranial or visceral endothermy but revealed a central-posterior distribution of myotomal red muscle that is a mixture of the character states typifying ectotherms (lateral-posterior) and red muscle endotherms (central-anterior). Dissection of a specimen confirmed, and an osteological proxy supported, that *L. imperialis* has not evolved the vascular rete that is vital to retaining heat in the red muscle. The combination of presumably relying on caudal propulsion while exhibiting internal red muscle without associated retina is unique to *L. imperialis* among all extant fishes, raising the macroevolutionary question of whether this species – in geologic timescales – will remain an ectotherm or evolve red muscle endothermy.

P1.58 | Identifying historically collected larval coregonines to species using a redesigned genetic assay

Collin Atwood, Joe Sweeney, Nick Sard, Preston Fuerbacher, Morgan Bulger, Kayelah Brown, Jim McKenna

316 Native coregonines are integral planktivores in the Great Lakes, contributing significantly to the lakes ecosystem's stability and resilience. Cisco (*Coregonus artedii*) and Lake Whitefish (*Coregonus clupeaformis*) once abundant in the Great Lakes, faced population declines in the 1900s due to overfishing and competition with non-native fishes. In the context of ongoing restoration efforts, identifying larval coregonine species is vital for better understanding the factors that affect recruitment. However, phenotypic variation makes it difficult to visually differentiate the species at the larval stage. To address this impediment, a Polymerase Chain Reaction Restriction Fragment Length Polymorphism assay that identifies each species was developed in 2018. Analyzing historical samples collected in Chaumont Bay, Lake Ontario, results indicated low amplification success with the original assay (19% ± 23%). We developed a new assay at a smaller locus (202 base pairs) that greatly increased amplification success (81% ± 20%) and species identification accuracy. The redesigned assay will enable the evaluation of a multi-decade larval coregonine time series to better understand the climatic-related factors affecting coregonine population dynamics and to enhance the restoration efforts of these imperiled species.

34.6 | Evaluating the effects of infrared light on the health and welfare of false water cobras (*Hydrodynastes gigas*)

Lauren Augustine, Pete DiGeronimo, Katherin Plate, Brianna Light, Zachary Loughman

105 In order to satisfy their behavioral, psychological and physiological needs, reptiles in captivity should be provided access to a similar range of environmental conditions as they would encounter in nature. Short wavelength infrared (IR A) and medium wavelength IR (B) are critical light spectrums for reptiles to thermoregulate, however, it is a common husbandry practice to house snakes in enclosures that only provide long wavelength IR (C) in the form of heat tape, or under the enclosure heat. Inappropriate thermal husbandry can have profound effects on the wellbeing of reptiles in captivity and, in turn, impact conservation and research outcomes. Herein, 34 juvenile false water cobras (*Hydrodynastes gigas*) were divided at random into two thermal treatments, a control group provided with heat tape, and an experimental group provided with a halogen light bulb. Each group was provided identical husbandry, and the wellbeing of each snake is being evaluated based on appetite, growth, hematology and blood biochemistry, shed rate and quality, fecal rate and quality, behavior, mortality and morbidity. Health samples were collected from each snake at the beginning of the study (November 2023) and will be collected again at 6 and 12 months. Preliminary results show no significant differences in appetite, growth, shed rate and quality, fecal rate and quality, mortality and morbidity, but a significant difference in behavior. Samples for hematology and blood biochemistry will be collected and assessed in April and October 2024. We hypothesize there will be a significant difference in hematology and blood biochemistry between treatments.

P1.8 | Using Stable Isotope Simulations to Understand the Trophic Ecology of Elasmobranchs in Delaware Bay

Tess Avery, Noah Motz, Benjamin Marsaly, Devon Scott, Aaron Carlisle

386 Delaware Bay (DB) is a critical foraging and nursery habitat for a range of taxa, including many ecologically and economically important species. DB supports an abundant and diverse elasmobranch assemblage, but how this ecosystem supports such a high number of upper trophic level consumers remains poorly understood. An important part to understanding how DB supports its diverse elasmobranch assemblage is understanding which sources of primary production and components of the food web support different elasmobranch species. To address this question, we used stable isotope ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) data of elasmobranchs and prey species from DB to reconstruct how energy moves through the food web and estimate the isotopic signatures of different potential prey functional groups (e.g. benthic crustaceans, filter feeding fishes, cephalopods, demersal fishes, etc.). We simulated the stable isotope composition of a theoretical elasmobranch population in DB in different scenarios where they exhibit different diets and degrees of specialization (or generalization) on different prey groups. We then compared our simulated elasmobranch stable isotope values for the different scenarios to our observed stable isotope values to see how well they correspond. By evaluating how well the observed elasmobranch stable isotope values align with the different simulations, we were able to elucidate various aspects of their trophic ecology, including reliance on different prey functional groups and where different elasmobranchs fall on the generalist to specialist spectrum. Ultimately, this approach will enhance our understanding of food web dynamics in DB and how this ecosystem supports such a robust elasmobranch assemblage.

10.1 | Spirited Discoveries: Raising a Jar to Understanding Larval Fish Diversity using the Ethanol Storage Fluid

Tanner Bahm, Kyle Piller

72 Ethanol preserved museum specimens represent a potential untapped reservoir of DNA for studies of species diversity and identity, assemblage structure, and phylogenetic relationships. In many cases, removal of tissue samples from ethanol preserved specimens is unrealistic due to the historic value of the specimen or the destructive nature of the tissue extraction. There is some evidence that DNA from museum specimens may leach into the storage fluid, but despite the potential value of DNA from the storage fluid, extracting DNA from the fluid has not been adequately tested. We obtained several jars of larval fish specimens from the Gulf of Mexico collected by the National Oceanic and Atmospheric Administration (NOAA). These samples were preserved in ethanol and were then sent to Europe for morphologically based species identification. The goal of this study was to test the efficacy of extracting DNA directly from the storage DNA of these larval species, rather than the specimens themselves. To date, we have successfully extracted DNA and amplified mtDNA from these samples. Our overall goal is to confirm the species identity in each jar, as well as to compare the number of individuals in each jar to the number of recovered sequence reads, potentially giving us a proxy of specimen number in each jar.

P2.27 | Using DNA Barcoding and Morphometrics to Determine a Potential Case of Cryptic Species in the Purple Spaghetti Eel (*Moringua raitaborua*)

David Baker, John Whalen, David Gauthier

407 With the advent of modern genetic barcoding techniques, many taxonomic classifications have been able to be revised and clarified, but many more remain unclear. One such group is the tropical eel genus *Moringua*. The actual number of valid species in the *Moringua* genus is unclear, with numbers ranging from nearly 40 to less than 15. Sex and age related differences have contributed to confusion, with immature forms often being classified as different genera or families. Recently one species in particular, *Moringua raitaborua*, has come to the attention of experts in the field as potentially consisting of multiple cryptic species. Two distinct morphs of *M. raitaborua* have been observed, with specimens from reef and rubble environments possessing a protruding lower jaw and well-developed pectoral

fins, while specimens from soft bottomed river mouths have jaws equal in length and underdeveloped or entirely absent pectoral fins. This project is complementing current research on contemporary *Moringua* specimens in the Philippines by performing morphological analysis and genetic sequencing on historical specimens of *M. raitaborua* and other *Moringua* archived in the Smithsonian. Body measurements and vertebral counts will be analyzed to discover if there is a relationship between the two morphs and any other detectable physical differences. The sequence results will be combined with previously existing data to assemble a new phylogenetic tree and determine whether the original identifications of these specimens were correct, if they were misidentified, or if there are indeed cryptic species within *M. raitaborua* that need to be described.

35.8 | Movements, Residence Time, and Use of Intertidal Environments by Two Shark Species in the Upper Bay of Fundy

Charles Bangley, Chelsea Eldridge, Daniel Hasselman, Joanna Mills Flemming, Frederick Whoriskey, Megan Winton, Bryan Franks, Greg Skomal, Chris Fischer

351 Minas Basin, one of the uppermost reaches of the Bay of Fundy, is characterized by extreme changes in water depth over the tidal cycle. It is inhabited by a variety of anadromous and marine fishes, including migratory predators such as spiny dogfish (*Squalus acanthias*) and white sharks (*Carcharodon carcharias*). White sharks are currently listed under the Canadian Species At Risk Act (SARA) and spiny dogfish are under assessment for potential listing as well, making assessment of overlap with tidal power development sites and other human activities a pressing concern. Using acoustic telemetry detections of both species, we were able to describe movements and habitat use across much of the area of Minas Basin, from the entrance at Minas Passage to the mouth of Cobequid Bay. White sharks were present from June to October while dogfish were detected year-round. Individuals of both species made multiple returns to the area over the same season. For white sharks, a correlation was found between fewer individuals and greater residence time (measured in minutes over which transmissions were detected on a single receiver without a gap in detection of at least one hour). This was not found in spiny dogfish, which were often detected with conspecifics. Both species were detected in intertidal environments, including sites where receivers were out of the water at low tide. This information will increase understanding of habitat use by marine top predators in extreme intertidal environments and provide important context for movements through tidal power demonstration sites in Minas Passage.

16.7 | Exploring the evolution of acoustic communication in holocentrid fishes: a multidisciplinary approach

Marine Banse, David Lecchini, Terry Donaldson, Maarten Van Steenberge, Gontran Sonet, Eric Parmentier

240 Despite many fish species are known for their social acoustic communication abilities, few studies investigated the evolutionary history of this trait. The aim of this study was to tackle this challenging topic by investigating a wide range of holocentrid species using a multidisciplinary approach. We first carried out a comparative analysis of the 7662 sounds recorded in the same behavioural context, from 388 individuals across 73 populations (Guadeloupe, French Polynesia, Guam, Seychelles, Philippines) and 33 species. This comparison conclusively demonstrated that sounds can be used to accurately determine the belonging to given taxa across different taxonomic levels. Interestingly, some *Myripristis* species developed patterns in their calls, enabling them to explore the acoustic space more thoroughly. We then compared the sound-producing apparatus between subfamilies and genera but also within genus, and built a phylogenetic tree to evaluate the evolution of both acoustical and morphological features. Results strongly support that modifications in the calls are related to morphological differences, suggesting that acoustic communication can be a driving force in the diversification process.

P1.9 | Geographic variations of Sandbar Shark (*Carcharhinus plumbeus*) life history traits

Joseph Barney, Lillian Georgio, Angela Salado, Aidan Keenan, Gerald Crow, Christopher Lowe, Bradley Wetherbee

119 Life history traits influence reproductive effort and the potential rate of population growth. Because life history traits of widely distributed species vary geographically, population growth, ability to support fisheries and to recover from overexploitation also vary geographically. Therefore, information on life history traits from specific geographic locations is useful for management of populations on a local basis. In this study, we quantified 10 life history characteristics for Sandbar Sharks (*Carcharhinus plumbeus*) captured in shark control programs in the main Hawaiian Islands. We compared life history traits of sharks in Hawaii with values of Sandbar Sharks of other parts of the world (Taiwan, Australia, US East Coast, South Africa). The majority of life history traits examined varied among geographic locations. We hypothesize that variations among life history traits of Sandbar Sharks are related to water temperature, prey availability, migratory patterns, energetics and other ecological interactions. Incorporation of region-specific life history data into stock assessment are likely to improve effectiveness of management policies.

31.3 | Evaluating the Long-term Success of Two Stream-bank Restorations within the French Creek Watershed

Meredith Barney, Mark Kirk, Casey Bradshaw-Wilson, Kelly Pearce

82 Streambank restorations are often implemented as responses to anthropogenic stressors that alter instream habitat and impair biotic integrity. However, the long-term benefits of these restoration projects are often understudied. The Watershed Conservation and Research Center (WCRC) at Allegheny College, in conjunction with local community partners, performed two restorations at locations struggling with issues of erosion, sedimentation, and streambank stability. These restorations occurred in lower Woodcock Creek, a tributary to French Creek, in Crawford County, PA. The first site was located on the mainstem of Woodcock Creek (Craig Road), while the second was on a small, unnamed tributary (Telliho). Pre- and post-restoration data were collected at these sites in order to document and measure restoration success, as well as observe the ecosystem's response to these changes. Sampling included biotic assessments of fish and macroinvertebrates, as well as abiotic measurements of hydrology, substrate, sedimentation, and water chemistry. The restorations are expected to elicit long-term improvements in the biotic integrity, water quality, and habitat heterogeneity of the streams, as well as increase recruitment of sensitive species. Early biotic results of fish and macroinvertebrates indicate an increase in fish diversity at Craig Road, which included the addition of a new darter species. However, the site did experience turnover of certain gamefish species. The second site, Telliho, saw a decrease in fish diversity, likely due to the loss of sizeable pools that previously housed larger fish species. Both sites saw no increases in macroinvertebrate diversity. Additional abiotic data is still being processed, and continued long-term monitoring is planned for both sites, to further evaluate how successful these restoration efforts have been for the French Creek Watershed.

32.4 | Genetic Adaptation to Climate Change Among Nursery Habitats of the Bull Shark (*Carcharhinus leucas*)

Shannon Barry, Matthew Ajemian, Charles Bangley, Marcus Drymon, Bryan Frazier, Laura Garcia Barcia, Jayne Gardiner, James Gelsleichter, Dean Grubbs, Tristan Guttridge, Neil Hammerschlag, Mike Heithaus, Matthew Smukall, Bradley Strickland, Tonya Wiley, Toby Daly-Engel

258 The distribution of marine species is likely to be heavily altered by climate change, with some marine species observed migrating poleward to novel habitats that were previously outside of their geographic range. In 2018, bull sharks (*Carcharhinus leucas*) were found to have expanded their critical reproductive habitat in the northwestern Atlantic Ocean, with recent genetic data supporting a poleward expansion of habitat >900 km of their previously described northernmost nursery, an expansion that was correlated with rising sea surface temperature (SST) over the past 30 years. This raises the question: If shark populations are undergoing poleward expansion in response to climate change, then what will be the resulting impact to the genetic diversity

and viability of these species? This research seeks to investigate this question by identifying signatures of local adaptation of bull sharks within nursery habitats using Single Nucleotide Polymorphisms (SNPs) to identify genetic structure and diversity metrics. These results, plus telemetry data (acoustic tag detections, provided by collaborators in the Florida Atlantic Coastal Telemetry (FACT) network) will be mapped to a seascape of oceanographic factors such as salinity, depth, and SST to identify gene-environment correlations. These data will provide insight into how bull sharks are currently adapting to habitat changes, with future directions incorporating these data into species distribution models to accurately predict climate impacts on the future distribution of bull shark populations.

28.7 | Three New Species of Small Blood-feeding Catfishes (Trichomycteridae: Vandelliinae: Paravandellia) and Discovery of the Candiru's Tooth Brush.

Jonathan Baskin, Elisabeth Henschel, Rupert Collins, Nathan Lujan

487 We reexamine the recently debated morphological diagnosis of the poorly-known South American parasitic catfish genus *Paravandellia* and describe the first three *Paravandellia* species from the Amazon or Orinoco drainages. This increases the total valid species in the genus to seven and just begins to fill a vast gap in the genus's historically disjunct distribution, which until recently was restricted to the Essequibo, Magdalena, and Parana river drainages north and south of the Amazon. The genus's small size, ranging from 14 to 30 mm SL, contributes to their obscure biology, which is further complicated by complex distributions possibly caused by host-attachment and dispersion. We suggest that much of this taxon's diversity and unique biology remains to be revealed. Diagnostic features of the genus include: 1. medial teeth on the premaxilla, 2. a previously overlooked arrangement of the lateralmost branchiostegal ray extending dorsolaterally between the interopercular and opercular bones to a position external to the opercular odontodes (a condition perhaps unique among actinopterygians). Upon opercular eversion, the distal end of the ray is displaced anteriorly from over the odontodes, potentially functioning to clear the odontodes and thus aid in host attachment or detachment. The mechanism is here christened the Candiru's Tooth Brush.

P2.61 | Distribution and prevalence of Chytrid fungus (*Batrachochytrium dendrobatidis*) on anurans within the Iwokrama Forest, Guyana.

Mark Bastian, Gyanpriya Maharaj, Alessandro Catenazzi, Maureen Donnelly

95 Chytridiomycosis is an infectious disease caused by *Batrachochytrium dendrobatidis* and *Batrachochytrium salamandrivorans* pathogens and is responsible for many declines in global amphibian populations. This study examined the prevalence of the *B. dendrobatidis* fungus among anurans at Turtle Mountain, Iwokrama, Guyana. A total of 75 individuals were sampled in the wet and dry seasons. We tested for the presence of *B. dendrobatidis* by quantifying zoospores found on anuran skins using Real-Time qPCR assay and the Taqman/MGB probe. Of the 75 samples, there was one confirmed "positive" for *B. dendrobatidis*. This accounted for 1.33% of disease prevalence within anuran communities. Although this accounted for a low disease prevalence, Turtle Mountain is still considered a positive site due to the pathogenicity of *B. dendrobatidis*. This positive case was associated with the generalist, *Rhinella martyi*. As such, this poses a serious threat to specialist anurans and other amphibians at Turtle Mountain and the wider Iwokrama Protected Area. We also looked at correlations among abiotic factors and how they affect anuran communities. NMDS (Stress value = 0) indicated that these associations were not random but species specific to wet and dry seasons. The presence of such a deadly fungal pathogen could mean massive die-offs of amphibians, resulting in general population declines and extinction of susceptible endemic species. Additionally, such an impact in a protected area will disrupt the natural ecology and ecosystem services that are offered by these important bioindicators.

8.6 | A new *Nucras* (Squamata: Lacertidae) from Zambia

Aaron Bauer, Jackie Childers, Marius Burger

146 Species of the lacertid genus *Nucras* are restricted to sub-Saharan Africa. They are characterized by elongate, cylindrical trunks and very long tails. Unlike many other African lacertids, they are relatively secretive, and distributional data as well as natural history observations are limited. *Nucras* is most speciose in southern Africa and recent research in South Africa, Namibia and Angola has resulted in the description or resurrection of several species. Three species have been recorded from Zambia: *N. ornata*, *N. boulengeri*, and an undescribed and uncollected, but distinctive species photographed more than 20 years ago. We report the discovery of another species from near Senga Hill, Northern Province. Phylogenetic analysis of 1686 bp from three mitochondrial markers placed the new species as sister to a clade including *N. ornata*, *N. intertexta*, *N. holubi* and *N. damarana*, and much more deeply divergent with respect to the clade including its geographically nearest neighbor, *N. boulengeri*. Morphologically it most closely resembles *N. ornata*, from which it is distinguished by size, color pattern, and head shape, and from which it is separated by 500+ airline km. The allocation of names to *Nucras* in southeastern Africa is hampered by the vague type locality of *N. ornata*, the existence of two largely forgotten nominal taxa, *N. cameranoi* and *N. pseudotessellata*, and poor sampling, particularly in parts of Mozambique.

34.3 | Direct-development, early larval development and metamorphosis in the paedomorphic salamander *Amphiuma tridactylum*

Christopher Beachy, Clifford Fontenot Jr.

98 The salamander family Amphiumidae is intriguing for several reasons. It is species poor (three species), includes two gigantized species (*A. meansanum* and *A. tridactylum*), and is likely the sister taxon to the species rich and widespread family Plethodontidae. All three species of *Amphiuma* are generally paedomorphic in the sense that most of the tissue/organs fail to undergo metamorphosis. However, the gills of *Amphiuma* experience metamorphosis: they are resorbed after a brief larval period. Little is known about this larval period for all three species because eggs and hatchling/young *Amphiuma* are either unknown or rare. For *A. meansanum*, gill resorption has been observed to occur 7-14 days after hatching. We were fortunate to see a herp group report of a found egg clutch of *A. tridactylum*. We obtained this egg clutch on 19 November 2023 and have used the eggs and hatchlings in a series of experiments. In this report we tested the hypothesis that timing to gill resorption can be influenced by growth and inundation. Upon hatching, we placed individual larvae in three treatments: fed and immersed in water, not fed and immersed in water, and not fed and not immersed in water. This allowed for testing two hypotheses: (1) growth history influences metamorphic timing and (2) metamorphosis can develop whether larvae are immersed in standing water or not. Nearly all animals (40 of 42) metamorphosed fully. Two larvae died before completion gill resorption; both were in the non-immersion treatment. Larvae completed gill resorption regardless of feeding and immersion regime. The time required to complete gill resorption is being analyzed. These results will have significant meaning: all amphibian metamorphic timing is influenced by growth rate EXCEPT in the sister plethodontids.

16.4 | Phylogeography of Deep-Water Snappers in Honduras and Belize

Makenna Beehler, Ivy Baremore, Dylan Gore, Toby Daly-Engel

388 Silk snapper (*Lutjanus vivanus*) and cardinal snapper (*Pristipomoides macropthalmus*) are deep-water fishes (100-550 m depth) found throughout the western Atlantic Ocean. These species are heavily exploited in commercial and artisanal fisheries in Mesoamerica, including Honduras and Belize. Genetic assessments are needed to determine stock structure and make effective management recommendations for these countries. Genetic patterns are frequently documented in shallow coastal fishes, but similar studies on deep-water fishes are less common. Deep-water fisheries in Honduras and Belize are geographically connected to stocks in the wider Caribbean Sea, but remain understudied and largely unmanaged. Deep-water snappers have relatively conservative life history traits compared with shallow-water teleosts,

including slow growth and late maturity, making it difficult for them to rebound from overexploitation. We utilized DNA samples taken from snappers across 12 island and coastal locations throughout Honduras and Belize to determine the number of evolutionarily distinct groups and potential management units. We sequenced 500 base pairs of the mitochondrial cytochrome b gene and performed Bayesian phylogeographic analysis and genetic connectivity (FST). Preliminary results indicate a lack of genetic structure between Honduras and Belize in both species of snappers, with subtle differentiation between the northern and southern populations of *P. macrophthalmus* in Belize. These results shed new light on the stock structure of deep-water snappers in the Caribbean, providing a context for management that spans international borders.

P2.19 | Morphological Constraints of a Shrimp Goby Mutualism

Emma Bell, Elizabeth Miller, Luke Tornabene

305 Many different organisms have established symbiotic relationships that span the spectrum from commensalism, to mutualism, to parasitism. As organisms evolve these relationships, they become shaped by the demands of partnership, leading to species with optimal features to support symbiosis. The most advantageous of symbiotic partnerships is mutualism, in which both members receive a positive benefit. While these relationships confer the most fitness for both partners, the morphological or behavior requirements of the symbiosis may be constraining their evolutionary pathways when compared to related species that do not participate in symbiosis. In the highly diverse family Gobiidae, a mutualistic relationship has arisen multiple times between goby and shrimp. The blind shrimp constructs and maintains a burrow for the pair to live in while the goby provides protection to the shrimp by guarding the entrance and alerting for predators. #_msocom_1 While the relationship is highly beneficial for both partners, we suggest that the mutualistic gobies are constrained evolutionarily, due to the need to live inside a burrow and effectively guard and communicate with their partnered shrimp. Using geometric morphometric analysis of shrimp and non-shrimp gobies we will ascertain whether specific morphological traits and body plans are confined in the shrimp-goby mutualism. By modeling morphometric data on a phylogenetic tree of the Gobiidae, we will be able to track shape change through the phylogeny and understand the shrimp associations effect on shape. The implications of this research will help bridge the gap in understanding of how evolution and morphology shape or confine symbiotic relationships.

18.1 | Development of a novel microsatellite panel and genotyping process for the management and conservation of American paddlefish (*Polyodon spathula*)

Leah Berkman, Alexandra Clussman, Madison Feeler, Michael Byrne

321 Neutral genetic markers illuminate population structure, effective population sizes, and reproductive behavior, providing a wealth of information for managing natural and supplemented populations. Genetic data obtained from these markers can help managers meet their goals for sustainable populations while conserving the diversity of co-occurring hatchery-reared and wild paddlefish (*Polyodon spathula*). Paddlefish have undergone a whole genome duplication in the recent past making the discovery of disomic genetic markers using traditional methods difficult. Improved genetic technology and the recent publication of the paddlefish genome now offer an alternative way to develop and genotype disomic markers, which can be used for monitoring and management efforts. In an effort to improve genotyping of neutral markers from paddlefish, we extracted perfect simple sequence repeats (SSRs) in silico from the paddlefish genome. We avoided regions of genome duplication and linked loci by considering only SSRs located on microchromosomes. We screened 203 novel SSRs and 27 published SSRs by genotyping 36 paddlefish from the Missouri and Black River drainages using next generation sequencing (Illumina Mi-Seq). We describe marker filtering steps and success rates and then demonstrate the utility of the process for refining hatchery practices for paddlefish rearing and stocking. This process will be available as a cost effective but powerful method to address many population-level questions for this species.

36.5 | Post-Release Stress and Mortality of Atlantic Sharpnose Sharks (*Rhizoprionodon terraenovae*)

Hayden Bessette, Bryan Frazier, Fabio Casu, Jody Beers

493 Catch-and-release fishing (CRF) is a common practice among coastal anglers and is often promoted as a vital conservation management strategy. However, despite fishes being released alive, the physiological stress caused by angling can induce negative acute and/or chronic effects, potentially leading to post-release mortality (PRM). Understanding and quantifying these impacts is imperative if CRF is to be used effectively as a conservation tool, particularly for vulnerable species. To address this research need, our study investigated the physiological stress response and PRM of Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) following rod-and-reel fishing. Atlantic sharpnose sharks (n=32) were tagged with survivorship pop-up satellite archival tags (sPSATs) from May to September of 2022 and 2023 to estimate PRM. Using blood samples taken immediately following capture, the stress responses of 38 individuals were assessed using Nuclear Magnetic Resonance (NMR) spectroscopy to determine metabolite concentrations in extracted plasma. Temperature, depth, and light intensity profiles collected by sPSATs indicated the PRM for Atlantic sharpnose sharks to be approximately 4%. This relatively high survivorship suggests the species is resilient to CRF in the southeastern United States. Based on analysis of NMR profiles, numerous metabolites correlated strongly with environmental parameters and capture characteristics, consistent with predictions. Our results suggest the determination of PRM, in conjunction with plasma analysis via NMR spectroscopy, has the potential to expand the understanding of the stress response of elasmobranchs to CRF, and aid in the management of this species.

P2.49 | Competition or Habitat: Which is Potentially More Influential in the Decline of a Northeastern Amphibian?

Hannah Bey

445 Land use changes are prominent in wetlands, which are key ecosystems for declining species like the Blanchard's cricket frog (*Acris blanchardi*). This amphibian faces range contractions, but the cause remains unclear. Previous studies suggest that green frogs (*Lithobates clamitans*) can outcompete cricket frogs and decrease their survival. This project explored the impacts of competition between these anurans over a leaf litter gradient. Both species were reared in outdoor mesocosms with low or high leaf litter. I manipulated six tadpole community types including tadpole-free controls, 25 cricket frogs, 50 cricket frogs, 25 green frogs, 50 green frogs, and 25 of both species in a mixed community. Leaf litter, rather than community structure, had the greatest impact on the development of both anurans. High leaf litter treatments corresponded with larger masses and quicker development, on average. Cricket frogs showed a trend of lower total survival in high density communities regardless of green frog presence. Green frogs had notably higher masses in high density mixed communities than high density green frog communities. Periphyton and phytoplankton became more abundant in high leaf litter treatments than low leaf litter treatments over time. Leaf litter quantity also impacted water quality parameters and nutrients. The manipulation of leaf litter resulted in distinct habitats, which impacted anurans more than differences in the magnitude or type (intraspecific versus interspecific) of competition within communities. Therefore, land use changes may more significantly contribute to the decline of imperiled species, like Blanchard's cricket frogs, than the presence of competitors across the landscape.

P2.20 | The Mechanosensory Lateral Line System of Barbs (*Cypriniformes*, *Cyprinidae*) Using Fluorescent Imaging of Neuromasts

Gus Bienenfeld, Maxwell Hampton, Jacqueline Webb

280 The mechanosensory lateral line (LL) system is composed of canal neuromasts (CNs) and superficial neuromasts (SN). The LL system of *Cypriniformes* has been studied at different levels of detail (notably in zebrafish, goldfish, several European species, and Asian cave species), but given their tremendous diversity it is not surprising that little is known about the LL system in other taxa. Four species of commercially available "barbs" (*Cypriniformes*, *Cyprinidae*; Tiger Barb, Cherry Barb, Odessa Barb, and Black Ruby Barb)

were examined using a vital fluorescent stain (4-di-2-ASP; 2 indiv./sp.) to determine if SNs are proliferated as they are in tetras (Characiformes, Characidae; Hampton and Webb, in prep.). All four species have canal neuromasts (CNs) within narrow cranial canals, and in an incomplete trunk canal (one CN/scale); they are consistently larger than SNs. A total of ~675 -1700 SNs were found on the head, trunk, and tail (one side) in each of the four study species. SNs are in dense lines and clusters on the dorsal and lateral surfaces of the head; small numbers are found on the ventral surface of the mandible. On the trunk, SNs are found in a vertical line on each LL scale, and on some or all of the non-LL scales (~5-14 SN/scale, with some rostro-caudal and interspecific variation). On the caudal fin, SNs are found in 4 to >8 lines that sit in the membranes between fin rays among species. Interspecific variation in the pattern and distribution of SNs will be discussed.

P1.52 | Evolution of blue and green chromoprotein pigments in darters

Emily Bierer, Katelyn Boone, Brady Porter

503 Coloration in darters plays an important role in visual communication, sexual selection, and speciation. Although blue coloration in fishes is typically structural, one blue pigment protein, termed Sandercyanin, was discovered in Walleye (*Sander vitreus*). Sandercyanin is a 21 kDa lipocalin chromoprotein that functions as a homotetramer, and binds biliverdin IX- α . We predict blue and green pigmentation in darters are homologous chromoproteins to Sandercyanin. Here, we focus on chromoproteins of the Rainbow darter (*Etheostoma caeruleum*), and Greenside darter (*Etheostoma blennioides*) and compare UV-Vis spectral absorption profiles from a variety of snubnose darter species showing similarity to Sandercyanin with a range of hues from blues to greens. There is a positive correlation between UV-Vis absorption and fluorescence emission across these chromoproteins. Mass Spectral analysis confirms biliverdin is the chromophore in both Rainbow and Greenside Darter chromoproteins. We hypothesize that the evolution of darter pigments involves variation in the protein structure. We developed PCR primers to amplify and sequence apolipoprotein D from darter genomic DNA for further comparison to Sandercyanin. Sequence analysis indicates gene size ranges between species due to intron length, while exon number, order, size and primary sequence appears to be relatively conserved between species. Ongoing peptide sequencing of pigments isolated from darter integument will support or reject our hypotheses that darter apolipoprotein D is homologous to Sandercyanin, and coloration differences result from protein sequence variation. Ultimately these data will contribute to understanding the evolution of pigments in one of the most colorful groups of freshwater fishes.

P1.72 | Representation matters: engaging minority students in STEM Education

Emily Bierer, Phillip Palmer

504 Being able to see yourself as a scientist can mold a young student's image of their future. One of the best ways to envision what career or field they may choose to pursue is having opportunities to try new things and see people that look like them or come from a similar background achieving their goals. Unfortunately, this isn't always a possibility for underrepresented individuals and in underfunded schools. We created a STEM summer camp with the focus of exposing minority students from urban school districts to diverse STEM fields. Students engaged in several hands-on experiments involving field ecology, microbiology, chemistry, and technology. To encourage the idea of providing as much representation as possible, students had the opportunity to interact with mentors, speakers, and classmates that came from different backgrounds with different STEM related goals. We hypothesized that by building these types of experiences would show an improvement in student learning and an increase in student participation in STEM fields. Pre and post survey data has supported our hypothesis that providing engaging opportunities not only improves learning but also supports positive experiences in relation to STEM education. Feedback from the participants in the camp has helped to morph the STEM camp to improve our engagement and representation present within the camp. Developing programming that is inclusive and demonstrates representation in addition to providing hands-on experiences can support students' interest in science and STEM careers.

CANCELLED - P1.50 | Evolutionary mechanisms of species discrimination and behavioral isolation in a stream fish model

Taylor Black, Rachel Moran

457 The rainbow darter (*Etheostoma caeruleum*) and orangethroat darter clade (*Caesia*) co-occur in multiple drainages where they produce hybrids with reduced fitness. Selection to avoid hybridization has led to male-driven behavioral isolation in sympatric populations but not in allopatric populations. This relationship induced the radiation of the orangethroat darter clade. Although males prefer conspecific females over heterospecific females, the signal(s) males use for species discrimination remains unknown. My work tests the possible role of olfactory cues in species discrimination.

26.6 | Climate and Land Use Interact to Influence Body Size of Fowler's Toad (*Anaxyrus fowleri*)

Paradyse Blackwood, Amanda Martin, Jennifer Sheridan

132 Anthropogenic changes to the environment have been associated with changes in body size of multiple organisms. However, while climate and land use influences on body size have been examined separately, the simultaneous effects and potential interactions of these two factors on body size have rarely been studied. We examined the size and mass of a common toad (Fowler's toad, *Anaxyrus fowleri*) using museum specimens from 1930 – 2020 to quantify the interactive effects of climate change (temperature and precipitation) and land use change (percent developed and forested area) on body size. We found that snout-vent-length (SVL) and mass declined over time, and that declines were best described by an interaction between temperature and precipitation, as well as an interaction between temperature and land use. The biggest size (SVL) declines were seen in areas with low precipitation and high forest cover as temperatures warmed, and the biggest declines in mass were observed in areas with low precipitation. This suggests that in areas with more forested areas have greater access to resources than conspecifics inhabiting areas with less developed/forested land, which may offset size declines expected from increased metabolism associated with warmer temperatures. This work highlights the need to examine interactive effects between climate and land use variables to better understand species morphology in a changing world.

21.5 | Development of DNA Methylation-Based Age Predictors in the Zebra Shark (*Stegostoma tigrinum*)

Samantha Bock, Kady Lyons, Lei Yang, Jennifer Wyffels, Gavin Naylor, Benjamin Parrott

187 Aging is a near universal feature of animal life histories. Vital rates (i.e., survival, fecundity) vary as a function of age and efforts to manage and conserve species rely on assessments of population age structure. However, accurate methods of age determination often require lethal sampling (e.g., otoliths in bony fishes) or are entirely lacking for many species, thereby impeding efforts to monitor vulnerable populations. This is especially relevant to chondrichthyans as this group is long-lived and contains a large proportion of endangered species. Recently, patterns of DNA methylation (DNAm) have been used to construct models ("epigenetic clocks") capable of predicting chronological age with high accuracy in a range of species, including many mammals, a few birds and reptiles, and several bony fishes. Epigenetic aging patterns have yet to be characterized in chondrichthyan species but hold the potential to provide accurate, non-lethal age estimation tools. Here, we describe DNAm-based age estimators in the zebra shark (*Stegostoma tigrinum*), a species of conservation concern. Genome-wide methylation data were generated from whole blood samples for a cohort of 66 known-age zebra sharks curated by a consortium of aquarium partners. Age-associated DNAm patterns were used to calibrate models capable of estimating age with a mean absolute error of 1.74 yr (5.8% of the estimated maximum lifespan) in aquarium-bred animals based on the methylation status of between 69 and 85 individual cytosines. Ongoing work aims to optimize the model's performance on wild-derived animals and characterize conserved DNAm aging signals across multiple chondrichthyan species.

28.2 | Homology of the Horizontal Intermediate Elements of the Pharyngeal Arches in Actinopterygii

Flávio Bockmann, Eric Hilton, Murilo de Carvalho, Marcelo de Carvalho

442 Although it is traditionally accepted that the pharyngeal arches of gnathostomes are serially homologous, the homologies between the elements of the anteriormost two – the mandibular and hyoid arches – are not clearly established because these are substantially modified when compared to the branchial arches. These changes are marked even in relatively basal and morphologically-conserved gnathostome lineages such as chondrichthyans and non-teleost actinopterygians (i.e., cladistians, chondrosteans, and holosteans), leading to the use of distinct terminologies for some elements. The horizontal intermediate elements, as defined here, are usually nodular or rod-like cartilages (sometimes ossified) located in the angle formed by the dorsal (epal) and ventral (ceratal) regions of each arch, connecting adjacent sets. The best-known intermediate elements are the symplectic and interhyal, both associated with the hyoid arch, and the so-called accessory cartilages connected to the ceratobranchials, most commonly to the fourth one. We investigated the homology of these elements by means of anatomical comparisons among basal actinopterygians at different ontogenetic stages. Our results indicate that the symplectic and interhyal belong to the epal and ceratal regions of the hyoid arch, respectively, which are, in turn, serially homologous to the accessory cartilages associated with the branchial arches. As a result, a new terminology is proposed to express the homologies between these elements. Here we speculate that the intermediate elements may be remnants of the primitive pharyngeal basket, bearing horizontal epi- and hypotrematic processes, as retained by lampreys, which exhibit a notably less mobile, lattice-like structure.

P2.69 | Presence of modified granular glands in ventral and dorsal tail tissue of male and female Green Salamanders (*Aneides aeneus*)

Karli Bortner, Nancy Staub

204 Plethodontids are well known for their pheromone producing glands. The mental (chin) region in particular is a well defined area of pheromone production in males. Hypothesized pheromone producing glands in other areas, often called caudal courtship or modified granular glands, have been observed on both the ventral and dorsal surfaces of the tail. In general, pheromone producing glands are considered sexually dimorphic, only present in males, and are thought to facilitate courtship. Because *Aneides aeneus* has a circular, rather than the typical linear, tail-straddling walk during courtship, we hypothesized that both males and females have modified granular glands on their tail. We found that females have glands that are histochemically and morphologically similar to those found in males. Modified granular glands were on the ventral and dorsal tailbase in both sexes. There was no sexual dimorphism in size or shape. Females had a higher frequency of these glands on the dorsal tailbase compared to males. The function of modified granular glands in females is unknown but we hypothesize they signal the male during courtship. This is the first description of dorsal and ventral modified granular glands in male and female *A. aeneus*.

11.2 | Examining the diet and habitat use of Salmon sharks (*Lamna ditropis*) through eDNA and fatty acid analysis

Reilly Boyt, Alexandra McInturf, Taal Levi, Lauren Meyer, Aaron Carlisle, Maddie English, Lisa Hillier, David Lowry, Taylor Chapple

336 Determining the diet of predators in marine systems is a critical technique to understand the impact that they play on threatened species survival. Studies on elasmobranch diet often rely on the use of traditional stomach content analysis. In order to improve our understanding of elasmobranch foraging and their impact on marine systems, new diet analysis methodology that provides more accurate, robust data is needed. While stomach contents can provide evidence of recent feeding from prey that is not yet fully digested, environmental DNA (eDNA) and fatty acid analysis offer a more detailed understanding of diet and habitat use over longer periods of time. In the stomach, prey items that are consumed leave traces of DNA, which can be identified through eDNA down to the exact species, making eDNA ideal for feeding ecology studies.

Similarly, fatty acids can be used to more precisely determine influences of habitat on recent shifts in diet. Species found at the base of food webs distinctly synthesize fatty acids. When these species are consumed, they leave a key signature in the liver and muscle tissue. This newly emerging science is in its infancy as a way to determine the diet of elasmobranchs and other fish species. In this study, we use these two new techniques to complement existing diet studies on salmon sharks (*Lamna ditropis*), an apex predator in the Northeast Pacific. Here we present our methodology and highlight future directions. Ultimately, this work will lay the foundation for more well-rounded dietary studies on elasmobranchs.

13.9 | Breaking Barriers Below the Surface: Navigating Challenges and Solutions for Accessible Marine Fieldwork

Reilly Boyt

256 One in four Americans and an estimated 20-25% of the global population are disabled, a number that is expected to rise due to factors like the ongoing Covid-19 pandemic. Despite this, STEM fields, especially field-based sciences like elasmobranch and other marine sciences, witness a substantial underrepresentation of disabled individuals. This is largely due to inaccessibility, inadequate accommodations, and a prevalent culture of ableism in the field. Recent efforts to foster inclusivity in the scientific community have made strides, yet disabled marine scientists continue to be excluded from vital conversations and initiatives. As we strive for a more inclusive scientific community, it is crucial to address the unique challenges faced by disabled scientists. The lack of accommodations not only hinders participation in critical studies but also poses safety concerns. Fieldwork plays a pivotal role in the development of early-career scientists, providing essential networking opportunities and the refinement of techniques and skills necessary for research. Being unable to access the field impedes their ability to gain the valuable field experience needed to be a successful scientist. Exclusion of disabled individuals not only narrows the perspectives within the scientific community but also restricts the flow of innovative ideas. This talk addresses many of the obstacles and issues encountered by disabled scientists in fieldwork while proposing actionable solutions that labs, organizations, universities, and societies can take. It aims to address the importance of inclusion, advocating for necessary changes to ensure that disabled scientists are an integral part of the evolving scientific landscape.

23.1 | Integrated Models to Improve Ongoing and Historical Studies of Herpetofauna

Danielle Bradke, Shelby Bauer, Kirstine Grab, John Maerz

268 Amphibians and reptiles mediate stressful environmental conditions by spending time in refugia, where they are inaccessible for sampling. Population studies employing sampling designs and analyses that do not adequately address imperfect detection, including animal availability, may lead to poor inferences and management decisions. Hierarchical sampling designs and models can be an effective way to account for multiple processes affecting animal observations; however, concerns about the comparability of past data to future data may dissuade ecologists from updating sampling designs in ongoing studies. We demonstrate how integrated models can be used to overcome this obstacle and improve inference in ongoing studies of herpetofauna using a case study of forest management effects on terrestrial salamanders. We show that our original sampling design, which did not effectively address observation processes, resulted in salamander abundance estimates that were biased low and poorly detected management effects. Changing sampling methodology mid-study to accommodate a more realistic hierarchical design improved estimates of abundance and our ability to detect a negative effect of forest management with higher confidence. We also show that a historical dataset with design flaws can be integrated with data collected during an unrelated study to improve abundance estimates and make better inferences. We suggest ways to adapt sampling designs and overcome barriers to using hierarchical and integrated approaches. Understanding and incorporating hierarchical study designs and analyses will improve research and lead to better management decisions regarding amphibians and reptiles.

35.7 | Pelagic sharks target mesoscale eddies in the open ocean

Camrin Braun, Simon Thorrold, Peter Gaube

53 Mesoscale eddies and current meanders make up the internal weather of the ocean, exciting vertical fluxes and transporting pelagic communities thousands of kilometers. These ubiquitous features cover ~30% of the open ocean yet their influence on pelagic predators remains largely unknown. By combining movement data collected by more than 300 tagged sharks of 5 different species with ocean observations made by a constellation of satellites and data-assimilating ocean models, we collocated shark positions to mesoscale eddies to quantify how sharks interact with these energetic features in the Atlantic Ocean. Of particular interest is our comparison of eddy use by endo- and ectothermic sharks across a range of oceanographic regimes with varying eddy energy. The life history differences among shark taxa primarily provide thermoregulatory constraints on species' habitat use and structure how individuals are able to leverage deep ocean prey resources. Our results challenge the existing paradigm that anticyclonic eddies are generally unproductive, ocean "deserts" and suggest that their warm temperature anomalies at depth may facilitate connectivity between the epipelagic and the ocean twilight zone. This study also provides valuable new insight into open ocean habitat use by pelagic predators and how mesoscale eddies and meanders structure pelagic ecosystems. We propose that observations of mesoscale features should be incorporated into dynamic ocean management approaches. Furthermore, our results shed new light on the ecosystem value of mesopelagic prey, suggesting additional considerations are necessary before biomass extraction from the ocean's twilight zone as these activities could interrupt a key link between planktonic production and top predators.

9.2 | U.S. Atlantic Shark Fishery Management Update

Karyl Brewster-Geisz

38 The Highly Migratory Species Management Division of the National Marine Fisheries Service (NOAA Fisheries) is responsible for the management of the U.S. federal shark fishery in the Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea. Federal management of the Atlantic shark fishery began in 1993, and the management measures established at that time are the basis for those in place today, including permitting and reporting requirements, management complexes, commercial quotas, and recreational bag limits. At the 2023 meeting, I provided a 30-year retrospective of the fishery, focusing on how management has adapted to the changing science. I noted that while management has worked and the stocks of species involved are rebuilding, the fishery itself is at a crossroads. This year, I will provide an update on the current state of the fishery given recent emerging issues such as increasing reports of depredation across fisheries and the implementation of the listing of Requiem sharks on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

5.2 | Synthesizing Rates of Elasmobranch At-Vessel and Post-Release Mortality Across Gear Types and Taxonomy

Bethany Brodbeck, Nick Beltramini, Tobey Curtis, Yonat Swimmer, Edward Hale, Aaron Carlisle

392 Elasmobranchs are widely recognized as being particularly susceptible to overexploitation due to their life history characteristics, making accurate stock assessments even more imperative to maintaining healthy populations. Unfortunately, at-vessel mortality (AVM) and post-release mortality (PRM) rates are available for very few species across fisheries and gear types, hindering management efforts. Fisheries management must often use conservative mortality estimates when data are unavailable or apply surrogate rates from different species and/or gear types. However, mortality rates can be highly variable among species, within species, and across fisheries. As a result, using proxy values may lead to incorrect stock assessments and harvest quotas, negatively impacting the sustainability of these fisheries. To assist future management efforts, we synthesized all available literature regarding AVM and PRM for elasmobranchs (n = 109 publications). We used these data to characterize mortality rates for various gear types (e.g., trawl, longline, gillnet, purse seine, and recreational rod-and-reel) by taxonomy (orders and families).

We also calculated an index variable that describes the current state of our knowledge to better inform future studies on where they should potentially focus their efforts. Our analysis demonstrates a clear lack of knowledge of mortality rates across taxonomic groups and gear types and highlights a need for additional research on elasmobranch AVM and PRM.

31.2 | Mechanisms Behind the Decline of a Class A Brown Trout (*Salmo trutta*) Fishery

Eden Brody, Mark Kirk, Meredith Barney, Casey Bradshaw-Wilson, Lee Demi

325 Salmonid fishes are perhaps some of the most ecologically, recreationally, and commercially important species worldwide, however, many of these fisheries are in decline. Recent climatic trends have increased stream temperature, and land use patterns have caused increased sedimentation, both of which adversely affect Salmonid populations. Identifying the mechanisms responsible for local declines is essential for future restoration efforts. Caldwell Creek is a Class A Brown Trout (*Salmo trutta*) fishery in Northwest Pennsylvania that is reported to be experiencing a decline in trout abundance. This decline in trout populations is hypothesized to be associated with increased fine sediment inputs within the watershed. To evaluate the extent and potential causes of this decline in trout abundance, data on physical habitat, water quality, sedimentation levels, macroinvertebrate communities, and trout populations were collected from 10 sample sites in the Caldwell and Pine Creek watersheds. Data was analyzed to determine the differences in historic and current trout population metrics and the connections between abiotic stream inputs and trout populations. Results indicated a significant decline in the abundance of Brown Trout in Caldwell Creek. Analysis of abiotic inputs revealed that water temperature, stream-sediment loads, habitat quality, and watershed area were the primary factors influencing trout abundance in Caldwell Creek. This indicates that changes in thermal regimes due to climatic trends and increases in sediment loads from logging activity are likely responsible for the decline in trout abundance, suggesting that extensive restoration and mitigation work is needed for the sustainability of the Caldwell Creek Brown Trout Fishery.

26.10 | Morphological Variation in the Chondrichthyan Inner Ear and the Evolution of Low Frequency Sound Detection

Allison Bronson, Jordyn Neal, Taylor Cawthon, Malcolm Edwards-Silva, Angel Palomera, Madeline Pierce

341 The ecomorphology of the vestibular system of vertebrates has been investigated in numerous tetrapod groups but is rarely studied in fishes. Existing studies in elasmobranchs have focused mainly on the membranous labyrinth and its relationship with hearing, rather than on overall shape of the skeletal labyrinth and the potential effects of its variation on the sense of equilibrium. Using high resolution CT scanning, we reconstructed skeletal labyrinth morphology across a taxonomically diverse dataset of sharks and rays. We found an unexpectedly wide range of morphological diversity, which may indicate the influence of phylogeny, habitat, or locomotion. Though extant sharks and rays are generally specialized for Low Frequency Sound Detection (LFSD), we also found variation in structures associated with LFSD and compared those with fossilized skeletal labyrinths from stem group chondrichthyans, in order to better understand when and how these structures have evolved.

2.7 | Reef Song: can fishes enhance coral reef resilience and recovery?

Rohan Brooker, Miles Parsons, Daniel Pygas, Defne Sahin, Tiffany Sih, Diego Barneche, James Gilmour, Mark Meekan, Luke Thomas, Shaun Wilson

472 Coral reefs are exposed to increasingly frequent and severe disturbance, limiting time and opportunity for recovery. There is a clear need to explore new ways of enhancing coral health and resilience, to amplify recovery potential where possible. Ecosystem-based methods that take advantage of natural patterns and interactions may prove particularly valuable, reducing the inputs required to initiate this process. Coral reefs support complex communities of

fishes, many of which have a close relationship with corals. A growing body of evidence suggests reef fishes can support coral health; however, additional work is required to determine if and how these relationships can be harnessed to improve reef resilience and recovery. The Reef Song project, part the Australian Coral Reef Resilience Initiative (ACRRI), aims to address this issue. In a multi-year approach, Reef Song brings together novel research from Australia's east and west coasts to identify (a) how fishes influence coral growth and resilience, (b) how we can support coral-associated fish communities to enhance positive effects (e.g. by using sound to fish boost recruitment or diversity), (c) what ecosystem characteristics impact the effectiveness of these techniques, and (d) how this knowledge can inform practical, scalable solutions to improve reef recovery and restoration efforts. In this talk, I will outline the Reef Song project, our key experiments, initial findings, and discuss the next steps.

22.4 | Extensive genome-scale sampling untangles ancient jawed vertebrate phylogeny

Chase Brownstein

64 Jawed vertebrates, which comprise more than 62,000 species distributed across every major ecosystem on Earth, include numerous species-rich, ancient, and iconic clades with contentious relationships. Here, we leverage a dataset of 1,105 exons aligned for 554 species to resolve deep jawed vertebrate phylogeny. We identify strong support for clades that have only recently been resolved using genome-wide sequence data and comparative genomics, including the sister relationship of Elopomorpha (eels, tarpons, bonefishes) and Osteoglossomorpha (arwanas, elephantfishes) in Teleostei, the reciprocal monophyly of sharks and rays, the resolution of turtles and Archosauria as sister lineages, the placement of geckoes sister to all other lizards, and the resolution of Toxicofera, a clade formed by iguanians, anguimorphs, and snakes. Our results also provide support a clade containing coelacanth and lungfishes exclusive of tetrapods and the common ancestry of sturgeons, paddlefishes, and bichirs that is the sister lineage of all other ray-finned fishes. We find consistently low resolution across adaptive radiations classically hypothesized to have been spurred by ecological opportunity following mass extinctions, including birds, placental mammals, and spiny-rayed fishes, supporting the existence of genome-wide molecular signal of explosive diversification in the evolution of the most species-rich vertebrate lineages. These results establish how genome sequencing has dramatically changed the reconstruction of vertebrate phylogeny.

P2.28 | Misleading Allopatric Histories and the Evolution of the Sawfin Shiner

Chase Brownstein, Daemin Kim, Maya Stokes, Eva Hoffman, Gregory Watkins-Colwell, Thomas Near

84 Southeastern North America is a major biodiversity hotspot with hundreds of endemic species. The varied landscapes and geology of this region make it an exceptional system for studying the geographic basis of speciation in aquatic organisms. The most species-rich group of freshwater fishes are the more than 300 species of shiners and chubs that comprise the true minnows, Leuciscidae. Yet, the phylogenetics and species diversity of the shiners remains less studied than major clades of eastern North American vertebrates. Here, we use genomic data in combination with high-resolution computed tomography and detailed examination of external morphology to delimit and describe species diversity in the *Notropis spectrunculus* Mirror Shiner complex from the Blue Ridge in Georgia, Virginia, Tennessee, and the Carolinas. We formally describe the Sawfin Shiner, a species known for over half a century. The Sawfin Shiner differs from all other shiners by a high number of integumentary and osteological characteristics. There is no clear variation in osteology or external morphology consistent with drainage-level speciation among populations of Sawfin Shiner, despite low levels of gene flow among populations in different drainage basins comparable to species-level splits in other populations of Appalachian fishes. Our results demonstrate contrasting signatures of geographic distribution and morphological differentiation in eastern North American fishes and emphasize the role of integrative natural history for examining species diversity.

P1.71 | Cortisol synchrony influences pair-bond stability in the serially monogamous Convict Cichlid (*Amatitlania nigrofasciata*)

Kiedon Bryant, Edmund Rodgers

456 Endocrine synchronization is a biological process that is vital to social bonding. The mechanisms that mediate this process have been well studied in many vertebrate clades with evolved complex social behaviors. However, studies focusing on such processes in the less neurologically complex teleost clade are surprisingly lacking. In this study, we investigated the hypothesis that mated pairs of convict cichlids (*Amatitlania nigrofasciata*) perform cortisol synchronization and that the disruption of this process leads to pair-bond instability. Mated pairs were subjected to both behavioral and non-invasive waterborne hormonal assays to better understand the biological complexity of endocrine synchrony and its role in pair-bonding. Baseline cortisol assays indicated a positive correlation between male and female cortisol levels. Individuals that were subjected to a prolonged separation from their mate exhibited a negative correlation in cortisol synchrony after being reunited with their mate. Cortisol synchrony was disrupted, but pairs did not show a significant variance of intrapair aggression after initial pair reunion. However, more than half of the pairs that received the stressor exhibited significantly higher levels of intrapair aggression than their time matched controls approximately 5-7 days following this reunion, suggesting pair-dissolution. Not only does this study provide crucial insights in regard to the role of cortisol synchrony in serially monogamous systems, but it also suggests that the mechanisms that mediate the synchronization of endocrine for the formation of social bonds are more evolutionarily conserved than originally thought.

25.4 | Effect of a Gonadotropin Releasing Hormone Agonist on the Reproductive System of Male Cownose Rays (*Rhinoptera bonasus*)

Chris Buckner, Lance Adams, Robert George, Jared Durrett, Stacia White, Tim Handzel, Erin Legacki, Jennifer Wyffels

109 Cownose rays (*Rhinoptera bonasus*) are popular exhibit animals in zoos and aquariums. They are viviparous and females give birth to one young at the end of an 11-12 month gestation. Time to sexual maturity is 7-8 years for females and 6-7 years for males with a lifespan of more than 20 years. Because of their long lifespan and annual reproductive cycle, ray populations in human care can increase in number at unsustainable rates. To limit reproduction and mating related injuries, rays are often maintained in single sex groups. Ideally, reproduction could be reversibly managed using contraceptive agents to reduce aggressive mating behaviors and prevent or limit reproduction without the need to separate sexes. The objective of this study was to evaluate the effect of deslorelin, a GnRH agonist, on the reproductive system of male cownose rays. An implant (9.4 mg) was placed intramuscular in the right wing of male (n=3) rays. Control and treated rays were examined monthly for 1.5 years after implantation. Males treated with deslorelin had peak plasma androgen concentrations within the first quarter of treatment compared to control males. Androgen concentrations decreased gradually over time but remained elevated for 1.5 years after implantation. With few exceptions, semen with motile sperm was collected monthly from all males and the alkaline gland contained fluid suggesting deslorelin did not halt spermatogenesis or accessory gland fluid production. Despite significant effects on the endocrine component of reproduction for male cownose rays they remained fertile.

P1.66 | New Insights into the Diversity of Microsternarchini (Hypopomidae: Gymnotiformes) using Nuclear Genes

Matthew Burnett, José Alves-Gomes, Guillermo Orti

423 Gymnotiformes comprise a speciose order of fishes distributed throughout South and Central America, characterized by their electric organ discharges and electroreceptive capabilities. There are currently 285 valid species, but despite this high level of specific diversity, we suspect there remains a wealth of undescribed diversity, especially within the tribe Microsternarchini, which currently contains four species across three genera. Previous molecular work has revealed at least four distinct, undescribed lineages within the genus

Microsternarchus, although this only relied on COI data. Here we reconstruct the first phylogeny of Microsternarchini using double digest restriction enzyme associated DNA (ddRAD) markers. These multi-locus markers have shown to be useful in resolving phylogenetic relationships as they provide data across the whole genome, and can be used to detect gene flow and introgression. Congruence between the ddRAD and COI phylogenies lends support to the hypothesis of undescribed diversity, and lays the groundwork for future investigation into this group.

P1.78 | Effective Eradication of an Introduced Population of Common Watersnakes, *Nerodia sipedon*, in California

Lee Burrows, Brian Todd, Thomas Jensen

473 Non-native species pose significant threats to native biodiversity, especially when they establish or spread. It is more difficult to remove non-native species the further entrenched they become, making it more effective to focus eradication effort early in the invasion process. We evaluated the effectiveness of nine years of removal effort in a recently established population of non-native Common Watersnakes, *Nerodia sipedon*, introduced to Roseville, California. We used aquatic minnow traps to capture and remove snakes from 2015–2023. We estimated annual abundance using the Leslie depletion method and examined relative mass of snakes over time. We removed 110 snakes from 2015–2019, with none captured after 2019. Abundance declined annually during removal, with large estimates initially at 55 snakes in 2015 and 41 snakes in 2016, followed by a rapid decline to 4 snakes in 2017, 7 snakes in 2018, and 8 snakes in 2019. Abundance and relative mass of snakes were decreasing before removal began, possibly due to a drought, but relative mass increased after removal began, suggesting possible competitive release. Our results suggest the population was successfully eradicated, with no snakes seen since 2019. Drought conditions likely aided eradication, but the increase in relative mass of snakes as abundance declined highlights a possible risk of compensatory growth and a population rebound had removal effort ended prematurely. This study highlights the value of targeting removal effort to coincide with challenging environmental conditions, while revealing the risk of populations recovering from density-dependent releases if removal effort ends before successful eradication.

2.6 | Morpho-molecular Distinction of the Indo-Pacific Scorpionfish Genus *Parascorpaena* Bleeker 1876 (*Scorpaenidae: Scorpaenini*)

Roxanne Cabebe, Kentaro Mochizuki, Hiroyuki Motomura

74 A review of the validity of the morphological features defining the scorpionfish genus *Parascorpaena* resulted in the re-identification of *Parascorpaena bandanensis* as *Sebastapistes strongia*, reducing the valid species under the genus from nine to eight. The revised definition of *Parascorpaena*, based on morphological characters observed among the valid species, includes a complete lateral line, continuing onto the caudal-fin base, second to fifth or sixth pectoral-fin rays branched, two or three suborbital spines, body covered with pseudo-cycloid scales, lower jaw slightly shorter than the upper jaw, presence of palatine teeth, villiform teeth on the upper jaw, absence of lateral lacrimal spine, simple anterior and posterior lacrimal spines without additional spinous points, and a posterior lacrimal spine (PLS) strongly oriented forward with smaller specimens exhibiting forward curvature, while specimens <20 mm standard length have PLS oriented ventrally. Using one nuclear (recombination activating gene 1) and two mitochondrial (mitochondrial cytochrome oxidase I, 16S ribosomal ribonucleic acid) gene markers, a concatenated phylogenetic tree was constructed, showing the monophyletic nature of *Parascorpaena*. Furthermore, the molecular analysis placed *Parascorpaena* closer to one group of *Sebastapistes* (*Sebastapistes mauritiana* et c.), suggesting that they are potential sister taxa. This research expands our understanding on the systematics of the genus *Parascorpaena* by confirming the monophyly of the genus, affirming its sister taxa, and scrutinizing the validity of the morphological characteristics conventionally used to distinguish it with other genera.

28.1 | Taxonomic Overview of the Stone Loaches Genus *Barbatula* (Cypriniformes: Nemacheilidae) from Switzerland.

Bárbara Calegari, Lukas Rüber, Jörg Freyhof, Conor Waldo, Bernhard Wegscheider, Dario Josi, Ole Seehausen

417 Loaches are typically small, benthic, stream-dwelling fishes distributed in Eurasia, Morocco and Ethiopia. Stone loaches (Nemacheilidae) from European waters comprise two genera, *Barbatula*, and *Oxynoemacheilus*. Currently, six valid species of *Barbatula* are recognized in southeastern Europe based on molecular and morphological data (*B. hispanica*, *B. leoparda*, *B. quignardi*, *B. sturanyi*, *B. vardensis*, and *B. zetensis*), and the type species *Barbatula barbatula*, reported throughout northern Eurasia, from Spain to Japan. However, the wide distribution range combined with the high variation of color pattern and external morphology of *B. barbatula* suggests that it represents a species complex. Notwithstanding, several molecular studies based on mitochondrial markers with populations from different European regions detected the presence of several evolutionary lineages within this nominal species suggesting higher species diversity. A barcode assessment of fishes in Swiss rivers and lakes revealed two undescribed lineages, distinct genetically and morphologically from congeners. Currently, our analysis recorded *Barbatula* sp. nov. 1 mostly confined to the stream habitats widespread throughout the Aare-Rhine river system in Switzerland, and in Danube streams of Bavaria region in Germany and in Austria, while the second new species *Barbatula* sp. nov. 2 is distributed mostly restricted to the lakes of the Aare-Rhine system in Switzerland suggesting its endemism. The two new species are distinguishable from its congeners distributed in Europe by several differences in head and mouth shape, and morphometric proportions of the body and head. Further, the two new species differ from each other by orbital size, head depth, shape of dentary and opercle and other morphological traits.

P2.26 | Biogeography and Evolution of Auchenipteridae (Siluriformes): A Molecular and Morphological Perspective

*Bárbara Calegari, Tiago Carvalho, Roberto Reis**

420 Auchenipteridae is a monophyletic catfish family distributed along all major basins in South and Central America. Despite the high diversification in Auchenipteridae, biogeographical analyses are rare due to the lack of fossils that could be compared to the contemporaneous fish diversity. To start understanding this diversification, we tested how the rich landscape dynamics have shaped the drainage basin network influencing the radiation of auchenipterids. We estimated divergence times within Auchenipteridae by applying a total-evidence, fossil calibrated dating under birth-death model. Our results recovered age estimates to Auchenipteridae from the Eocene at 49.3 Ma (45–53 Ma). At this time, the basal division within Auchenipteridae occurs giving rise to the two major modern groups, Auchenipterinae and Centromochlinae aging at 42.9 Ma (38–47 Ma) and 42 Ma (37–46 Ma), respectively, before the Eocene-Oligocene boundary. It appears that Auchenipteridae started diversifying at the Paleocene-Eocene boundary in both Western Amazon and Paraná-Paraguay areas. Centromochlinae had early evolved mostly on the Paraná-Paraguay + Tapajós-Xingú areas with subsequent cladogenetic events expanding the distribution to other areas. Most dispersal events among the bioregions, mainly by Auchenipterinae members, occurred from Western Amazonia to the Paraná-Paraguay, facilitated by intermittent connections across the low-elevation watershed (Izozog wetlands) between the upper Madeira and upper Paraguay. Auchenipteridae is an interesting exclusively Neotropical group to study evolutionary radiation, with remarkable contemporary richness and complex biogeographical history of high biotic interchange that appears to be associated with repetitive bursts of speciation under different mechanisms that drove the diversification of the family.

P2.29 | A New Species of the Minnow Genus *Phoxinus* (Cypriniformes: Leuciscidae) From Lakes of the Aare Catchment in Switzerland.

Bárbara Calegari, Merline Roth, Conor Waldox, Bernhard Wegscheider, Dario Josi, Lukas Rüber, Ole Seehausen

418 *Phoxinus* is a freshwater genus of small fishes currently composed of 21 species widely distributed along Eurasian basins and North America. Currently, 13 valid species of *Phoxinus* are considered to occur in European drainages. Until recently, only two native minnow species were recorded to Switzerland, *P. phoxinus* distributed in the northern perialpine region, and *P. lumaireui* restricted to the southern drainages of the Alps. However, recent molecular studies evidenced the widely distributed *P. phoxinus* as a species complex with multiple independent lineages in Europe, some of which remain undescribed (Palandacic et al., 2015, 2017, Denys et al., 2020). Seeking to delimitate the different lineages of *Phoxinus* distributed over all four major drainages in Switzerland, an integrative taxonomy approach was used including mitochondrial sequence data, microsatellite genotypes and new morphological data to assess the relationships between populations. Preliminary results recognized at least four deeply divergent genetic lineages occurring in Switzerland: three valid species (*P. csikii*, *P. septimaniae*, and *P. lumaireui*), and one divergent lineage, that could possibly be recognized under a historically available name of *P. morella*. Additionally we detected two genetically and ecologically differentiated lineages within *P. csiki* clade, in which haplotypes from eastern river system of Alps represent *P. csiki* stricto sensu, and haplotypes restricted to lake system from Aare catchment represent a new species, indicating its endemism to Switzerland. Our results revealed much greater species diversity of *Phoxinus* in Switzerland than previously assumed.

P2.76 | The Effect of Ambient Light at Night on Stress and Energy Reallocation: Trade-offs Between Growth and Reproduction

David Calemmo, Christopher Howey

421 With the growth of urban areas, animals are now faced by more ambient light at night (ALAN) than ever before (Baughet al., 2017). This disrupts their natural biological clock throwing them out of homeostasis and dismantling vital processes. Glucocorticoids are hormones that mobilize glucose into the blood stream allowing for proper energy cycles and response to stress. The aim of this experiment is to determine how ALAN alters glucocorticoid concentrations within the body and how this disturbance affects body condition and testicular size and spermatogenesis in green anoles (*Anolis carolinensis*). Green anoles will be housed in natural light conditions (12:12 Light:Dark cycle) and in ALAN experimental conditions (24:0 Light:Dark cycle). After 10 weeks we will measure glucocorticoid concentrations before sacrificing and dissecting the anoles to mass and stain the testes. Staining techniques will determine spermatogenesis activity within the testis. I will compare differences in testis mass and spermatogenesis activity between treatments and compare to differences in overall anole body condition and glucocorticoid concentrations. Results from this study may give insight into how stress effects organisms over extended periods of time specifically observing the reallocation of energy from non-vital systems.

8.2 | The Metabolic and Temporal Effort of Ecdysis in Timber Rattlesnakes (*Crotalus horridus*)

Maxwell Carnes-Mason, Jason Ortega, Steven Beaupre

17 The semi-frequent, synchronous replacement of the entire epidermis is a requisite energetic expenditure in squamate reptiles. In snakes, ecdysis requires metabolic effort in three distinct quantities: the biosynthesis of new tissue, the effort to physically remove the old skin, and energy sequestered in new tissue in the form of proteins and lipids. Ecdysis also requires significant temporal investment as animals alter their behavior and seek refuge during ecdytic cycles. The metabolic and temporal efforts associated with ecdysis have been poorly studied. Herein, we present the first measurements of the cost of skin biosynthesis in ecdytic snakes. We used open flow respirometry to measure the metabolic effort (biosynthesis and removal) and duration of ecdysis at 25°C in nine Timber rattlesnakes in a range of body sizes (117g-1100g).

We found that energetic effort of biosynthesis scaled with body mass, but effort of physical removal was variable and unrelated to body mass or size. We estimated that total effort (kJ) of a single shed event accounts for 3% (~163 kJ) of the total annual energy budget of a 500g adult, representing the energetic equivalent of consumption of ~2 adult deer mice. Using measurements of metabolic effort, we were able to determine the complete duration of the process and found that a single shed event takes approximately 4 weeks at 25°C, with energetic investment beginning up to two weeks prior to any external morphological evidence of impending shed. Our data demonstrate that ecdysis is a significant energetic and temporal cost for snakes, and further emphasize the need for additional studies of frequency and timing of ecdytic cycles.

30.3 | Clear as Mudsnares: Stable Isotope Analysis Reveals a Dietary Shift in Farancia

Cynthia Carter, Stephen Mullin

133 Ecological theory predicts that the proportion of predatory relationships within a trophic web should increase with a greater number of species comprising that web. An increased number of species within a community is also associated with ecological patterns such as niche partitioning, competition, or some level of polymorphism within the species comprising that community. The roles that snakes play within trophic webs are challenging to assess because these predators are difficult to detect, eat infrequently, and almost never leave evidence of successful predation. We used stable isotope analysis to examine the diet of Red-bellied Mudsnares inhabiting a mosaic of wetland habitats near the northwestern limit of their range. Snakes representing the two age-classes differed in their isotopic profiles, with adults being enriched in nitrogen relative to juveniles. Mixing models based on plasma tissue predicted that more than 50% of the diet of juvenile mudsnakes consists of a single prey type, whereas adults exhibit a more generalized pattern of diet composition. We compare these results to records of prey items consumed by mudsnakes, as well as contemporary assessments of the diets of syntopic snake species.

36.7 | Roamers and residents: Contextualizing tiger shark (*Galeocerdo cuvier*) use of protected areas in the Caribbean

Grace Casselberry, Andy Danylichuk, Kristen Ewen, Bryan DeAngelis, Gregory Skomal

479 Fisheries management of highly migratory species in the Caribbean presents numerous challenges related to the geography of the region and resources available for regulatory enforcement. Consequently, shark populations in the Caribbean have undergone significant declines due to overharvest and habitat loss, with the U.S. Virgin Islands (USVI) identified as one of the last strongholds for these populations. However, little is known about shark spatial ecology in this region. To provide a more complete understanding of tiger shark movements in the USVI and the greater Caribbean, 17 sharks were tagged internally with coded acoustic telemetry transmitters and externally with fin mounted, real-time transmitting satellite tags in Buck Island Reef National Monument (BIRNM), a marine protected area (MPA) in St. Croix, USVI. Preliminary results from data collected from November 2019 – April 2024 show varying use of BIRNM with some individuals being largely transient and others exhibiting regular, year round use of the MPA. Overall, mean residency was significantly higher from January through May than in the latter half of the year. Integrated acoustic and satellite telemetry tracks revealed that sharks spent time in the jurisdictional waters of all islands in the U.S. Caribbean, but also crossed boundaries into nine other Caribbean nations and spent extensive time in international waters in the Caribbean Sea and Northwestern Atlantic. By applying network analysis to these data, we quantified connectivity between BIRNM, other jurisdictions, and regional fisheries management areas. A high degree of connectivity exists between the U.S. Caribbean and coastal Venezuela, where one shark was harvested in a gillnet fishery 57 days after tagging. While tagged sharks were detected in nine other year round or seasonal closed areas, they spent a relatively low proportion of their time in these management zones. Our results highlight the complexity of applying spatial management approaches for highly mobile, wide-ranging species.

P1.20 | Taking a Closer Sniff at Shark Noses: Analyzing Elasmobranch Olfactory Morphology through Scanning Electron Microscopy Imaging

Gabriella Castillo, Lauren Simonitis, Aubrey Clark, Marianne Porter, Tricia Meredith

63 The elasmobranch olfactory system consists of two paired olfactory capsules housing the olfactory rosettes. The rosettes comprise sheets of tissue with primary and secondary folds, known as lamellae. As sharks swim, odorants dissolved in water flow through their nares (nostrils) and pass over the lamellae of the rosettes. Lamellae contain regions of sensory and non-sensory epithelium. The sensory regions of lamellae are composed of ciliated supporting cells and olfactory receptor neurons (ORNs), which bind to odorants in the water. Information is then sent to the brain for further processing. Using scanning electron microscopy (SEM) imaging, I have been able to analyze the internal olfactory morphology of two samples of *Squalus suckleyi* (Pacific Spiny Dogfish shark). Under the mentorship of Dr. Lauren Simonitis, I have spent the last few months working in Dr. Marianne Porter's Lab at the FAU High School Imaging Lab learning the techniques used to analyze the internal olfactory morphology of sharks. Through the use of SEM imaging, I have been able to identify the regions of ciliated sensory epithelium and the much smoother non-sensory tissue, allowing me to map the lamellar surface area devoted to sensitivity in different regions of the rosette of Pacific Spiny Dogfish sharks.

5.3 | Predictive Modeling of Adaptive Variation in Tiger Sharks (*Galeocerdo cuvier*) Across the Western North Atlantic

Eloise Cave, Anna Weber, Michael Criscitiello, Jeannine Ott, Toby Daly-Engel

241 Adaptive variation plays a key role in a species' ability to persist in the face of changing ecological conditions. The field of seascape genomics allows scientists to explore how spatial relationships and environmental factors in the ocean shape the geographic distribution and genetic patterning in marine organisms. Here, we aim to assess patterns of potentially-adaptive genetic variation in tiger sharks (*Galeocerdo cuvier*) across the western Atlantic, northern Caribbean, and Gulf of Mexico (GOM). Single nucleotide polymorphisms (SNPs) were generated on 283 tiger sharks by Double-Digest Restriction Site Associated DNA sequencing (ddRAD-seq) and sequenced on a Nextseq 550 and a Novaseq 6000. A redundancy analysis (RDA) was employed to identify outlier SNP loci that exhibited significant associations with environmental factors. Of 3,833 SNPs, 25 candidate SNPs showed signals of environmental selection: 15 were associated with sea surface nitrate, nine SNPs with salinity, and one with dissolved oxygen. The RDA identified three genetic clusters (northern GOM, Big Bend of Florida, and coastal Atlantic) that showed correlation with different environmental factors despite close spatial proximity. We are now employing a Gradient Forest model to map future adaptive variation in different climate scenarios in a predictive rather than reactive approach to management. This study reveals how even the largest shark species may adapt to local environmental conditions, providing insight for conservation of locally-adapted populations in the face of climate change.

P1.39 | Quantifying the Maternal Transfer of Microplastics in Spiny Dogfish (*Squalus acanthias*)

Abigail Cavaris, George Boneillo, Daniel Abel

207 Particulate microplastic particles are ubiquitous in marine species and their environment. Microplastics have been observed in the digestive tracts and livers of both adult and young-of-year shark species, but there remains a gap in research regarding the maternal transfer of microplastics during the internal growth and development of fetal sharks. In this study, the digestive tracts (n=19), livers (n=20), yolk sacs (n=9), and ova (n=12) of seven pregnant female Spiny Dogfish (*Squalus acanthias*) and their subsequent offspring were analyzed for the presence of microplastic particles. Preliminary results indicate that microplastics are present in the liver and digestive tracts of both adult and fetal spiny dogfish as well as in the fetal yolk sacs and ova. The majority of

these microplastics appear in the form of microfibers with blue as the primary coloration. Data are currently being statistically analyzed for trends in microplastic distribution and concentration within the analyzed organisms.

8.7 | Just another boring house gecko? Integrative taxonomy of the *Hemidactylus mabouia* complex

Luis Pires Ceriaco, Ishan Agarwal, Diogo Parrinha, Mariana Marques, Miguel Rodrigues, Aaron Bauer

163 The African Tropical House Gecko, *Hemidactylus mabouia*, is one of the most successful invasive species of gecko in the world, with established populations in South, Central and North America, the Caribbean and the East Atlantic Islands, parts of Europe, Asia and Australia. In continental Africa, the species has been historically understood as being one of the continent's most ubiquitous reptiles, with an almost pan-African distribution. Its wide distribution on the continent and proximity to human settlements has likely resulted in the disinterest in it that most herpetologists seem to have — too common to be interesting, "just another boring house gecko!". Recent molecular studies have however shown that *H. mabouia* is a species-complex comprised of more than 20 species level lineages. The nominotypical form occurs in West and Central Africa and all the invasive populations outside Africa belong to this lineage, but the East and Southern Africa populations represent an impressive number of locally endemic species that have so far gone unnoticed. Using an integrative taxonomic approach, combining molecular data with the morphological analysis of hundreds of specimens from across the range of the *H. mabouia* complex, we were able to identify 24 new species of *Hemidactylus* and map their distributions. These results refine our understanding of the biogeography of Sub-Saharan Africa and are an important reminder that how even some of the most ubiquitous species deserve integrative taxonomic studies.

P2.36 | An eighteenth century "fish-herbaria": unlocking the secrets of early Brazilian ichthyology

Luis Miguel Pires Ceriaco, Bruna Santos, Thiago Semedo, Lucas Garcia, Cristiano Moreira

165 Two Portuguese institutions, the Museu Maynense da Academia das Ciências de Lisboa (ACL), and the Museu da Ciência da Universidade de Coimbra (MCUC), house a collection of 85 dried fish specimens prepared in what can be called a "fish-herbaria" following a process similar to that developed by the Dutch naturalist Johan Frederic Gronovius (1690–1762). These specimens date back to the late eighteenth century and represent Brazilian taxa. Previous authors assumed that they were part of the collections amassed by the Brazilian-Portuguese naturalist Alexandre Rodrigues Ferreira (1756–1815) during his "philosophical voyage" to the Amazon. Here we present a review of these specimens, suggesting that they belonged to Friar José Mariano da Conceição Veloso (1742–1811) and describe the history of dispersal of these collections up to the present day. A total of 58 species in 50 genera, 32 families and 19 orders are represented in the collection. Only 8.6% of these specimens represent freshwater species, while 91.4% are marine or brackish water species. The present known distribution of these taxa is focused on southwestern Brazil, which agrees with the area where Veloso collected natural history specimens. A good percentage of the species were undescribed at the time Veloso collected them, and had they been published by him, would have had priority over species described decades later by famous eighteenth and nineteenth century ichthyologists.

P2.58 | Reproductive isolation and patterns of co-occurrence in Black-bellied and Shovel-nosed Salamanders (*Desmognathus*)

Rebecca Chastain, Benjamin Fitzpatrick, Aidan Shaw

246 Black-bellied and Shovel-nosed Salamanders (formerly classified as *Desmognathus quadramaculatus* and *D. marmoratus*) were once thought to be two species illustrating ecological niche partitioning, with Shovel-nosed Salamanders (SN) having an almost exclusively aquatic life history in medium to large mountain streams, and Black-bellied Salamanders (BB) a semi-aquatic strategy in those same streams in addition to smaller streams and springs.

Two decades of molecular systematics has revealed that the two phenotypes do not map to two evolutionarily coherent species. Each phenotype is present in two divergent clades of *Desmognathus* with different but overlapping geographic distributions. The current taxonomy reflects the hypothesis that each clade is composed of multiple species of each phenotype. Some evidence is consistent with the alternative hypothesis that the northern clade is a single polymorphic species. However, no previous study has tested whether the two phenotypes interbreed where they coexist. We obtained the large population samples necessary for such a test using population genetics. Our results confirm reproductive isolation between morphs within the southern clade and between the southern and northern clade. In contrast, preliminary analyses are consistent with free interbreeding between SN and BB phenotypes within at least some northern populations. If this interpretation holds up, the distribution of phenotypes and genotypes in the zone of contact between northern and southern lineages may have exciting implications for the interaction between ecology, genetics, and development.

11.16 | Study of Local Herpetofauna as an Undergraduate Research Project

Kuei-Chiu Chen

461 Students in undergraduate science programs are often encouraged to participate in research. Here we present an opportunity to study local herpetofauna to premedical students at an overseas branch of a US medical school in Qatar. Volunteer student researchers received IACUC training for wildlife studies and participated in specimen collection from the wild. They conducted morphological identification and DNA sequencing of the cytochrome oxidase (COI) barcoding gene. Specimens comprising 24 species were collected, including all but one reported lizard species and majority of the snake species in Qatar and representing all higher squamate clades. Sequencing data from the available species were uploaded to GenBank and the Barcode of Life Databases with sequences from at least nine species being the first records. To assess if COI could resolve the phylogeny of squamates the maximum likelihood analysis was conducted with *Sphenodon punctatus* sequence as outgroup. The results showed consistent sister taxa relationships between congeneric species. A strong support of sister taxa relationship was also found between species of Agamidae and Serpentes. However, none of the other higher taxa relationships was resolved clearly using COI data alone. The information was reported by a lead student author in a paper published in a local journal. This research process has empowered undergraduates to report new biodiversity information on a region where such studies are only caught on recently and should be expanded to include other fauna.

CANCELLED - P1.29 | Relative Abundance, Seasonal Occurrence, and Movement Patterns of Juvenile Sandbar Sharks, *Carcharhinus plumbeus*, in Northeast Florida and Southeast Georgia

Katherine Chiaviello, Ashley Johnson, R. Grubbs, Bryan Franks

365 The sandbar shark, *Carcharhinus plumbeus*, is a protected species that undergoes seasonal migrations along the eastern coast of the United States. Young-of-the-year (YOY) and juvenile sandbar sharks use inshore coastal nursery habitats for multiple years after birth. Based on preliminary catch data, juvenile sandbar sharks are commonly captured within the lower St. Mary's River, known as Cumberland Sound, suggesting this area may function as a nursery for this species, although details regarding fine-scale use are lacking. The major objectives for this study are to measure the seasonal occurrence, relative abundance, and movement patterns of YOY and juvenile sandbar sharks within inshore waters of Northeast (NE) Florida and Southeast (SE) Georgia. When characterizing nursery habitats, measuring catch per unit effort (CPUE) to quantify YOY and juvenile sandbar shark abundance will help delineate specific nursery habitat within the region. CPUE will be compared between months and with environmental parameters to resolve factors impacting relative abundance. YOY and juveniles (n=5), with a ~1:1 sex ratio will be tagged using Innovasea V13-1x continuous acoustic transmitters and manually tracked using a VR100 acoustic receiver with a directional hydrophone to examine fine scale movement patterns. Measuring relative abundance and defining

movement patterns within this potential nursery will fill critical knowledge gaps of habitat use in juvenile sandbar sharks to better manage and protect the health and survival of this species.

29.3 | Health Assessments in Free-Ranging Sand Tigers (*Carcharhinus taurus*) in the North Atlantic

Emily Christiansen, Michael Hyatt, Robert George, Kady Lyons, Jennifer Wyffels

323 The capture and handling of free-ranging elasmobranchs for tagging and other ecology research projects provides an invaluable opportunity to collect biological samples and obtain benchmarks of health for wild populations, as well as identify differences that may exist between life stages and regional sub-populations. A group of public aquarium institutions have been engaged in a collaborative effort to study sand tiger sharks in the northwest Atlantic since 2015, and the involvement of veterinary staff from these institutions in the research efforts has facilitated direct comparison of free-ranging animal health status with that of animals in managed care. Samples from New York (n = 31), North Carolina (n = 30), and South Carolina (n = 20), were collected and analyzed over several field seasons, including subadult males and females as well as mature adults of both sexes in both active and resting reproductive states. Ultrasound exams were performed on many of the animals to assess reproductive status and organ health, and blood samples were collected for blood gas analysis, complete blood counts, biochemistry panels, protein electrophoresis, acute phase proteins, fatty acid analysis, trace minerals and vitamin levels. Many of the values were consistent across groups, but several interesting differences have been identified, most likely attributable to ontogenetic, regional and seasonal differences at the time of sampling.

P1.35 | Morphological and Genetic Analysis of *Rostroraja* in the Gulf of Mexico

Kaitlyn Cisz, Lindsey Nelson, Christian Jones, Eric Hilton, Jan McDowell

156 Two of the eight species in the genus *Rostroraja* are known to occur within the Gulf of Mexico: Clearnose Skate, *Rostroraja eglantaria* (Bosc 1800) and Roundel Skate, *Rostroraja texana* (Chandler 1921). Samples of *R. texana* were collected in 2019 from the Southeast Area Monitoring and Assessment Program (SEAMAP) trawl surveys in the northern Gulf of Mexico. Preliminary assessment of these specimens suggests that a third species of *Rostroraja* is also being caught in the Gulf of Mexico, tentatively identified as the Ocellate Skate, *Rostroraja ackleyi* (Garman 1881). The geographic range of *R. ackleyi* is currently described as being limited to the area stretching from Southern Florida to Cuba, and the far northwestern edge of the Yucatan Peninsula, and not overlapping with that of *R. texana*. Since *R. ackleyi* and *R. texana* share many morphological characteristics, including similar body form and pectoral ocelli, it is possible that if *R. ackleyi* is present in the Gulf of Mexico, it is being mistaken as *R. texana*. The purpose of this project is to use morphological and genetic data to determine if *R. ackleyi* is present in the Gulf of Mexico. Misidentification of species can have serious implications on the exploitation of both species. It is therefore important to determine which species occur in the region to better inform management decisions.

P2.21 | CryptoVert: Digitizing Cryptobenthic Fishes in Support of oVert

Todd Clardy, Madison Wilson, Teresa Porri, William Ludt

198 Cryptobenthic fishes are small-bodied, short-lived inhabitants of reef systems around the world. In recent years, our understanding of the ecological importance of cryptobenthic fishes has increased, with their taxonomic diversity and varied ecological roles of particular note. However, there is relatively little detailed information on the anatomy of these fish to allow in-depth investigations into their adaptations to such specialized lifestyles. In this presentation, we summarize a digitization project led by the Department of Ichthyology at the Natural History Museum of Los Angeles County, in support of the openVert project (oVert), in which we have been working to digitize cryptobenthic fishes since 2020. In this project, each specimen is photographed and then scanned twice at 10 µm resolution, once using traditional CT scans to document the

skeletal system and again using contrast-enhanced CT scans to examine soft tissue anatomy, including muscle, digestive, circulatory, and nervous systems. To date, a total of 289 scans have been made across 12 families of cryptobenthic fishes. Of these, 233 scans have uploaded to MorphoSource and are available as open downloads, with additional scans uploaded weekly. We anticipate these scans will support research into general trends in vertebrate anatomical evolution associated with body size and will be a valuable resource for the development of new questions and hypotheses in a variety of scientific disciplines.

15.8 | Comparative three-dimensional olfactory morphology of three elasmobranch species

Aubrey Clark, Lauren Simonitis, Marianne Porter, Tricia Meredith

274 In elasmobranchs, the gross morphology of the olfactory system is conserved among species. In the chondrocranium, cartilaginous capsules house a paired set of peripheral organs, called olfactory rosettes, that are exposed to environmental water flow via openings in the capsules. The rosettes are composed of lamellae-folded tissue containing regions for odorant binding. The rosettes have a broad range of sizes, shapes, and internal arrangements that vary among species. While the functions of these variations are unknown, they are hypothesized to optimize water flow and odorant binding. We aimed to quantify the morphology of the olfactory system in three diverse elasmobranch species. We stained fixed specimens (N= 6; bonnet-head shark, *Sphyrn tiburo*; pacific spiny dogfish, *Squalus suckleyi*; and blacktip shark, *Carcharhinus limbatus*) with 5% phosphotungstic acid (PTA). We then collected three-dimensional morphology data using a Bruker Skyscan 1173 microCT scanner. We quantified the morphology of the rosette, internal structures, capsule, and the channels used to direct water flow. Based on prior research, we expect to see species-specific differences in these structures, such as larger interlamellar spacing in rosettes with fewer lamellae. These variations may control water flow and hydrodynamic behavior to optimize odorant detection in elasmobranchs.

P1.21 | How tough are ya? Comparative mechanical properties of shark vertebral columns

Aubrey Clark, Madisan Biordi, Aisha Mirza, Marianne Porter

272 The vertebral column of fishes undergoes constant bending during swimming and maneuvering. In elasmobranchs (sharks, rays, and skates), the vertebral column is composed of highly mineralized cartilage as stiff and strong as mammalian trabecular bone. Swimming sharks have a double oscillating system, where the head yaw's frequency and amplitude differ from the tailbeat, which suggests that forces in the anterior portion of the vertebral column may differ from the posterior. We hypothesized that the mechanical properties may vary across vertebral column region in response to the varied cranial-caudal forces. We quantified vertebrae mechanical properties of 15 shark species (3 orders) from three body regions (anterior, middle, and posterior). We hypothesized that across all species, the posterior vertebrae would be the stiffest (MPa, resisting deformation) and toughest (MPa, absorbing energy) while swimming. Using an Instron E1000, we quantified compressive mechanical properties for each body region. We expect that vertebrae from the middle body region will be the stiffest and toughest to act as a pivot point for the double oscillating system. Understanding vertebral column properties provides insights into the mechanical underpinnings of aquatic movement. This work was supported by the United States National Science Foundation (IOS award 194713).

CANCELLED - P1.59 | eDNA Collection: Enhancing Biodiversity Assessments Through Semi-Passive Methods

Paul Clerkin, Miguel Montalvo, Jan McDowell

344 Marine monitoring and species surveys are the foundation of living resources management. Traditional physical catch surveys (longline, trawl, seine, etc.) have long been crucial to collect information relevant to management, but rely on expensive, time-intensive, and invasive methods. Recent developments in environmental DNA (eDNA) show promise in cheaper, swifter

field sampling, and collaboration with citizen scientists. However, some environments still pose challenges for citizen science projects, namely marine ecosystems, due to issues with subsurface water collection, filtration, and contamination. This project introduces the Semi-passive Quick Underwater In-situ Deployment eDNA (SQUID-e) sampler, designed for quick intuitive deployments by stakeholders interested in eDNA surveys without water collection and in-lab filtration. The SQUID-e's inverse funnel forces water through its filter negating the need to collect or filter water samples, and a changeable filter cartridge allows for quick and easy filter changes without the need for forceps while minimizing contamination risk. Here we share our primary results of the SQUID-e's efficacy in detecting aquatic species, future direction for development, and potential implementations. This promising approach holds potential for making eDNA studies widely available to non-experts and expanding tools for citizen scientists.

1.6 | Coastal development in a shark nursery: impacts of long-term habitat change on juvenile lemon shark survival in Bimini, the Bahamas

Emily Cormier, Matthew Smukall, Felicie Dhellemmes, Derek Tittensor, Heike Lotze

355 Many shark species are currently facing anthropogenic driven pressures, including the loss of critical habitat. In Bimini, the Bahamas, mangrove and seagrass areas provide a nursery for juvenile lemon sharks (*Negaprion brevirostris*), which show high site fidelity during the early years of their life. Additionally, female lemon sharks show natal philopatry, making these areas critical to their reproduction. Over the past two decades, coastal development has removed large areas of mangrove in the Bimini lagoon, potentially reducing the overall viability of Bimini's nurseries. To understand the impacts of coastal development on two neighboring nursery areas, annual mangrove and seagrass extent was mapped from 1999 to 2020 using satellite remote sensing. We then analysed the effect of calculated habitat extents on annual shark survival estimates from a long-term mark-recapture dataset. While satellite remote sensing revealed a clear effect of development on seagrass extent, implications for shark survival were less clear. In both nurseries, habitat extent did not significantly affect survival, possibly due to habitat availability in other parts of the Bimini lagoon. However, the amount of habitat change in a year differentially affected survival in both nurseries. Counter intuitively, the nursery in closer proximity to development showed marginally increased survival probability in years with greater change, while the further nursery showed decreased survival probability with greater change. These results highlight the nuanced impacts of coastal construction on shark survival and emphasize the importance of mitigating construction impacts while protecting remaining mangrove areas to ensure continued lemon shark resiliency.

P2.9 | Reassessing The Relationship of Spawning Mode to Conservation of North American Minnows (Leuciscidae)

Joel Corush, Milton Tan

401 Minnows (Leuciscidae) are the most species-rich freshwater fishes in North America. They display a wide variety of spawning modes, and a large number of species are listed as threatened or endangered. A relationship between spawning mode and conservation status has been suggested, however at that time no adequate phylogeny or appropriate comparative methods were available for proper testing. Here we integrate the most complete phylogenetic reconstruction of minnows coupled with phylogenetic comparative methods to reassess the relationship between spawning mode to conservation status of North American minnows. Additionally, we assess the predictive power of phylogenetic imputation of conservation status and spawning mode to data deficient species.

P1.61 | Mercury Levels of Freshwater Fish in the Santa Ana River, Southern California

Nellie Covert, William Ota, Christine Jackson, Kurt Anderson, George Jackson

362 Mercury pollution remains a concern of conservation biologists and ecologists due to bioaccumulation and biomagnification leading to long-lived predators accumulating higher concentrations of mercury than primary consumers. Ingesting high levels of mercury can cause a suite of complications for wildlife and the people that consume them. Mercury poisoning can cause lethal and sublethal effects. Some sublethal effects include deformities, decreased reproductive rates, altered hormone production, and ataxia. It is critical to understand mercury accumulation in freshwater fish in Southern California which can be consumed by the human population. To explore mercury contamination, three fish species were collected from four sites along the Santa Ana River. Muscle samples were collected from yellow bullhead (*Ameiurus natalis*), large-mouth bass (*Micropterus salmoides*), and mosquitofish (*Gambusia affinis*). Samples were dried first using a freeze-dryer, stored in a -80 °C freezer, and dried again using a speed dryer right before analysis. Milestone Direct Mercury Analyzer-80 (DMA-80) was used for the mercury analysis. Results have shown presence of mercury in all samples 0.0161 mg/kg - 0.5303 mg/kg with a relationship between sites and size of the individual. Detection of mercury levels indicates a need for further investigation. The sites analyzed are near areas of various anthropogenic activity. Additionally, these sites are accessible meaning not only are native wildlife like the arroyo chub (*Gila orcuttii*) and the Santa Ana sucker (*Catostomus santaanae*) exposed to these mercury levels, but also people that fish along this river.

P2.34 | The Fish Collection at University of Massachusetts Amherst

Cristina Cox Fernandes, Katherine Doyle, Cristian Paunescu

483 The fish collection of the UMass Amherst Natural History Collections was established in the 1950's by ichthyology professor Thomas J. Andrews. Within the collection, the oldest specimens date back to the early 1900s. By the 1980's, Andrews had collected and catalogued more than 1,800 lots. From its early days, our fish collection has been used in the teaching of ichthyology courses, labs and research. At present, the collection houses about 54,000 specimens, both fluid and skeletal, in about 5,500 lots. The freshwater fishes come primarily from Massachusetts as well as 20 other states, while the marine fishes come mainly from the western North Atlantic. A highlight of our collection is a set of 628 skeletons of marine fishes from the Gulf of Mexico, obtained during fishing tournaments at Dauphin Island, Alabama, prepared and deposited by Professor Emeritus Willy Bemis and his collaborators. 4,900 lots or so are preserved in fluids, all of which can be accessed by Specify software. The skeletal specimens are the next to be catalogued in the same way. The history and development of our fish collection, as part of the UMass Natural History collection, has had its ups and downs over the decades, as faculty members have left and retired. Yet, during the past 10 years or so, the collection space and infrastructure have been significantly improved. This was possible thanks to the Department of Biology and to two endowments that allow us to function independently for curatorial maintenance.

P2.46 | Neurodevelopmental Impacts of Organophosphates on Early-stage Amphibian Larvae

Delanie Crabtree, Sara McClelland

371 Malathion, an organophosphorus insecticide, has been found in surface waters in the US and worldwide. Surface water contamination results in amphibians being exposed to malathion throughout their most sensitive life stages, those of larval development. While the levels commonly found in nature are presumed not to cause harm, little research is actually done to test this. Other organophosphate pesticides have been shown to impact tadpoles even at low, ecologically appropriate concentrations, however, the impact of low, environmentally relevant concentrations of malathion on neurodevelopment and behavior have never been tested. To explore the effects of malathion on amphibians, Northern Leopard Frog tadpoles (*Lithobates [Rana] pipiens*) were exposed to either a vehicle control or to 1 µg/L of malathion for three weeks in

a blind laboratory study. Behavior and brain morphology were analyzed. Results revealed significant changes in brain morphology, as well as changes in the behavior, providing evidence that even low, putatively safe levels of malathion can affect tadpole neurodevelopment. This work has implications for management of how we apply chemical toxins and for conservation efforts aimed at protecting declining amphibian populations. (If interested, we have a second poster assessing effects of malathion on late-stage larvae as well.)

P1.19 | Blood Culture Survey in Free-Ranging Sand Tiger Sharks (*Carcharias taurus*)

Chestina Craig, Kady Lyons, Bryan Frazier, Johanne Lewis, Lisa Brown

478 In vertebrates, blood is considered a sterile environment, and the presence of bacteria indicates a systemic infection. However, bacteria in the bloodstream has been detected from seemingly healthy mammals, several species of teleost fish, and elasmobranchs. Elasmobranchs, both captive and wild-caught individuals, have been shown to harbor bacteria in their blood, several of which are known to be pathogenic in fishes (e.g., *Vibrio* spp. and *Pseudomonas* spp.). It is unclear whether bacteria in the blood is a baseline condition in elasmobranch fishes, or what factors may influence their presence in healthy individuals. The objectives of this study were to determine the prevalence of bacteria in the blood of free-ranging sand tiger sharks, and to evaluate whether shark length or sex influenced bacterial prevalence. Wild sand tiger sharks were captured and sampled via longline off the coast of South Carolina. Collected blood samples were placed in liquid culture media in the field, followed by incubation and plating on marine agar in the lab to observe growth of bacterial colonies. Of the sharks tested (n = 22), 72% yielded anaerobic bacterial colonies from their cultured blood. There was no significant difference in bacterial presence between sexes and no significant relationship with length. The results from this study demonstrate that bacteria is culturable from the blood of sand tiger sharks. Further work should be done to identify the species of bacteria within the bloodstream and determine the effect of this bacterial presence on the elasmobranch immune system.

20.1 | Whole-Genome Sequencing Reveals the Presence of Japanese Sardine (*Sardinops melanostictus*) in the California Current: Climate Change or Business as Usual?

Matthew Craig, Gary Longo

168 In the early stages of a project assessing population genetic structure in Pacific Sardine (*Sardinops sagax*) in the California Current Ecosystem (CCE), we observed two, highly distinct groups that differed at levels normally observed between different species. Upon further examination, it was determined that the dataset indeed represented two species, Pacific Sardine (*S. sagax*) and Japanese Sardine (*S. melanostictus*). In order to evaluate the spatiotemporal distribution of Japanese sardine in the CCE, we developed a modified GTSeq method to rapidly assign the correct species to archived tissue samples that were collected in the CCE from 2013-2023. Overall, species assignment was obtained for >3000 individuals. Japanese sardine were identified predominantly from samples collected in 2022 and 2023 and from Oregon to southern California, USA. We hypothesize that dispersal of the Japanese sardine may have been facilitated by notable periods of anomalously warm surface waters in the northeast Pacific coupled with range expansion precipitated by a rebuilding population.

15.2 | Behavioral electrosensitivity increases with size in the sandbar shark, *Carcharhinus plumbeus*

Lisa Crawford, Charles Edelson, Robert Hueter, Jayne Gardiner

75 During elasmobranch ontogeny, increasing body size has been proposed to result in a tradeoff between increased sensitivity and decreased spatial resolution of the electrosensory system, but this hypothesis has not previously been tested. Further, the sensitivity of the electrosensory system has not been examined in any large sharks. In the present study, we examined the behavioral electrosensitivity of large (likely adult) sandbar sharks to prey-simulating electric fields, compared with previously published results for small (juvenile) sandbar sharks. We found that the large sandbar sharks, which were

approximately three times larger than the small juveniles previously tested, had lower minimum (0.002 nV/cm) and median (0.5 nV/cm) response thresholds. These represent the lowest sensitivity thresholds of any elasmobranch studied to date. Since electric field detection plays an important role in feeding behavior, increases in sensitivity of the electrosensory system and the corresponding increase in electric field detection distance with growth may be linked to ontogenetic dietary changes.

P2.73 | The Jumping performance of two Eleutherodactylus frog species: the effect of temperature.

Gisela Crespo-Martínez

33 This study was undertaken to compare the effect of changes in ambient temperature on the jumping performance of two congeneric tropical frog species, specialist *Eleutherodactylus wightmanae*, and generalist *Eleutherodactylus coqui*, obtained from three distinct populations across their east-west longitudinal range in Puerto Rico. Three ambient temperatures currently experienced in their natural habitat were selected for treatments: 18°C, 21°C, and 24°C. Jumping performance was determined by the average distance traveled per jump and the average speed per jump based on three consecutive jumps. A significant increase in distance per jump was observed in both species with the temperature treatment of 24°C, resulting in the longest jump. A significant difference in jumped distance was seen between species, with the specialist *Eleutherodactylus wightmanae* outperforming the generalist *Eleutherodactylus coqui* in all treatments. At a population level, individuals of both species obtained from the Toro Negro Forest jumped farther in all temperature treatments. Speed per jump was not affected by temperature treatments; instead, differences in speed were observed at the population and species level. Individuals of *Eleutherodactylus coqui* obtained from the Cayey Forest were significantly slower than all other sites in all treatments. In contrast, individuals of *Eleutherodactylus wightmanae* from the Maricao Forest were slowest in all treatments. The study provides evidence of the species-specific response to increases in temperature and the local adaptation capabilities and thermal plasticity observed across the longitudinal range for two frog species of Puerto Rico.

P1.30 | Migratory patterns of neonate and juvenile shortfin makos (*Isurus oxyrinchus*) and a possible nursery in the western North Atlantic

Julia Crews, Erin Burge, Craig O'Connell, Shae Shandroff, Steven Sitzer, Timothy Lis

15 Shortfin makos, *Isurus oxyrinchus* (Rafinesque 1810), are lamnid sharks that have a global distribution in temperate and tropical marine regions. Despite this, locations of critical early life history events such as mating, birthing areas, nurseries are unknown or unconfirmed. With a recent IUCN re-classification as endangered, identifying such areas may aid in population recovery and/or long-term and effective management plans. The objective of this study is to identify a possible nursery area for shortfin mako sharks off the coast of Montauk, NY, USA. To aid in identifying a nursery, sharks were tagged with acoustic and/or satellite tags to track the movement of neonates [<70 cm TL] and juveniles [<200 cm TL]. To date, eight neonates have been satellite tagged and tracked for a minimum of 3 months. Site fidelity will be determined from tag data in ArcGIS. By identifying a nursery ground for shortfin makos, knowledge gaps that currently exist for this overexploited species can be closed and long-term effective management plans can be created.

P1.74 | The Scaling of Aquatic Suction Feeding Performance in Salamanders: Using New Data to Define Feeding Success

Claire Crookston, Stephen Deban

153 The biomechanics of suction feeding in aquatic salamanders is understudied, with kinematic measurements available from a handful of studies (Reilly & Lauder, 1989; Reilly, 1995; Heiss & Grell, 2019). This mode of prey capture by salamanders has been labeled as stereotyped and unmodulated, and this conclusion is supported by evidence of a limited scope. A critical area of expertise left out of this discussion is the physics of fluid motion

during suction feeding and 3D biomechanical measures that can quantify feeding performance across scales. The present study introduces new data to help resolve the classic question of performance scaling with body size by re-analyzing the aquatic suction feeding of *Ambystoma mexicanum*. We captured high-speed video of the feeding cycle from the lateral and frontal views. We digitized classic kinematics variables while integrating particle image velocimetry to capture fluid flow in front of the mouth. We calculated pressure change and power of suction for each animal and compared these to post-mortem buccal volume measurements along with mass and cross-sectional area of the muscles involved in feeding to account for any possible elastic compensatory mechanisms. This ongoing study acknowledges the physical properties of the surrounding fluid during aquatic suction feeding while adding to the body of knowledge on feeding dynamics in salamanders to generate new biomechanical and physiological questions pertaining to caudate feeding success.

14.1 | Distribution and Genomic Diversity of Mimic and Channel Shiners in the Upper Mississippi River

Roberto Cucalón, Joel Corush, Mark Davis, Milton Tan

24 Morphologically similar species represent a challenge for identification. Uncertain identification of fishes can lead to misunderstandings about the diversity, distribution, and biology of the species. This can be particularly troublesome in North American shiners (family Leuciscidae). One example of this are the mimic shiner (*Paranotropis volucellus*) and channel shiner (*Paranotropis wickliffi*). These species are often confused in regions of sympatry and are even considered under a single entry in recent field guides. We investigated the genomic identification and differentiation of mimic and channel shiners in the Upper Mississippi River using mitochondrial Cyt b and nuclear genomic RADseq data. Here, we demonstrated clear genomic differentiation between mimic and channel shiner species in the Upper Mississippi. This supported the idea that mimic and channel shiners can be distinguished at the genetic level, corroborating the recognition of channel shiners as distinct species. Our research also supported that the distribution of the mimic and channel shiners in the Upper Mississippi River do not align with the distribution suggested by morphological investigations. We found considerable differences in genetic diversity between the two species as well, which may be explained by ecological differences between species. Furthermore, we identified hybrids between the mimic and channel shiners. Our results demonstrate how genetic methods are useful for accurately understanding the diversity and distribution of these two shiner species. Future work will aim to incorporate samples and combination with morphological data to provide more resolution to the distribution, differentiation, and identification of the two species.

P1.43 | Species Distributions and Population Structure of Illinois' Spring Cavefish (*Forbesichthys* spp.) using Genomics

Roberto Cucalón, Joel Corush, Matthew Niemiller, Brian Metzke, Mark Davis, Milton Tan

399 *Forbesichthys* spp. are facultative cave-dwellers restricted to springs and caves in southern Illinois (IL) and Missouri (MO), Kentucky (KY), and Tennessee (TN). Traditionally, they were considered a single species, the Spring Cavefish (*F. agassizii*), but recent molecular evidence led to the resurrection of the Shawnee Hills Cavefish (*F. papilliferus*). The Shawnee Hills Cavefish is hypothesized to be restricted to IL, MO, and KY, while the Spring Cavefish is restricted to the Eastern Highland Rim of central TN. However, the distribution of the Shawnee Hills Cavefish is difficult to understand due to their intermittent appearance in surface springs, making sampling challenging. We employed Restriction-site Associated DNA sequencing (RADseq) and analyzed 918 bp from the mitochondrial gene NADH dehydrogenase 2 (ND2) to investigate *Forbesichthys* spp.'s species status, distribution, connectivity, and population size. Our results corroborate the separation and hypothesized distribution of the Shawnee Hills Cavefish to caves from IL, MO, and KY while the Spring Cavefish to the Eastern Highland Rim of central TN. Furthermore, populations in IL and MO form a genetically distinct cluster separate from the KY population. We suggest recognizing these genetic clusters as Evolutionary Significant Unit (ESU) for management. Although all populations analyzed appear to have reasonable genetic diversity and stability over time, this regionalization has

implications for the policy of groundwater usage in southern Illinois. This study provides information relevant to understanding potential population breaks and the uniqueness of potential lineages that may deserve protection.

P1.95 | Effects of Temperature and Moisture on Color and Microbial Growth of *Plethodon cinereus* (Eastern Red-backed Salamander)

Leana Cuzzocrea, Jennifer Deitloff

384 *Plethodon cinereus* (Eastern Red-backed Salamander) is a slim, woodland salamander commonly found in the eastern United States. This species is generally found in two color-morphs, red-backed and lead-backed morphs. Previous studies have demonstrated that color and microbial growth can change due to certain abiotic factors in their environments. Here, I tested the hypothesis that temperature and moisture affect color and microbial growth. I collected 60 salamanders at a location in central Pennsylvania. I brought them to the East Campus Science Center Laboratory at Lock Haven University for experimentation. To test this hypothesis, I designed an experiment with *Plethodon cinereus* housed in different controlled environments. Housing differences included temperature and moisture. Four treatment groups were the focus, and I assigned 15 salamanders to each group. I quantified microbial growth utilizing a technique that consisted of taking photographs of the filter papers with a ruler in the photo and the use of *tspdig* (windows program) to quantify the area with visible microbial growth. I analyzed the change of skin color by collecting the color of each salamander at a local in-between the hind legs on the dorsal side. My collections occurred before and after the experiment with a skin reflectance spectrophotometer. This provided quantitative data on pigmentation variations. I will discuss the results.

CANCELLED - P1.24.5 | Eating Local: Variability in Stable Isotopes Within Juvenile Lemon Sharks, *Negaprion brevirostris*, From the SE US and Bahamas

P2.79 | Immune and Endocrine Tradeoffs in the Western Terrestrial Gartersnakes (*Thamnophis elegans*)

Isabella Davis, Norman Hunter, Jennifer Terry, Susannah French, Lorin Neuman-Lee

76 Ecophysiological investigations in wild, free-living organisms are essential to understanding the way that an organism shifts resources to react to its changing environment. However, few studies have examined multiple physiological characteristics in snakes across seasons. In 2011, blood samples from males and females from five populations of Western Terrestrial Gartersnakes (*Thamnophis elegans*) were taken in Cache Valley, UT in the fall and spring to assess endocrine and immune characteristics. Testosterone, corticosterone, estradiol, and progesterone concentrations were measured by conducting radioimmunoassays. Immune capability was assessed using a bacterial killing assay. Relationships among the four steroid hormones and immune capability were assessed to compare potential energetic shifts between sexes and seasons. By establishing a baseline understanding of individual relationships in this reptile, we are better able to assess differences in resource allocation throughout seasonal differences.

33.2 | Evolutionary Relationships and Biogeographic Patterns of Lizardfishes (Aulopiformes)

Matthew Davis, Michelle Moore, W. Leo Smith

160 This study focuses on the morphologically diverse and species-rich marine lineage of lizardfishes (Aulopiformes). Aulopiform species possess morphological and life-history adaptations (e.g., bioluminescent organs, fang-like teeth, hermaphroditism) that have been hypothesized to have resulted from the selective pressures associated with their habitats that range from inshore to the deep sea. In this study, the patterns and processes of diversification among aulopiform fishes are investigated with a densely-sampled hypothesis of evolutionary relationships inferred from ultraconserved elements, protein-coding gene fragments, and morphological data. The biogeographic patterns

of lizardfishes are investigated for the known biodiversity of aulopiforms, with patterns of benthic and pelagic areas of endemism across the world's oceans assessed. A Bayesian inference of biogeographic history with the aulopiform phylogeny is also performed to explore biogeographic patterns of lizardfishes through time.

1.2 | Patterns in Movement Behavior of the Smalltooth Sawfish (*Pristis pectinata*) in the Southeastern United States

Ashley Dawdy, Gregg Poulakis, Dean Grubbs

343 The smalltooth sawfish (*Pristis pectinata*) is a Critically Endangered ray species native to the United States and Bahamas. The first native marine fish to be listed on the Endangered Species Act in 2003, *P. pectinata* suffered a massive population decline and subsequent range contraction attributed to high bycatch rates in commercial fisheries, loss of mangrove habitat due to coastal urbanization, and poaching. While Critical Habitat has been designated for juvenile *P. pectinata* in the United States, it remains undesignated for adults. The Grubbs lab and collaborators have internally tagged over 80 large juvenile and adult *P. pectinata* with 10-year acoustic transmitters in the Florida Keys and Everglades National Park since 2016 that have since been detected on over 600 acoustic receivers. Here, we explore trends in migratory behavior across sex and life stage, as well as movement and social networks, to gain understanding of important habitats and corridors for large juvenile and adult *P. pectinata*. These efforts seek to further inform and improve conservation efforts for the species.

2.3 | Release from Competition Drove Accelerated Morphological Diversification in Freshwater Habitats

Victor de Brito, Lily Hughes, Devin Bloom

88 Species interactions play a crucial role in shaping phenotypic diversification. However, establishing empirical links between biotic interactions and macroevolutionary patterns remains challenging. The theory of ecological opportunity posits that dispersal to habitats with lower levels of competition can lead to increased phenotypic diversity. Thus, transitions to depauperate freshwater habitats may be predicted to promote morphological diversification. In this study, we explore the link between morphological evolution and levels of competition in freshwater fishes. We used phylogenetic comparative methods to analyze morphological diversification in Atheriniformes, a group that has repeatedly colonized freshwater environments across the globe. Our results provide evidence that morphological diversification in Atheriniformes was influenced by levels of competition in freshwater habitats. The evolution of morphological traits linked to species interaction is best explained by an OU model that assumes distinct adaptive peaks according to different levels of competition in freshwater habitats. Clades that colonized depauperated regions generally present elevated rates of trait evolution, and there is a negative correlation between rates of trait evolution and the diversity of incumbent freshwater fishes. Trait diversification increases towards the present in clades that colonized freshwaters, which contradicts the classic pattern of decelerated diversification over time during adaptive radiation. Additionally, competition with closely related taxa in Australia might have also driven Atheriniformes lineages to occupy distinct regions of morphospace. Our results provide a compelling case that morphological evolution is strongly tied to competition, and the colonization of depauperated regions allows access to ecological opportunity, leading to increased trait diversification in fishes.

15.10 | Morphology and ontogenetic drift of dermal and oral denticles of the Daggernose shark *Carcharhinus oxyrhynchus* (Müller & Henle, 1839) (Carcharhiniformes, Carcharhinidae)

Arthur de Lima, Thiago Loboda, Aline Poscai, João Paulo da Silva, Mario de Pinna

176 The morphology of dermal denticles or placoid scales vary consistently across elasmobranchs. Those micro-structures consist essentially of modified scales histologically homologous to oral teeth (i.e., an enamel cap with an inner pulp nourished by a blood vessels). They have a highly variable morphology

not only among different taxa but also within the same specimen among different body regions. Functionally, they directly impact shark hydrodynamics, although they may also provide additional protection during foraging and mating. Here, we describe the morphology and ontogenetic variation of the dermal denticles of the Daggernose shark (*Isogomphodon oxyrinchus*), an endangered estuarine species endemic to the north-eastern coast of South America. In total, 21 body regions at three different life stages (neonate, juvenile and adult) were sampled and examined using Scanning Electronic Microscopy (SEM). Morphological variation among different body sections is evident within life stages, especially on the clasper and on the gill slits, while ontogenetically the drift is more pronounced between neonate and juvenile. Morphological changes were also observed between juveniles and adults, with neonates showing very few emerging scales in some regions. Results illustrate in detail a kind of morphological variation that has been irregularly reported for other Elasmobranchii groups within Galeomorphii and which is potentially present on other Carcharhinidae taxa besides *I. oxyrinchus*.

P2.24 | Evolution Of The Large-Prey Swallowing Mechanism Of Snaketooths (Teleostei; Chiasmodontidae)

Murilo Nogueira de Lima Pastana, G. David Johnson, Alessio Datovo

237 Chiasmodontidae is a small group of marine fishes composed of 36 valid species distributed in four genera: *Chiasmodon* Johnson, 1864, *Kali* Lloyd, 1909, *Pseudoscopelus* Lütken, 1892; and *Dysalotus* MacGilchrist, 1905. They are small to medium sized fishes (up to 400 mm SL) inhabiting the meso- and bathypelagic oceanic regions between depths of 500 to 3,000 meters. Chiasmodontids are commonly known as Black Swallowers or Snaketooths, alluding their unusual abilities of feeding on large prey, reaching up to 100% of the fish's mass. The ability of chiasmodontids to swallow big prey has historically attracted great attention from scientists and media, and morphological characteristics commonly attributed to this capacity include the reduction of some bones and muscles, diverse dentition, enlarged mouth, and very distensible stomach and body walls. Despite being one of the fishes with most extreme adaptations related to large-prey hunting, no illustrations or detailed descriptions of the skeletal or muscular system of these fishes have ever been provided, and anatomical aspects of the swallowing mechanism employed by chiasmodontids during feeding remain unknown to the science community. Our research explores the evolutionary steps behind the extreme mouth-gape opening, esophageal and abdominal expansion involved in the large-prey swallowing mechanism of Snaketooths, addressing muscular and skeletal modifications that allow: 1) an extreme mouth-gape opening for prey capture, 2) branchial and esophageal expansion for prey swallowing, and 3) abdominal expansion to allocate prey that may represent 100% of its body volume, making chiasmodontids one of the vertebrate predators consuming the largest prey among vertebrates.

33.3 | Phylogeny and evolution of Siluriformes (Teleostei), a supermatrix analysis, consilience with previous data and hypotheses, and a tentative biogeographic scenario

Mario de Pinna, Luiz Peixoto, Victor Tagliacollo, Marcelo Britto

438 Understanding of phylogenetic relationships among Siluriformes has undergone continuous progress over the past 100 years, with the latest couple of decades seeing pronounced increment in large part due to the availability of molecular data. Despite ongoing controversy in several important aspects, there is now much higher-level information corroborated by independent analyses and different sources of data. Catfishes have the widest geographic distribution of any ostariophysans, with a presence on all continents and the only ones on Australia, New Guinea, Madagascar and Antarctica. Their transcontinental biogeographic history has been occasionally considered as intractable because of the lack of clear transcontinental tracks. Herein we present a scenario that attempts to reconcile current notions of catfish phylogeny with their geography, in particular with the fragmentation history of Gondwana. The phylogenetic hypothesis adopted is based on a supermatrix analysis of 2000+ terminals, modulated by morphological data. Results corroborate the position of *Diplomystidae* as the sister group to all other siluriforms, with *Loricarioids*, *Cetopsids*, *Neotropical doradoids* and a clade formed by *Clariidae*+*Plotosidae*+*Chacidae*+*Siluridae* as next successive sister branches

to the rest of the order. Other relevant clades include (*Austroglanididae* (*Ariidae*, *Anchariidae*)) and (*Pangasiidae* (*Cranoglanididae*, *Ictaluridae*)). Groups largely coincident with previously-proposed "Big Africa" and "Big Asia" are corroborated, as is the position of North American *Lacantuniidae* within former, as sister group to *Claroteidae*. Although Gondwanan, catfishes do not follow usual split patterns of Gondwanan-related freshwater fishes. Their vast distribution today is apparently explained by distributional expansions associated with early stages of continental breakup and the opening of intercontinental waterways, coinciding with the invasion of lowland and estuarine habitats by specific lineages. Continental-mass separation was thus a factor of dispersion (as opposed to dispersal) in its initial stages, providing extensive pericontinental coastal passageways. Intercontinental vicariance only came into play later, with opening ocean basins. Catfish fossils are an important source of data in this scenario, especially in demonstrating past marine occurrences and distributions.

32.1 | Strength of top-down and bottom up processes involving reef sharks in the world's largest shark sanctuary

Simon Dedman, Frances Farabaugh, Natalie Klinnard, Aaron Wirsing, Michael Heithaus

279 Elucidating the strength of top-down effects of sharks in coral reef systems is important for conservation and management, but has remained challenging. From 2016-2017, we collected 2,017 baited remote video station (BRUVS) deployments and 120 underwater visual censuses across 24 coral reefs in French Polynesia. Using these data, remote sensing information, and reef coral surveys, we explored top-down and bottom up processes across a gradient of human impacts. Using a causal inference framework, we isolated connections within the ecosystem to quantify cause-and-effect relationships between reef sharks and teleosts.

Either reef sharks modulate abundances of large teleosts, controlling predation pressure on small teleosts like grazers and stabilising reef health, or reef health dictates diversity and abundance of small teleosts, controlling predation teleost and shark abundances.

Once both pathways were compared for the strength of statistical support, we used the main influential variables the causal models selected, as explanatory variables to model the relative influence of each predictor (e.g. reef shark abundance) to the response (e.g. coral condition). This process also described the shape of the relationships, confirming whether predictors are beneficial or detrimental.

Collectively, these analyses allowed us to use an incredibly rich dataset from a relatively pristine reef system, to answer a key question in shark ecology: whether mesopredatory reef sharks exert top-down control on reefs, or if they (and large predatory teleosts) are themselves controlled by reef health. This approach will facilitate similar analyses on the broader global FinPrint dataset in future.

P1.16 | Movegroup: an R package to calculate and visualise space use and home range for groups of animals

Simon Dedman, Maurits van Zinnicq Bergmann

188 Calculating home ranges is a common task for spatial analysis of sharks, typically producing contours containing 50 and 95% of their space use, which can inform MPA selection and reveal habitat preferences. Improving on the original Minimum Convex Polygon approach, the kernel utilization distribution (KUD) approach added the intensity of subarea use, which was itself bettered by the Brownian bridge movement model (BBMM) approach, which models movements between subsequent relocations explicitly, translating animal movement speed into between-point variance. Dynamic Brownian bridge movement models (dBBMM) refine this further by allowing this variance (spatial error) to change along a movement trajectory, improving performance, especially for irregular tracks (e.g. satellite tag data).

dBBMM space use can be calculated for a single animal using the move package, however this is unsuitable for multiple individuals, for a few reasons. Firstly, it requires a continuous chronological record, but multiple individuals will likely overlap in time. Second, individuals' data are typically unequal in space and time: some tags stay on longer, some individuals travel further.

These sampling imbalances would invalidate group-level space-use calculations if not accounted by group-level scaling. Movegroup processes multiple individuals, using scaling to ensure biologically accurate results, and unbalanced receiver arrays can be easily accommodated. Movegroup automates the typical workflow, scaling and reprojecting multiple tracks to the same projection and extent, plotting rich output maps, and saving space use and variance calculations. The package is well documented, and is available on GitHub and CRAN.

12.3 | Shifting scales: Diversity of central Florida herpetofauna after 60 years of urbanization and establishment of non-native species

Hannah DeGraw, Nathan Swinburne, Jenna Palmisano, Jessica Yates

30 Biodiversity has severely declined worldwide, in part because of introduced species and habitat alteration. Within the last 75 years, urbanization and establishment of non-native species exponentially increased in Florida, leading to substantial losses of natural areas and displacement of native species, respectively. The University of Central Florida (UCF) was founded in 1963, leading to development of ranchlands and wetlands, and provides a unique opportunity to assess potential effects of habitat alteration and introduction of non-native species on herpetofauna. We analyzed a 60-year dataset of herpetofauna found within UCF's campus to understand how reptiles and amphibians respond to urbanization and introduction of non-native species. We also conducted surveys of 16 campus wetlands during 2023 to determine which habitat and/or environmental conditions predicted probabilities of species detection and site occupancy. We found that the frequency of herpetofaunal observations changed since 1963, but not all species responded in the same manner. Observations of non-native herpetofauna exponentially increased over time, while records of habitat specialists decreased. Non-native amphibians disproportionately occupied artificial campus ponds. Ambient temperatures predicted detection probabilities of multiple species, whereas habitat variables including pond origin and dominant vegetation predicted the probability of campus ponds being occupied by amphibians. Our results indicate that herpetofauna at UCF have significantly shifted since the university opened. Eighty acres of campus natural lands continue to be threatened with development. We recommend protection of these natural habitats, particularly wetlands, and management of invasive species to ensure that additional losses of native herpetofauna do not occur.

36.3 | Employing 14 years of data to assess Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, response to a changing environment in Florida's Big Bend

Jessica Dehn, Ralph Grubbs

123 The Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, is considered to be the most abundant shark species found in the coastal waters of the Gulf of Mexico and northern Atlantic Ocean. Though, due to its small size, even at adulthood, it is often subject to pressures from predation and commercial fishing. Management of elasmobranchs, like most organisms, requires a holistic approach in which many facets of the organism are investigated. This includes understanding responses of these migratory species to seasonal changes in environmental conditions. For 14 years (2009-2023), the Grubbs lab has conducted annual and monthly summer surveys under the NOAA GulfSPAN (Gulf of Mexico Shark Pupping and Nursery) umbrella, which monitors distribution and abundance of coastal shark species. The annual survey takes place off the coast of the Florida Big Bend, a stretch of coastline between St. Marks River and the Anclote River, where seagrass habitats predominate. This area is divided into four locations with stations (n=140) subsampled every year (n~40) based on a spatially balanced, random survey design. Atlantic sharpnose sharks were captured via fishery-independent longline and gillnet and provided an indicator for how altered environments (sea surface temperature, dissolved oxygen, salinity) can alter presence of a species over extended time. Preliminary analysis shows a significant decline between year and per-set catch-per-unit-effort for gillnet (p=1.80-11) and longline (p=1.87-07).

24.6 | Environmental Color Matching in Eastern Indigo Snakes (*Drymarchon couperi*): Crypsis or Conspicuousness?

Jennifer Deitloff, Francesca Erickson, Craig Guyer, James Godwin

259 Conflicting evolutionary forces shape animal color signals. These signals can result from the sexual selection favoring bright, conspicuous coloration and natural selection prioritizing cryptic colors for predator avoidance. Sexual dichromatism, where males and females within a species display distinct color traits, often reflects mating preferences. However, the function of color in the Eastern Indigo Snake (*Drymarchon couperi*), which is predominantly iridescent black but exhibits color variations on its head and ventral scales, is unknown. This study aims to examine potential environmental conditions in which these color variations occur, including pre- and post-burn habitats. We compared environmental background color (pre- and post-burn) to color from the sublabial scales of snakes that were captive bred to determine whether these snakes in this environment would be cryptic or conspicuous to potential predators. Understanding whether this coloration serves predator evasion or mate attraction will aid in captive breeding and repatriation efforts, contributing to the recovery of this federally threatened species.

P1.62 | Comparative ontogeny of the Siberian Sturgeon, *Acipenser baerii* (Acipenseriformes: Acipenseridae), the Sterlet, *Acipenser ruthenus*, and their hybrids

Anu Desai, Eric Hilton

277 Owing to their more rapid growth rate and overall improved reproductive fitness, hybrids between species of sturgeons (*Acipenser* spp.) account for a component of those reared in captivity for the aquaculture industry surrounding these fishes. Despite their commercial importance, little information exists regarding the ontogeny of these hybrids in comparison to their parent species. The goal of this study was to examine the morphological differences and overall patterns of growth that the hybrids of two purebred sturgeon that are commonly used in aquaculture, the Siberian Sturgeon (*A. baerii*), and the Sterlet (*A. ruthenus*), in relation to both of these parent species. The developmental timing of the eye, head, pectoral fin, dorsal fin, pelvic fin, and anal fin were quantified along with the relationship between the total length of each individual and the relative position of the fins, with the goal of testing for morphological hybrid vigor (earlier or accelerated development of structures in the hybrids relative to the parent species). The development of the eye, head, and anal fin were the only measured traits that were accelerated in the hybrids relative to the parent species; all other characteristics were intermediate or slower in hybrids. A maternal inheritance pattern was observed in the developmental timing of the dorsal and pelvic fins in the *A. baerii*(female)x *A. ruthenus*(male) hybrid potentially supports the hypothesis that *A. baerii* has a dominant phenotype, potentially offsetting any instance of hybrid vigor that would otherwise occur.

P2.40 | Undescribed Herpetofaunal Diversity and Endemism in the Itombwe Plateau

Calum Devaney, Chifundera Kusamba, Angelica Casas, Eli Greenbaum

218 The Itombwe Plateau in eastern Democratic Republic of the Congo is one of the most biodiverse regions within the Albertine Rift hotspot. It is recognized as both a Key Biodiversity Area and a protected natural reserve. However, very little biological research has been done in this part of the world because of rampant human conflict. To understand patterns of species richness and endemism, we conducted an exhaustive search of the colonial-era literature, global biodiversity databases (e.g., GBIF), and 10,893 specimen records from fieldwork conducted from 2008–2024 to create a comprehensive list of every species of reptile and amphibian in the Itombwe Plateau. These data were combined with analyses of 16S (mtDNA) barcoding data of 235 Itombwe specimens, which identified 30 currently undescribed species. With these data, we conducted an analysis of the conservation status for all Itombwe amphibian and reptile species, including new taxa identified from the 16S barcoding data, with IUCN Red List Criteria. These findings suggest that Itombwe has the highest numbers of endemic and threatened species in the Albertine Rift, making it the hottest area of this biodiversity hot spot,

and arguably the most important area for herpetological conservation in continental Africa. Combining the fields of molecular evolution, taxonomy, and conservation biology is paramount to identify areas with high levels of endemism and threatened species for informed conservation strategies.

14.5 | Specimens Previously Identified as *Helcogramma fuscipectoris* (Tripterygiidae) Include Two Distinct Species, Based on Morphological and Molecular Analyses

Yuna Dewa, Nozomu Muto, Hiroyuki Motomura

110 The genus *Helcogramma* McCulloch and Waite, 1918 (Perciformes: Tripterygiidae) is currently known from 41 valid species distributed from the Indo-Pacific and Atlantic oceans. The present study revealed that specimens previously identified as *H. fuscipectoris* (Fowler, 1946) include two morphotypes, viz., Type A (collected from the Ryukyu Islands and Taiwan), and Type B (Japanese mainland and the Izu and Ogasawara islands). Type A is clearly distinguished from Type B by having the following characters: five sensory pores below eye (vs. six in Type B); body narrower, its width 15.3–21.5% (mean 18.5%) in standard length [vs. wider, 19.3–22.9% (20.7%)]; and a blue stripe extending from posterior tip of upper jaw through preopercular margin in nuptial males when fresh (vs. from ventral margin of orbit through preopercular margin). Furthermore, each type formed a monophyletic clade on the neighbor-joining phylogenetic tree based on 615 bp sequences of COI gene, with divergence between Types A and B individuals ranging from 13.2–14.0%. *Helcogramma fuscipectoris* was originally described as *Enneapterygius fuscipectoris* from the Aguni Island, the Ryukyu Islands, Japan. Subsequently, Fricke (1997) regarded two nominal species, *E. personatus* Fowler, 1946 and *E. quadrimaculatus* Fowler, 1946, as junior synonyms of *H. fuscipectoris*. Re-examination of type series of the above mentioned three nominal species in this study revealed that *H. fuscipectoris* is valid and applies to Type A. Two nominal species are also confirmed here to be junior synonyms of *H. fuscipectoris*, and Type B is considered to be an undescribed species.

CANCELLED - 30.4 | A Century of Change: The Fishes of Catatank Creek

Casey Dillman

492 The Cornell University Museum of Vertebrates (CUMV) has several long-term sampling sites. Of these, Catatank Creek is the most regularly and longest sampled locality. The first collection efforts concerned with the community of fishes occurred in 1930 and sampling has continued every other year up to and including 2022. This talk will explore several aspects of near century of ichthyological sampling including changes in the faunal assemblage, and a look at preliminary results from stable isotopes (C, N, and S) in this community over time.

P2.60 | Sticky Thumbs Out: Using Population Genomics to Reveal the Invasion Pathways of a Hitch-hiking Invasive Gecko

Jack Dirck, Jeanne Robertson, Robert Espinoza

303 Mediterranean House Geckos (*Hemidactylus turcicus*) are one of the most widespread introduced reptiles. Since their introduction from the Mediterranean Basin into the USA in 1910, these geckos have colonized 26 states across four distinct climates despite having poor innate dispersal proclivities (<20 m/generation). They achieved this remarkable range expansion by relying on humans for long-distance movements. Despite being familiar and successful introduced reptiles, no study has attempted to reconstruct their invasion history on a continental scale. Using a population-genomics approach (RADseq) based on ~450 geckos from 23 counties across seven US states, our study will (1) estimate whether one or multiple independent introductions occurred, (2) identify pathways of spread and major hubs of dispersal, and (3) characterize patterns of genetic variation across the US. Given extensive maritime traffic into Gulf Coast ports, we hypothesize that multiple introductions occurred. We further predict that the earliest established populations in these ports and proximate inland cities have served as major hubs of dispersal. Characterizing the genetic variation of geckos across

this region will allow us to identify the principal dispersal hubs and corridors of spread. Given distant colonization events are human-mediated, a weak pattern of isolation by distance is expected, rather than a typical diffusion model of natural dispersal. Further, our lab has quantified climate-associated variation in body size, scale and integument morphology, thermal tolerances, evaporative water loss, and metabolism among *H. turcicus* populations across the US. Future investigations could determine the genetic variation that underlies these phenotypic differences.

29.1 | From Shores to Shipwrecks: NC Aquariums' Role in Sand Tiger Shark Conservation Research

Holly Doerr, Carol Price

121 Sand tiger sharks (*Carcharias taurus*) are a popular species highlighted in zoos and aquariums around the world. Historically found in many of the world's coastal oceans, their global populations have declined significantly in recent decades. Known to occupy both demersal and pelagic ranges, these sharks are frequently observed at artificial reefs, including shipwrecks, along North Carolina's coastline. Applying a variety of research approaches, we are investigating occupancy and residency patterns, site fidelity, habitat use and ecology in context of life history stages. Our field research includes Spot A Shark USA (SAS), a community-science driven program that identifies sand tiger sharks via unique photoidentification software, and telemetry technology that uses acoustic tags and receivers to track individual movement patterns over several years. SAS has catalogued over 2500 individual sand tiger shark encounters, with more than 100 sharks reencountered across multiple dates. Additionally, the telemetry of 27 sharks has yielded over 2 million data points that span 5 years and detail migrations between New York and Florida. When combined, these data indicate "hot spots" at several shipwrecks off Cape Lookout, NC, especially for mature and pregnant females, indicating the importance of these habitats to the sharks' reproductive ecology. NC Aquariums also participated in a long-term, interinstitutional study to define space use, swim patterns and behavior in human care. Collectively, our research provides detailed information about sand tiger sharks, allowing us to better understand both their wild populations in NC coastal habitats, as well as their optimal health and wellbeing in human care.

P1.64 | Ecomorphology of Longnose Gar *Lepisosteus osseus*: on the influence of size, sex, and river location.

Jason Doll, Ian Fischer, Aaron Selby, Stephen Jacquemin, Solomon David, Daniel Sinopoli

57 Ecomorphology is key to understanding the influences of habitat on the evolution and biogeography of species. Morphological studies on the underappreciated and relatively understudied gars (*Lepisosteidae*), outside of the phylogenetic context, are rare. To investigate the effects of sex, allometry and river section on morphology, 230 Longnose Gars (*Lepisosteus osseus*) were collected from three different sites corresponding to the upper, middle and lower Great Pee Dee River in South Carolina. Dorsal and lateral photographs were taken from each specimen and landmarked for 2D geometric morphometric analyses. Potential sexual dimorphic traits were also measured in the field on individual specimens. Discriminant function analysis (DFA) was conducted to compare the accuracy of those characters to a previous study on Spotted Gars (*Lepisosteus oculatus*). While location was a statistically significant predictor of shape, the differences were not biologically meaningful. Sex was a strong predictor of shape, with the greatest differences seen in the largest individuals. Discriminant function analysis found that the Snout Length-to-Total Length ratio was able to accurately predict individual sex 71% of the time, with females having longer snouts than males. Significant differences in this ratio between sexes can allow biologists to approximate sex without lethal gonadal inspection. This study presents the first standardized 2D geometric morphometrics protocol for *Lepisosteidae*.

P2.1 | Inferring parameters for Bioregion delimitation in Trichomycteridae

Laura Donin, Mário Pinna, Victor Tagliacollo

306 Trichomycteridae is the second most diverse family within the neotropical superfamily Loricarioidea, comprising more than 419 valid species. The greatest diversity of Trichomycteridae is located in the Amazon basin, where most subfamilies are richly represented, albeit notably lacking representatives of Microcambevininae and scant representatives of the otherwise highly diverse Trichomycterinae. In light of the diversity of lineages, phenotypes, and habitats, Trichomycteridae species have been used as models for taxonomic, evolutionary, and biogeographic studies. Despite considerable recent progress in elucidating the biogeographic history of Neotropical freshwater fishes, certain lineages, including Trichomycteridae, remain underexplored. Biogeographical regions serve as vital units for understanding species spatial distribution, bearing significance in conservation, historical biogeography, ecology, and evolution. Although the concept of bioregions is widely utilized in biogeographical studies, the specific parameters used as input data often lack clarity. This study aims to define bioregions tailored to Trichomycteridae, employing the most suitable set of parameters for our dataset. A spatial dataset was compiled and analyzed using the program Infomap Bioregions, employing a combination of alternative values for cell size and individual capacity per cell. The results demonstrate an optimal combination of parameters that better delineates bioregions in Trichomycteridae and which will provide a basis for a broad-scale biogeographic analysis of the family.

19.5 | Multi-stage Integrated Species Distribution Modeling to Improve Estimates of Population and Community Change

Jeffrey Doser, Sarah Saunders, Shannon Reault, Brooke Bateman, Joanna Grand, Elise Zipkin

234 The 21st century has seen a proliferation of data from large-scale monitoring programs, citizen science programs, and autonomous monitoring approaches (e.g., acoustic recording units) to understand population trends, distribution shifts, biodiversity patterns, and their associated drivers. As such data sources are often piecemeal and have different limitations (e.g., preferential or biased sampling), model-based data integration is an attractive solution to make the most of all available data. However, integrating disparate data sets is complicated by differences in spatial resolution, spatio-temporal extent, and observational biases under different sampling protocols. Here we present a multi-stage hierarchical Bayesian modeling approach for integrating multiple data sets with a focus on estimating spatial variation in population trends across a species' range. Our multi-stage approach fits a distinct model to each data source in individual stages and uses model estimates from previous stages as predictor variables in subsequent stages to improve estimates of the ecological process of interest. We apply our modeling framework to quantify the relative contributions of climate and land use change in driving heterogeneous bird population trends across the continental USA from 2000-2019. By fitting models in stages, our proposed framework can integrate a variety of data types (e.g., count, biomass, presence-absence), integrate single species and/or multi-species data sources, and can be implemented using user-friendly, formula-based R packages (e.g., spOccupancy, spAbundance). We conclude by discussing applications of the framework to understand the drivers of amphibian population trends across both local and broad scales.

13.3 | Depredation: an old conflict with the sea

Marcus Drymon, Amanda Jargowsky, Evan Prasky, Ed Camp, Ashley Oliphant, Sean Powers, Steven Scyphers

96 Depredation (the partial or complete removal of hooked species by non-target species) is a human-wildlife conflict as old as fishing itself. In some ways, depredation is no different today than it was a century ago. But in many ways, this conflict has become more complicated. Following three decades of successful management, some US shark populations have begun to rebuild. However, many anglers attribute perceived increases in shark depredation to management measures, claiming they have led to an "overpopulation" of sharks and/or learned behavior by sharks. We investigated whether these factors could explain the reported increases in depredation. Based on

fishery-independent surveys, neither shark population increases nor learned behavior by sharks is evident. However, increases in angler effort provide an alternative explanation that is not often considered. While far from a smoking gun, at least four themes emerge from this thought exercise. First, it is important to understand historical predator baselines. Second, it is important to acknowledge lifting baselines, i.e., instances where previously depleted populations are recovering. Third, it is important to remember that there are many instances when stakeholder observations were initially misaligned with traditional scientific observations but were ultimately recognized as pivotal for filling data gaps. Finally, and perhaps most important, is the acknowledgement that perceived conflict is as potent as real conflict. Arguably, it may not matter if depredation has increased or decreased; the overwhelming perception from stakeholders is an increase in depredation, and this is the perceived (or real) conflict that must be addressed.

9.3 | Look to the Future: Potential Revision of Atlantic Shark Management in the United States

Guy DuBeck, Karyl Brewster-Geisz, Ann Williamson, Becky Curtis

159 The Highly Migratory Species Management Division of the National Marine Fisheries Service (NOAA Fisheries) is responsible for the management of the U.S. federal shark fisheries in the Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea. Federal management of Atlantic sharks began in 1993, and the management measures established at that time are the basis for those in place today, including permitting and reporting requirements, management complexes, commercial quotas, and recreational bag limits. Recently, new science and information available for shark species supports revision of domestic shark management. Consistent with efforts to rebuild overfished stocks and prevent overfishing, NOAA Fisheries plans to optimize the ability for commercial and recreational shark fishers to fully harvest the available, science-based shark quotas. Any potential management revisions will continue to need strong scientific research and support.

33.4 | Diversity and Evolution of Gymnotiformes: Results of Seven Years Studying Neotropical Electric Fishes

Guilherme Dutra, Carlos de Santana, Luiz Peixoto, Murilo Pastana, Naercio Menezes

266 Diversity and Evolution of Gymnotiformes (DEGY) is an international cooperative project including the Museu de Zoologia da Universidade de São Paulo, Brazil (MZUSP) and the National Museum of Natural History, Smithsonian Institution (United States) engaged on taxonomy, phylogeny, anatomy, biogeography and conservation studies on the Gymnotiformes, an order that includes the neotropical electric fishes. Forty participants from 16 national and/or international institutions were associated to the project. Ten expeditions to different areas in South America were undertaken intending to get additional specimens of poorly known species, to record their electric organ discharge, tissue samples for molecular studies, and water samples for eDNA studies. The results indicate that up to now the project has cataloged more than 1000 fish lots and more than 2000 tissue samples in MZUSP fish collection. Members of the project also undertook technical visits to several fish collections in South America, United States and Europe in order to check specimens' identification for molecular studies and map the distribution of each gymnotiform species. During the project 22 articles, 16 book chapters and 38 publications about Gymnotiformes and other Neotropical fishes were published, including the description of 14 new species and one new genus for Gymnotiformes. Outreach actions include the maintenance of exhibitions on electric fishes both in MZUSP and the Smithsonian Zoo.

P2.30 | Description of a New Species of the Glass Knifefish Genus *Eigenmannia* (Gymnotiformes: Sternopygidae) from the Rio Branco Basin, Brazil

Guilherme Dutra, Luiz Peixoto, Laura Donin, Carlos de Santana, Naercio Menezes

260 The species of *Eigenmannia* are small to medium-sized electric fishes that inhabit a myriad of aquatic environments including floodplains, rapids,

river channels and subterranean drainages in the Neotropics. This study describes a new species from the Rio Branco basin, Brazil. The proposal is based on morphological and molecular datasets. The new species is distinguished from all congeners by the following combination of characters: lateral line stripe extending from first perforated lateral line scale to distal portion of caudal filament, presence of superior midlateral stripe with origin posterior to end of body cavity anal fin hyaline, caudal filament corresponding to 15.2–43.1% LEA, subterminal mouth, 14–16 pectoral-fin rays, 166–219 anal-fin rays, 10–13 scales rows above lateral line at vertical through posterior tip of pectoral fin, 100–128 scales on lateral line, 22–28 premaxillary teeth, 19–23 dentary teeth, 7–10 endopterygoid teeth, depth of posterodorsal expansion on infra-orbitals 1+2 half as long as infra-orbitals 1+2 length, basibranchial 1 unossified, 13 precaudal vertebrae, and length of coronomeckelian bone corresponding to 20% of Meckel's cartilage length. Furthermore, molecular species delimitation analyses (ASAP and bPTP) also recovered the new species as an independent lineage. The critical importance of including voucher examination as one of the steps in the pipeline for using DNA sequences present in public repositories in taxonomic and phylogenetic studies is discussed.

18.3 | Assessment of genomic diversity within and between two cryptic shiners, *Notropis megalops* and *N. amabilis*.

Kayla Dye, Kevin Conway, Andrew Fields, Megan Bean, Amanda Pinion, Sarah Robertson, Christopher Hollenbeck, David Portnoy

387 *Notropis megalops* and *N. amabilis* are considered Species of Greatest Conservation Need by the Texas Parks and Wildlife Department and co-occur on a very small scale throughout the spring-fed tributaries of the lower Rio Grande within Texas. Morphological differences have been observed between these species, however, proper identification in situ remains problematic. Given their status and range of overlap with potential for hybridization, a robust genetic assessment of *N. megalops* and *N. amabilis* is warranted. Therefore, we used genome-wide markers (ddRAD-seq) to determine the genetic distance, assess for hybridization, and identify diagnostic SNPs between *N. megalops* and *N. amabilis* individuals throughout their range of overlap. Genomic analyses recovered two distinct genetic groups (i.e., species) with no evidence of interaction or hybridization (FCT = 0.96). Additionally, 6,315 diagnostic SNPs were identified between *N. megalops* and *N. amabilis* and ultimately filtered to 463 SNPs at 183 loci for future development of a quick and effective assay capable of distinguishing these species. Overall, these results facilitate the implementation of accurate conservation policies and management practices.

P1.13 | Trends in chondrichthyan diet & feeding research from 2003-2023

Samantha Dzierba, Alyssa Klim, Ashley Liao, Angelique Rea, Jonathon Kuntz, Meghan Balk, Sora Kim, Lisa Whitenack

480 Understanding what and how chondrichthyans eat, why they eat it, and how this impacts their lives is necessary to understand basic biological processes and inform conservation and management decisions. As the field continues to grow, it is important to understand the state of the field as we move forward - which groups are studied (or understudied), which methods are used, and the limitations of the field as it stands now. The goal of this study is to identify trends in chondrichthyan diet and feeding research over the past 20 years via a systematic literature review in support of a larger review of the field. After two training sets to ensure our four coders were in agreement and our search parameters were working, we searched for articles using the Web of Science database for five-year intervals across 2003-2023. We focused on five general research methods: stable isotope analysis, fatty acid analysis, observational studies, stomach contents, and morphology. For each of the 266 papers, our coders recorded the taxa studied, the methods used, whether studies used more than one method, and whether the study focused on extant or extinct taxa. There was a clear trend in the number of studies increasing from 2003 (n=14) to 2023 (n=89). Preliminary results indicate that much of this growth is due to the increasing prevalence of stable isotope analysis, although other broad research areas show growth as well. Studies cover a wide range of species across families, but elasmobranchs are studied more often than holocephalans.

P2.42 | Correlates of Rattlesnake Detection on Camera Traps

Sarah Ebert, John Holloway, Emily Gray, Carissa Adams, Casey Hitchens, McKenzie Merritt, Shane Welch, Jayme Waldron

391 Camera traps allow researchers to maximize sampling effort with minimal disturbance to wildlife and have become increasingly popular in wildlife research. Camera traps are primarily used to study large mammals and have not been extensively tested for snake species, many of which are understudied and imperiled. The Adapted-Hunt Drift Fence Technique (AHDriFT) arrays were designed to improve detection of herpetofauna by incorporating camera traps with drift fences. We installed AHDriFT camera arrays (n=20) at a study site in coastal South Carolina where mark-recapture and radio telemetry surveys were used to monitor the eastern diamondback rattlesnake (*Crotalus adamanteus*; EDB), a species in decline across its range. Our goal was to examine the effectiveness of camera traps for detecting EDBs. We used EDB telemetry relocations within 150 m of an active AHDriFT array and logistic regression and occupancy modeling to examine detection probabilities at multiple temporal scales. Although our camera traps captured 67 EDB detections over 16 months our analyses indicated poor detection even when snakes were in proximity to the camera arrays. Our findings likely reflect the species foraging strategy and suggest that low vagility characteristic of ambush predators likely limit camera trapping as a suitable method for monitoring the species' occupancy.

P2.10 | Species Boundaries and Evolutionary History of the Genus *Thorichthys* (Herichthyines: Heroini)

Diego Elías, Alfonso González-Díaz, Caleb McMahan

376 A robust understanding of species diversity and their geographic distributions is key for the conservation of freshwater biota. Heroini cichlids are one of the most diverse groups of freshwater fishes in the northern Neotropics, and many species are threatened by pervasive threats such as damming, land use change, and introduction of non-native fishes. Despite this, our understanding of species boundaries and phylogenetic relationships among Heroini cichlids is still lacking, particularly at the intrageneric level. One of the most species-rich genera of Heroini is *Thorichthys* with nine valid species distributed from northern Honduras to Mexico. Its widespread distribution, hypothesized cryptic diversity, and sympatric distribution among different species makes *Thorichthys* a unique system to study patterns and processes of diversification of northern Neotropical cichlids. Here, we used genomic-scale DNA sequence data to infer the first taxonomically-complete phylogeny of the genus *Thorichthys*. We additionally used population genetic and species delimitation analyses of this molecular data to evaluate evidence of potential cryptic diversity across the ranges of *Thorichthys* species. The resulting species delimitation and phylogenetic hypotheses were then used in downstream analyses to investigate how the complex geologic history of the riverscapes of the northern Neotropics shaped the evolutionary history of *Thorichthys*. Our findings provide essential information on the diversity and geographic distributions of an overlooked yet diverse and threatened group of cichlids in the northern Neotropics.

36.8 | Response of juvenile white sharks (*Carcharodon carcharias*) to a rare tropical storm event in Southern California.

Jack Elstner, Emily Spurgeon, Patrick Rex, Elizabeth Jahn, Zach Merson, Whitney Jones, Lauren Faulkner, Ryan Logan, Christopher Lowe, Brice Semmens

498 Hurricanes and tropical storms are extreme weather phenomena that pose profound risk to the ecological communities that lie in their path. Although coastal ecosystems are particularly vulnerable to storm disturbance, research describing the response of marine taxa to extreme weather remains limited, especially for highly mobile marine predators. In this study, we use high-resolution acoustic telemetry to examine the response of juvenile white sharks (*Carcharodon carcharias*) to a rare tropical storm event in Southern California. Using data collected at a prominent white shark nursery aggregation site in San Diego, we quantify patterns of movement and habitat selection before, during, and after the storm and relate these responses to proximal

environmental cues. We document partial evacuation from the aggregation site during the storm, as well as other behavioral strategies that individuals appear to adopt in response to the risks posed by storm conditions. In doing so, we quantify the sensitivity and resilience of juvenile white sharks to storm perturbation and evaluate their behavioral plasticity in a dynamic ocean. In addition, we present an accessible modeling approach to statistically estimate and account for reduced performance of acoustic receivers during noisy storm conditions.

P1.10 | Big Fish, Little Plastics: Investigating Microplastic Accumulation and Trophic Transfer in Salmon Sharks

Madeline English, Alexandra McInturf, Bonnie Hamilton, Olivia Boisen, Reilly Boyt, Matthew Savoca, Susanne Brander, Taylor Chapple

229 Microplastic ingestion in marine organisms, especially fish, is a growing concern, yet its prevalence in sharks of the Northeast Pacific remains largely unexplored. One species ideally suited to address this knowledge gap is the salmon shark (*Lamna ditropis*). Salmon sharks are regionally endothermic and have a high metabolic rate, and their food consumption rates and energetic requirements are higher than those of most shark species. In addition to contributing to their ecological impact as consumers, these traits may also influence how frequently they encounter plastics. In this study, we use a combination of methods including stomach content analysis, high-resolution microscopy, and Fourier-transform infrared spectroscopy to investigate anthropogenic microparticle (natural or synthetic particles < 5 mm) quantities and types in salmon sharks and their prey off the Oregon Coast. We aim to quantify the amount of microparticles consumed by these predators along the Oregon Coast and determine whether there is sufficient evidence to suggest that trophic transfer occurs. Our preliminary findings indicate a high presence of ingested microparticles of diverse morphologies, highlighting the need for further investigation into the impact of microparticles on salmon sharks as well as other elasmobranch species.

26.9 | The western South Atlantic chimaeras (Chondrichthyes: Holocephali: Chimaeriformes), with descriptions of two new species of *Chimaera* Linnaeus, 1758

Vinicius C. Espíndola, Marcelo R. S. de Melo

Chimaeras, also known as elephant fish, rabbitfish, or ghost shark, are relatively rare, primarily deep-sea fishes, with worldwide distribution on the deeper portions of the continental shelves and slopes, to about 3,000 meters deep. Up to date, six species had been previously reported from the western South Atlantic: the callorhinchid *Callorhynchus callorhynchus*, the chimaerids *Hydrolagus alberti*, *H. affinis*, and *H. matalanasi*, and the rhinochimaerids *Harriotta chaetirhamphus* and *Rhinochimaera atlantica*. In this taxonomic review, we unveil the first report of the genus *Chimaera* in the area presents descriptions of two new species, in addition to updated maps of distribution, diagnoses, and a regional key for the species.

P2.72 | Where Should ASIH be Headed? An Open Discussion and Listening Space.

Robert Espinoza, Henry Bart

347 The purpose of this poster is to provide an open forum for discussions with the leadership of the American Society of Ichthyologists and Herpetologists (ASIH). What can we do better to (1) grow and support our diverse membership, especially students; (2) foster greater membership involvement and organizational fiscal stability; (3) improve JMIH and Ichthyology & Herpetology; (4) prioritize resources to meet future obligations and goals; and (5) reinforce what we already do well? We can also deliberate the future of ichthyology and herpetology or anything else members wish to discuss with the President, President-Elect, and other members of ASIH leadership. We are here to listen to compliments, critiques, and ideas to improve our Society. [We will also share drink tickets with members who stop by to chat!]

26.3 | Deploy the proboscis!: Functional morphology & kinematics of a novel form of extreme jaw protrusion in the hingemouth, *Phractolaemus ansorgii* (Gonorynchiformes)

Allyson Evans, Emily Naylor, Nathan Lujan, Sandy Kawano, L. Patricia Hernandez

424 Variation in the mechanisms of premaxillary protrusion and the performance advantages they confer have been implicated in the success of diverse teleost fish lineages such as minnows and spiny-rayed fishes. Highly kinetic systems that actuate jaw protrusion have long been fascinating to functional morphologists as they represent multiple solutions to the same ecological challenge — that of feeding in a viscous, fluid medium. However, scarce are the studies that investigate jaw protrusion beyond Cypriniformes and Acanthomorpha and beyond the relatively conserved musculoskeletal architecture enabling it. Here we investigate an isolated and independent origin of jaw protrusion in the hingemouth, *Phractolaemus ansorgii*, which employs a novel arrangement of bones, musculature, and connective tissue to feed on detritus via a deployable proboscis. We quantify 3D feeding kinematics and find *P. ansorgii* are capable of modulating the angle and distance of jaw protrusion, with maximum anterior protrusion exceeding 30% of head length. This represents a previously undescribed example of extreme jaw protrusion on par with many cichlid species. Furthermore, we describe what is in essence a second functional mouth at the end of the proboscis composed of flexible connective tissues and intricate skin folds that function to probe and grasp along the substrate. Though this highly specialized mechanism may have limited versatility over evolutionary timescales, it represents a unique functional solution for life evolved in fluid.

P2.23 | Comparative Anatomy of Otomorphan Epibranchial Organs

Allyson Evans, L. Patricia Hernandez, Joshua Egan

83 The ability to extract small prey items from large volumes of water is widespread among microphagous fishes, all of which face the same metabolic hurdle of consuming enough food particles to meet their nutritional needs. Certain planktivorous and detritivorous fishes possess an epibranchial organ (EBO) in their posterior pharynx that facilitates the aggregation of small prey. Morphologically complex and phylogenetically diverse, EBOs are novel trophic structures that have evolved independently in at least six families across teleosts with the majority of both morphological and taxonomic diversity occurring within otomorphan fishes. Otomorphan EBOs range from the small slits in the roof of the pharynx to medioventrally expanded, papillae-lined pouches. Despite their phenotypic diversity, they share several anatomical components including an internal tube with an epithelium rich in mucus-producing cells, a surrounding layer of skeletal muscle, and support from the posterior branchial arches. Here, we present a comparative study of EBOs from thirteen otomorphan species. Using gross dissection, histology, and scanning electron microscopy, we describe the degree to which architectural components of the EBO exhibit patterns of convergence in shape, size, muscularity, adiposity, and the morphology of the papillae that line their internal surface. Grounded within both a functional and phylogenetic framework, we discuss whether differences in this intricate anatomy can best be explained by specializations to a similar feeding ecology or by phylogenetic relatedness.

36.1 | Age and Growth Estimates for the Nurse Shark (*Ginglymostoma cirratum*) Over 17 Years in Bimini, The Bahamas

Baylie Fadool, Kylie Bostick, Lauran Brewster, Alexander Hansell, John Carlson, Matthew Smukall

21 The nurse shark (*Ginglymostoma cirratum*) is abundant in coastal waters of the Atlantic Ocean, yet many aspects of their life history remain relatively understudied, aside from their reproductive behavior. This study focused on their age and growth to address significant data gaps and provide crucial information that can be used in fisheries assessment models. We used mark-recapture data of 91 individual *G. cirratum* from Bimini, The Bahamas, from 2003 to 2020, to calculate von Bertalanffy (vB) growth parameters, empirical growth rate, and age derived from the resulting length-at-age estimates. The Fabens method

for estimating growth from mark-recapture methods was applied through a Bayesian framework using Markov chain Monte Carlo (MCMC) methods. This provided growth parameters with an asymptotic total length (L_{∞}) of 303.28 cm and a growth coefficient (k) of 0.04 yr⁻¹. The average growth rate for *G. cirratum* was approximately 8.68 ± 6.00 cm yr⁻¹. This study also suggests that the previous maximum age for *G. cirratum* is likely underestimated, with the oldest individual predicted to be 43 years old. Our study presents the first vB growth parameters and growth curve for *G. cirratum*. These results indicate that this species is slow-growing and long-lived, which improves our understanding of their life history. We hope that this study encourages future research to obtain more species-specific life history information for *G. cirratum* throughout their range to improve their conservation and management, especially since they were recently listed as a vulnerable species.

17.1 | Supply and Demand: Leveraging Expertise and Knowledge to Supply Tools to Meet the Demands of Conservation

Hap Fatzinger, Alexa Delaune, Hans Walters, Beth Firschau, Steve Kessel, Jill Arnold

294 For nearly four decades the field research and zoological communities have convened to drive the science and understanding of elasmobranchs in situ and ex situ. Collaborations such as the American Elasmobranch Society Elasmobranch Census by Warren Pryor of the Fort Wayne Children's Zoo in the mid-1980s and the Elasmobranch Husbandry Manual symposiums and publications in 2001 and 2013, are examples of how, through collaboration, the two communities supply the tools and resources needed, and successful conservation efforts demand, to build a future for global elasmobranch populations.

The Association of Zoos and Aquariums (AZA) envisions a world where all people respect, value and conserve wildlife and wild places. Through AZA's premiere conservation initiative SAFE: Saving Animals From Extinction, members and partners leverage combined efforts in a One Plan Approach to make its vision a reality. AZA SAFE Sharks and Rays began its support of elasmobranch conservation efforts over 10 years ago. Today, building upon member expertise and knowledge, the program is embarking on its next 5-year plan. The plan's success will be in its mandate for collaboration and breadth of application, ex situ and in situ.

Conservation funding is scarce. People to do the work too few and time too short. Conservation efforts demand collaboration and a supply of effective tools that help us work more efficiently. AZA SAFE Sharks and Rays is bringing the elasmobranch field research and zoological communities together to create those tools and resources that will help to ensure the future of elasmobranch populations around the world.

25.1 | Parthenogenesis in elasmobranchs under human care

Kevin Feldheim

117 Worldwide, aquariums are an important resource for raising public awareness on issues of marine conservation and biodiversity in general. Recently, these institutions have become vital in understanding several aspects of the life history and reproductive traits of elasmobranchs (sharks, skates and rays). In particular, aquariums have been vital in the relatively newly described phenomenon of parthenogenesis in these taxa. Since its discovery in 2007, parthenogenesis has been observed for many ex situ shark and ray species. Here, I review the brief history of parthenogenesis in elasmobranchs and discuss how aquariums can aid in this field moving forward.

P2.54 | No Evidence of Color-Based Honest Signaling in the Green and Black Poison Frog *Dendrobates auratus* in Costa Rica

Aaron Fernando, Katherine Porras-Brenes, Ralph Saporito

485 Aposematism is an anti-predator strategy that involves the use of conspicuous colors to warn predators about the presence of chemical defenses. Studies have found that organisms exhibiting more conspicuous colors often have higher quantities of defensive chemicals. In these cases, the degree of conspicuousness is a quantitative honest signal of toxicity that predators can

learn. Neotropical poison frogs utilize bright coloration and bold patterning as a warning of their alkaloid-based defenses. However, it is unclear if conspicuousness is a quantitative honest signal of defense levels in poison frogs. To address this question, we examined the relationship between coloration and alkaloid defenses in the green and black poison frog, *Dendrobates auratus*, from Costa Rica. We measured, quantified, and compared green coloration and alkaloid quantity in 60 frogs from three Caribbean and three Pacific populations. Contrary to quantitative honest signaling, we found that more conspicuously colored frogs (those with higher proportion of green) had lower quantities of alkaloid defenses. Interestingly, we found that frogs from Pacific populations were less conspicuous and contained more alkaloids, whereas frogs from Caribbean populations were more conspicuous and had less alkaloids, which may be explained by differences in predator communities between these two geographic regions of Costa Rica.

P2.2 | Geographic Patterns of Body Shape in Cryptobenthic Fish Communities of the Tropical Eastern Pacific

Roman Ferraro, Cindy Fajardo, Michael Burns, William Ludt

322 Body shape reflects how species interact with their environment and how they function within a community. Many times, body shape is influenced by the ecology and life history of a species and can vary considerably across lineages and ecological gradients. Among coral and rocky reef habitats, one abundant, and varied, group of fishes are cryptobenthic reef fishes (CRFs). Species comprising this group are generally <50mm in length and can comprise nearly 50% of biomass consumed on a reef, making them an essential component of reef ecosystems. Furthermore, these fishes perform a variety of functional ecosystem services. However, functional morphological variation across CRFs has not been studied in a biogeographical framework. The Tropical Eastern Pacific (TEP) is a biogeographic region separated from the Western Pacific by a semipermeable open ocean barrier, and from the Caribbean by the impermeable Isthmus of Panama, making it an ideal isolated marine region to examine community functional turnover in CRFs. Within this region there are more than 300 CRF species distributed amongst 12 families. In this study we examine how body shape varies in a CRF community context across the TEP using geometric morphometrics of vouchered museum specimens. Comparisons between biogeographic provinces and amongst families largely show CRF families across different biogeographic regions occupy similar regions of morphospace. However, we find significant differences in body shape disparity in certain families from different regions. We discuss these findings in relationship to shared geological and evolutionary history of these species, as well as their ecology.

P2.83 | Genome-wide data reinforces the evolutionary relationships of previously problematic earless lizards (Phrynosomatidae: Holbrookia)

Thomas Firmino, Corey Roelke, Adam Leache, Nathan Rains, Toby Hibbitts, Wade Ryberg, Travis Laduc, Sonal Singhal, Matthew Fujita

46 In the face of anthropogenic change and the potential loss of species, documenting biodiversity – including accurately delimiting species complexes – is of tantamount importance. Genome-wide data are powerful for investigating lineage divergence, though deciding if this divergence reflects species-level differentiation remains challenging. Here, we use genome-wide data to investigate species limits in four currently recognized species of Earless Lizards (Phrynosomatidae: Holbrookia), with a focus on *H. lacerata* and *H. subcaudalis*, the latter having potentially imperiled populations. This group's taxonomy has been repeatedly revised; most recently, *H. lacerata* and *H. subcaudalis* were elevated to species status using conserved morphological data and a few molecular markers. In this study, we used double-digest restriction-site associated DNA sequencing to delineate species limits for our focal taxa. We recovered five populations that corresponded to five well-supported lineages with very little gene flow among them. Our results support the recognition of *H. lacerata* and *H. subcaudalis* as two separate species, based on strong phylogenetic support for these lineages and genetic divergence measures that exceed those of currently recognized species within Holbrookia. Genomic methods for species delimitation offer a promising approach to assess biodiversity in taxonomically confounded taxa or organisms of conservation priority.

P1.81 | Calling phenology of an anuran assemblage in a periurban Illinois landscape

Mackenzie Fisher, Thomas Anderson

189 The timing of life history events (i.e., phenology) can affect population demographics, as well as species interactions. Determining phenological patterns and their drivers has become increasingly critical as many organisms are experiencing shifts in phenology with climate change. The goal of this study was to assess the calling phenology patterns and its drivers for eight anurans. We deployed Audiomoth recording devices at 7 ponds on the Southern Illinois University Edwardsville campus from February to September 2022. Each device recorded 7 2-min recordings from 2000-0200 each night over the survey period. We assessed drivers of each species' phenology using nearby weather station data (air temperature and rainfall). As expected, we found distinct groupings of species based on season, with spring peepers and boreal chorus frogs calling early in the spring, followed by American toads in late spring. Cricket frogs, gray tree frogs and American bullfrogs called across the summer months. Southern leopard frogs called from early spring through early summer but also had a separate calling period in late summer. Temperature and precipitation were both identified as drivers of calling phenology, but species differed in their respective responses. Ongoing phenology monitoring will elucidate interannual variation in phenological patterns across species.

27.3 | Desert slender salamander (*Batrachoseps aridus*) and salamanders in the desert (*Batrachoseps* sp.) of southern California

Robert Fisher

451 The desert slender salamander (*Batrachoseps aridus*) (DSS) was one of the first species listed as endangered under the Endangered Species Act by the U.S. Fish and Wildlife Service and one of the first species listed under California's Endangered Species Act. It has now been over 25 years since a verified sighting of the species has been documented. The two known historic locations for this species were surveyed over the last 6 years, several times each, and during prime activity periods, to determine the status of the habitat at the sites, and to attempt to detect any salamanders. Sampling was done with surrogate species for amphibian fungal disease detection, and remotely triggered cameras were deployed at one site to determine the source of illegal human sign. At neither site were salamanders detected during any surveys. We did find a possible third population discovered in the 1980's but failed to detect salamanders there in 2021. Our broad sampling for any salamanders in the desert starting in 2020 did detect multiple populations of salamanders in San Diego, and Imperial Counties, none of which appear to be the endangered DSS. We did detect one new population of apparent DSS in Riverside County in 2023 and we report it here for the first time as well as the potential rediscovery of the species. We will also discuss the novel desert animals from San Diego and Imperial Counties and a population in Riverside County detected in 2024.

14.10 | Are Elasmobranch Traits a Predictor of Extinction Risk

Sam Fisher, Isaac Trindade-Santos, Diala Ede, Lauren Sallan

474 Sharks and rays (Elasmobranchs) have a predominantly marine cosmopolitan distribution, but are widely assumed to face the highest risks of extinction due to their relatively slow growth, low reproductive rate, and relatively low species counts. In addition, sharks with greater ecological (functional) specialization are usually assumed to be at greater extinction risk than less specialized species in the same ecosystem. To investigate whether threatened elasmobranch species exhibit greater specialization compared to non-threatened counterparts, we measured 11 ecological traits across 806 IUCN-assessed species across 60 Large Marine Ecosystems (LMEs), and compared trait value distributions, ecologically-relevant and widely used summary metrics (functional uniqueness, distinctiveness, specialization), and diversity across risk categories. Our findings reveal that globally threatened species did not significantly differ from non-threatened species in most ecologically functional metrics derived from such traits. Few LMEs housed threatened sharks with high levels of functional specialization, while non-threatened species in

northern latitude LMEs exhibited higher functional specialization. Functional uniqueness varied significantly between threatened, non-threatened, and data deficit taxa in both sharks and rays. However, significant differences in functional distinctiveness were only evident within shark groups. Length at first maturity, mean temperature preference, and maximum depth emerged as statistically significant predictors of risk across IUCN classes for elasmobranchs overall. These findings suggest that while threatened sharks and rays may possess specific ecological trait combinations, these traits vary geographically and do not necessarily denote greater specialization, uniqueness, or distinctiveness compared to non-threatened counterparts. This highlights the need for reevaluation of current conservation strategies and prevention measures.

24.4 | Negative frequency-dependent selection on dorsal color and a model for polymorphism and divergence in small terrestrial salamanders

Benjamin Fitzpatrick

136 Color polymorphism within populations of small terrestrial salamanders has fascinated herpetologists for decades. Theory predicts eventual loss of polymorphism without some form of balancing selection. Polymorphism for presence or absence of a dorsal stripe is common in several species of small plethodontids, and research in *Plethodon cinereus* has revealed a plethora of potentially important associations between individual color pattern and ecological or behavioral variables. Color pattern variation in other systems, such as the *Desmognathus fuscus* and *D. ochrophaeus* complexes, has vexed taxonomists with its apparent lack of order. Here, I use data from field sampling and experiments together with a simple mathematical model to argue that visual predators can drive rare-form advantage, stabilizing polymorphism within species and reinforcing chance associations between color pattern and other traits affecting competition and coexistence. Rapid formation of predator search images can favor alternative cryptic color patterns and, under the right circumstances, predation might promote both extreme individual variation and stable coexistence between species with different forms of crypsis. This should be considered as an alternative to the hypothesis that diversity in salamander communities is regulated primarily by resource competition.

8.4 | Evolutionary March: Spatial Variability in Immunity along the Cane Toad Invasive Range in Australia

Felipe Floreste, Tsering Chan, Gregory Brown, Fernando Gomes, Vania Assis, Lee Rollins

213 Cane toads are native to South America but were introduced to the east coast of Australia in 1935 as an attempt to control crop pests. Since then, toads have expanded westward, and the dispersing populations have rapidly modified aspects of their physiology, behavior, and immune traits. For instance, invasion-front individuals show lower metabolic investment in immune function than range-edge counterparts. In addition, toads have been carrying the co-introduced South American lungworm *Rhabdias pseudosphaerocephala*, but toads on opposite ends of the invasion range also show different interactions with the parasite. Invasion-front toads host higher numbers of *Rhabdias* larvae in their lungs than those from range-core populations and range-core toads are more resistant to infection by local strains of *Rhabdias* than are toads from the invasion-front. Given the heterogeneity in immune function along the invasive range, we aim to test whether these spatial differences in immune response are rooted in the production of inflammatory biomarkers. More specifically, we predict a less intense and briefer gene expression of Th2-type cytokines and immune function (neutrophil to lymphocyte ratio — NLR; and plasma bacterial killing ability — BKA) in naive offspring from invasion-front populations when compared to range-core offspring following experimental infection with *R. pseudosphaerocephala*. Our preliminary results indicate locality-dependent effects on baseline immune function. Toads from the invasion-front show higher NLR than range-core counterparts, which might indicate an investment towards cheaper immune traits to reallocate energy for dispersion. Nevertheless, we believe gene expression data under analysis will further elucidate this hypothesis.

P2.71 | Exploring Immunomodulation in Toads: Differential Gene Expression Following Stimulation with Bacteria

Felipe Floreste, Patrício Garcia-Neto, Sandra Muxel, Stefanny C. M. Titon, Patrick da Silva, Fernando Gomes, Vania Assis

215 Amphibian populations are endangered due to emerging infectious diseases worldwide. In addition, opportunistic pathogens take advantage of the host's compromised immune system to proliferate. *Aeromonas hydrophila* is an opportunistic bacterium that causes the red-leg syndrome in immunosuppressed individuals and is one of the agents responsible for the decline of amphibian populations in the wild and in captivity. Although this bacterium is widely spread and commonly found in freshwater ponds, little is known about its effects and interactions with the amphibian immune system. We aim to investigate differential gene expression in two primary immune organs (spleen and liver) of toads (*Rhinella diptycha*) injected with heat-killed *A. hydrophila*. For that, wild-caught toads were injected intraperitoneally with 300µL of a bacterial solution containing 3 x 10⁸ bacteria cells, while the control group was not manipulated. Spleens and livers were collected six hours post-injection and submitted to transcriptomic analyses. We expect differential gene expression between the treated and control groups. More specifically, immune-related genes will be upregulated in the bacteria-injected toads. We hope to identify which genes and signaling pathways are activated in response to bacterial components, enhancing our understanding of pathogen recognition by the immune system in anurans.

9.1 | Bridging the gaps that hinder shark conservation: An analysis of international elasmobranch policy implementation by Atlantic fishing nations.

Sonja Fordham

230 Elasmobranchs are threatened mainly by overfishing, with international trade as a key driver. Over the last few decades, significant strides toward shark and ray conservation have been made through the Convention on International Trade in Endangered Species (CITES, a global wildlife treaty) and the International Commission for Conservation of Atlantic Tunas (ICCAT, a regional fishery management organization). Because sharks and rays are considered both commodities and wildlife, governments' approaches toward elasmobranch obligations under fisheries and environment agreements are, however, often misaligned. The success of international conservation measures relies on proper implementation at the national level. An associated lack of scrutiny is a core yet surmountable challenge to effective policies and population rebuilding. This presentation will review an analysis that documents the performance of ICCAT's 52 Parties and 5 Cooperators (CPCs) with respect to conservation obligations for Atlantic elasmobranch species listed under CITES between 2002 and 2020, highlights key policy and implementation gaps, and recommends priority improvements at national and international levels.

11.6 | Satellite and Acoustic Telemetry Reveals Deep Dives and Long Range Movements of the Bat Ray (*Myliobatis californica*)

Ryan Freedman, Ryan Logan, Varenka Lorenzi, Chris Caldwell, Vanessa Van Deusen, Chris Lowe, Kady Lyons

413 Bat Rays (*Myliobatis californica*) are a temperate species of stingray that uses a number of different habitats off the US and Mexican Pacific Coast. The species is commonly caught by pier fishermen and consumed by low income and vulnerable communities. The species is assumed to be highly mobile which means they may represent a vector of exposure to a number of contaminants to these human communities. To date, most studies have been conducted on the species movements in estuarine habitats but we tagged 5 Bat Rays with pop-off satellite tags and acoustic telemetry tags and additional 15 individuals with just acoustic tags in open coastal habitats off Southern California. Data revealed that Bat Rays would make deep dives over 300 meters deep and easily move from coastal habitats to offshore waters. Bat Rays made movements from the mainland to different offshore islands as well

indicating a high level of habitat connectivity for the species. We are looking to pair this movement data with measures of contaminant loads from each individual to model consumption risk locally.

16.9 | Fish Sound Production : the Swim Bladder is not a Resonant Structure

Romane Frey, Philippe Compère, Eric Parmentier

79 In teleost fishes, the swim bladder is an organ filled with gaz that, in addition to providing buoyancy, plays a role in hearing and, in some species, in acoustic communication. Although several studies in different species have demonstrated that the swim bladder has a prominent role in sound production, its function in this process remains largely unknown in the absence of extensive studies on the subject. A first approach, borned in the 60's, considered the swim bladder as a « resonant bubble » which describes it as an omnidirectional resonant gaz bubble, i.e. an acoustic monopole. This theory has been rarely discussed even though literature described, since then, an unusual high damping rate for a free bubble. Wrongly justified by the properties of the surroundings tissues, we show that this damping property is in fact an intrinsic property of the swim bladder, the organ fails to resonate. For the species with sonic muscles, sounds are more likely to be the result of a forced response to muscular contraction and should not be amplified at the eigenfrequencies of the swim bladder.

6.4 | Ecological implications of evolutionary divergence in the genus *Parachromis*

César Fuentes-Montejo, Wilfredo Matamoros, Miquel Gonzalez-Meler, Caleb McMahan

390 The ecological niche is a recurring and core concept in ecology which has been described as a multidimensional space that is used by every species. Recent studies have associated niche measurements with morphological and phylogenetic properties, suggesting they can help predict aspects of the trophic niche. *Parachromis* is a small clade of five species of predatory Neotropical cichlids whose ecology has been poorly studied. We used an integrative and comparative approach in order to understand the implications that evolutionary divergence has on species niche. We compared morphological functional traits, body shape variation, and isotopic signatures across the genus *Parachromis*. We used museum specimens from the native range of all species in the genus to obtain linear measurements, geometric morphometrics, and stable isotopes as descriptors of habitat use, locomotion, food acquisition, and trophic positioning. We then contrasted them with a phylogeny, in order to test for phylogenetic signal. Despite their close relatedness, there was a low phylogenetic signal for morphological measurements and isotopic space. However, some morphological traits explain the variation on isotopic space, relating locomotion and habitat use to their trophic positioning. Additionally, snout length, eye size, and fineness ratio have the greatest contribution to variation among species, allowing for easy identification and association to their predatory behavior. We conclude that morphological measurements match isotopic space in the genus *Parachromis*, but that phylogenetic relatedness does not explain observed variation.

10.2 | Environmental DNA analysis for detection of *Poeciliopsis* in northern Sonora, Mexico

Alanna Fulkerson, Alejandro Varela-Romero, Alexandre Gutierrez-Barragán, Doug Duncan, Mariana Mateos

225 Several species of *Poeciliopsis* occur in the Mexican state of Sonora; *Poeciliopsis jackschultzi* (Rio Concepcion Topminnow), is listed as endangered by the IUCN Red List, and whether it is still extant is unknown. The major threats appear to be habitat loss/degradation and invasive species. Survey efforts are hampered by the inability to use external morphology to distinguish *P. jackschultzi* from its co-occurring congeners: the Gila topminnow, *Poeciliopsis occidentalis*; and asexual hybrids whose maternal progenitor is the Headwater topminnow, *Poeciliopsis monacha*. Here, we present the results of a metabarcoding eDNA based method aimed at detection of teleosts. We collected and filtered in situ water samples in 2022 and in 2023,

based on known localities and historical occurrence of *Poeciliopsis* of interest. After DNA extraction, samples were subjected to PCR with the MiFish primer set, which targets a 163-185 bp region of the mitochondrial 12S rRNA gene of teleosts and is diagnostic for our target taxa. After filtering, we obtained ~500 million reads associated with 2925 unique sequences. Unfortunately, we did not detect a single feature assigned to *P. jackschultzi*, suggesting that it was absent or at an abundance below our detection ability. The most frequent features were assigned to the native cyprinids Longfin dace (*Agosia chrysogaster*) and Sonoran Chub (*Gila ditaenia*), followed by those assigned to *P. occidentalis* and *P. monacha*. Non-native fish were also detected; among these, Green sunfish (*Lepomis cyanellus*) had the highest frequency, followed by Bullhead (*Ameiurus melas*), Western mosquitofish (*Gambusia affinis*), Bluegill (*Lepomis macrochirus*), and Swordtail (*Xiphophorus*).

13.1 | Development of AI Tool Suite for Electronic Monitoring of Pacific Sleeper Sharks in Alaska

Keith Fuller, Cindy Tribuzio

180 The use of electronic monitoring (EM) technologies in fishery sciences (e.g., cameras combined with video review in lieu of at-sea observers) has continued to expand over the last several years. Our project has developed a machine learning/ AI pipeline for detection, species identification, and measurement of individual sharks from EM videos to better track trends in catch and inform stock assessments for a data-limited elasmobranch species in Alaska, the Pacific sleeper shark (*Somniosus pacificus*). As *S. pacificus* stock assessment in Alaska is done based entirely on catch data, this species stands to benefit greatly from any improvements in data sources. Thanks to strong detection and classification results we have begun to implement this technology within the EM data pathway. Our results suggest that this algorithm suite could increase review efficiency, provide previously unavailable size data, as well as provide assessors with the tools to evaluate accuracy of existing catch estimation methods for relatively rare species. Both the timely delivery of fisheries data and this novel data type will aid stock assessment processes. As the algorithm process created by this project is publicly available, this project also offers new tools for other management entities and researchers interested in expanding use of EM tools.

8.1 | Thermal and Habitat Effects on Rattlesnake Reproductive Ecology in the Southeastern U.S.

Matthew Gacheny, Shane Welch, John Holloway, Jayme Waldron

385 Ectotherms (e.g., reptiles) cannot metabolically regulate their body temperature and rely on behavioral strategies incorporating microhabitat use to thermoregulate across a range of environmental conditions. Thermoregulation affects all aspects of reptile life-history, rendering reptiles vulnerable to climate change. Therefore, microhabitat selection is an essential behavior allowing reptiles to ameliorate temperature fluctuations concerning life-history processes (e.g., reproduction). Fitness costs are incurred if suitable body temperatures are not maintained through appropriate microhabitat use by females during reproduction. Thus, we examined the influence of ground-level thermal properties on microhabitat use by reproductively active female Eastern Diamondback Rattlesnakes (*Crotalus adamanteus*; EDB) in the southeastern U.S. We employed a use-availability-based framework to examine thermal and structural characteristics of microhabitats selected by free-ranging, reproductively active female EDBs in South Carolina and at their northern range limit in North Carolina. We hypothesized that to optimize gestation, gravid females will select cooler microhabitats to avoid negative metabolic consequences of overheating. Concomitantly, we hypothesized that vitellogenic females will select overwinter microhabitats that minimize potentially metabolically demanding temperature fluctuations, thus stabilizing their energetic expenditures during yolk provisioning. This study will help improve our understanding of range-wide tradeoffs in reproductive female EDB microhabitat use while revealing key information about constraints on the species' distribution and its sensitivity to climate change.

14.7 | Damming consequences: morphological impacts of artificial barriers in riverine steelhead trout (*Oncorhynchus mykiss*)

Jacquelyn Galvez, Christian Lizaso, Jack Tseng

405 Artificial damming of freshwater rivers influences many aspects of stream ecology. Human made dams can create barriers to upstream breeding and rearing habitats of anadromous fishes and can limit gene flow between such populations. Studying fish populations impacted by damming provides a unique opportunity to study the downstream effects of these dispersal limitations, with potential to reveal how damming influences the evolutionary trajectory of populations and how endangered fishes cope with anthropogenic environmental change. In this study, we conducted a morphological comparison of anadromous steelhead trout, *Oncorhynchus mykiss*, along the South Fork Eel River. We used 2D geometric morphometrics to analyze differences in lateral body shape temporally (before versus during) and spatially (above versus below) across a human-made barrier, Benbow Dam. Results indicate differences in morphological dispersion both temporally and spatially. Furthermore, Procrustes ANOVA and pairwise comparisons also indicate differences in lateral body shape for all comparisons. These results lead us to propose functional hypotheses for how muscle mass and movement may differ in trout populations separated by a dam barrier, with particular emphasis on differing trends among resident and migratory fish.

13.7 | This is Why I'm Hot: How the Social Construction of Space Influences Conservation Behaviors.

Taylor Gamble

436 Environmental conservation is a critical global issue, with extreme climate-related events affecting biological ecosystems and human communities. Individual perceptions of climate and geological events are linked to perceived climate risk, health behaviors, and attitudes related to conservation. Moreover, research on temporal perception related to environmental attitudes is theorized to affect an individual's level of concern. I build on this body of work by exploring the relationship between individual perception and environmental conservation behavior to understand how individuals come to support pro-environmental initiatives behaviorally. Aquatic spaces have not traditionally been seen as sociological, however recently there has been an increased focus on the social aspect of these spaces. Using data from the 2018 nationally representative survey, "Weather, Society, and Government," I investigate the effect of individual perceptions of climate and geological events on water conservation behavior. Additionally, I explore how an individual's social capital and belief about the environment surrounding them might be affecting the relationships between perception and an individual's conservation-based behavior. The importance of these relationships can play a large role in science communication, community building, and the focus of future environmental conservation behavioral research in marine spaces.

23.4 | From Snakes to Wolves: Integrated Spatial Capture-recapture Models

Beth Gardner

361 Built on the foundation of traditional capture-recapture models, spatial capture-recapture (SCR) models have advanced rapidly since their inception. Initially, SCR models provided a way for researchers to incorporate spatially referenced capture information from trap arrays, allowing for model-based estimates of density. The timing of SCR model developments has paired well with the advancements of non-invasive data collection methods including camera trapping, genetic sampling, and acoustic recordings. With explicit incorporation of spatial capture information, SCR models can be used to explore not only demographics but how animals use space and select resources. SCR models provide a flexible framework for integrating multiple sources of data, for example, GPS/telemetry relocations or occupancy data. In this talk, I'll describe how we have analyzed data from snakes and wolves with integrated SCR models to better estimate demographic rates and movement patterns. These two examples offer a contrasting perspective of an invasive species and a recolonizing species providing a means to explore very different population dynamics.

16.10 | Biovisualizations of the cranial pit in the Rockhead Poacher, *Bothragonus swanii*

Daniel Geldof

149 Armored fishes suffer trade-offs for their protection from physical dangers. Their encasement comes with penalties to agility and situational awareness. Many armored fishes have evolved specialized morphology and behaviors counteracting their shortcomings. The Rockhead Poacher is a small, heavily-armored fish noteworthy for a large dorsal cavity in its head. This cavity, known as the cranial pit, has an undetermined function. I will explore the morphology of the cranial pit and speculate on its function in the context of life as an armored fish.

P2.22 | Anatomy of the Bioluminescent Organ in Ponyfishes (*Leiognathidae*)

Michael Ghedotti, Jordon Valdez, Rene Martin, John Sparks

209 Ponyfishes are a group of approximately 51 shallow marine and brackish-water species that produce light using a circumesophageal bioluminescent organ that houses bacteria in the genus *Photobacterium*. All species use bioluminescence transmitted through a guanine rich swimbladder with ventral transparency for ventral counter illumination, but others also emit light dorsally or laterally through transparent "windows." The external structure and sexual size dimorphism of this organ within the *Leiognathidae* has been well discussed. However, the fine-scale anatomy and histology of the light organ in this group is poorly understood. We particularly focus on describing the light organ in the genus *Photopectoralis* which emits light ventrally and laterally. All organs contain small, elongate chambers that house *Photobacterium*. These chambers are variously screened by melanocytes and/or guanine to emit light ventrally and to the swimbladder. Evolutionarily modified esophageal musculature associated with these organs may allow selective emission and rapid lateral blinking in males.

P2.37 | Gecko Wars: Assessing Competition and Displacement Behaviors among Invasive House Geckos (*Hemidactylus* spp.)

Ricardo Gibert, Robert Espinoza

192 The behavioral ecological character-displacement hypothesis posits that competition and behavioral interactions drive niche divergence, making this mechanism a likely determinant of invasive species distributions. House Geckos (*Hemidactylus* spp.) are nearly globally distributed and often human-commensal invasive lizards. Over the past century, Mediterranean House Geckos (*H. turcicus*) have established populations in the southern USA; followed by Tropical House Geckos (*H. mabouia*) decades later in southern Florida, and Sri Lankan House Geckos (*H. parvimaculatus*) within the last decade in southern Louisiana and Texas. These species are similar in size and occupy nearly identical niches, leading to speculation of competitive displacement of *H. turcicus*, which no longer occurs in southern Florida and is increasingly rare in southern Louisiana. Yet, no study has documented competition among these species. Our study will determine if the gradual disappearance of *H. turcicus* from previously occupied regions can be attributed to competition with congeners by ascertaining the competitive dominance hierarchy among these three species. We hypothesize competition will occur, as evidenced by dominance behaviors in staged encounters, with *H. turcicus* ranked as the weakest competitor. Geckos ($n \sim 20$ /species) are size-matched and paired in staged encounters across all combinations of species and sexes and introduced to an arena where behavioral interactions are video recorded. Predefined behaviors are quantified and categorized to assign dominance ranks and are compared via ANOVA to determine the dominance order among species. Our findings will broaden our understanding of the role of behavior as a mechanism of competitive displacement among co-occurring invasive species.

24.1 | Asymmetrical hybridization and environmental factors influence the spatial genetic structure of a killifish hybrid zone

Andrew Hardy, Michelle Gaither, Katie Lotterhos, Samuel Greaves, Kyra Cipolla, Emily Kerns, Andres Prieto, Matthew Gilg

477 Hybridization offers insight into speciation and the forces that maintain barriers to reproduction, and hybrid zones provide excellent opportunities to test how environmental parameters shapes barriers to reproduction and hybrid fitness. A hybrid zone between the killifish, *Fundulus heteroclitus* and *F. grandis*, had been identified in northeastern Florida, although the spatial structure and parameters that affect the distribution of the two species remain unknown. The present study aimed to determine the fine-scale spatial genetic patterns of the hybrid zone to test the hypothesis that species ranges are influenced by changes in dominant vegetation, and to determine how differences in reproductive barriers between the two species influence the observed patterns. The area of overlap between the two species spanned ~37 km and showed a mosaic pattern of hybridization, suggesting the spatial structure of the hybrid zone is largely influenced by the environment. Environmental association analysis, however, suggested a combination of environmental factors were driving the observed patterns as opposed to just the dominant vegetation. Hybridization tended to be rare at sites where *F. heteroclitus* was the more abundant species, suggesting that differences in preference for conspecifics can lead to differences in rates of introgression into parental taxa even at nuclear loci.

28.5 | Approaching to Endangered Fish Species of the Pampa Using FAIR Data

Julia Giora, Juliana Wingert

439 One of the main challenges in the construction of biodiversity knowledge is finding ways to transform what is provided in research publications into reusable formats, following the FAIR data principles. The openly accessible data known as FAIR data stands for Findable, Accessible, Interoperable and Reusable, and may be applied to many kinds of data as figures, tables, and bibliographic references. Most often, biodiversity data is restricted in the so-called "PDF prison", and these data are the basis for building new scientific knowledge, as they should be used in decision-making in conservation actions. Plazi's infrastructure and workflow transform such data into reusable formats that can then be exported and linked across different platforms, such as the GBIF, BLR, Zenodo, Synospecies, ChecklistBank, and OpenBiodiv among others. Pampa is one of the five Brazilian biomes, covering the majority of the Rio Grande do Sul state area, and is currently considered as threatened. We are herein presenting an effort to make literature data about endangered fishes from the Pampa biome a reusable database with essential information about the species descriptions. Plazi uses its own visual editor to extract data and annotate documents in XML, a compatible format suitable for reading by computers. A total of 44 original descriptions of species of fishes were liberated. All information provided in the publications was connected to referenced figures and tables, and made available on the corresponding platforms. A dashboard was created as an interactive graphical tool summarizing how the extracted information interacts at different levels.

22.5 | Hole-y moly: Morphology and evolution of the genus *Monomitopus* (Ophidiidae)

Matthew Girard, G. Johnson

29 The genus *Monomitopus* (Ophidiidae) is a group of demersal cusk-eels found between 150 and 1600 meters in tropical and subtropical seas. Members of the genus can be differentiated from other ophidiids by their large eye, strong opercular spine, two or three spines at the lower angle of the preopercle, and basibranchial 3 tooth plate that extends anteriorly above basibranchials 1 and 2. During the discovery and description of a new species from Hawai'i, we found several distinct morphological features in the neurocranium and pectoral girdle in *M. agassizii* and *M. ainonaka*, including a pair of large foramina associated with the braincase that have not previously been described in ophidiiforms. In this study, we describe the variation in and examine the distribution of these morphological characters across all

15 species of *Monomitopus* using a combination of μ CT-scanned and stained specimens. Based on these and other characters, we discuss the evolution of this genus and its placement within the Ophidiidae.

P1.36 | How Background Color and Circadian Rhythm Impacts Dorsal Coloration in Clearnose Skates

Scott Goldberg, Jonathan Cohen, Aaron Carlisle

317 The ability for a fish's skin to lighten or darken in response to changes in background has been demonstrated in many taxa, including several, though not all, of the elasmobranch species tested. Despite the fact that this adaptation was first described in the 1920's, this process remains poorly described in elasmobranchs. This adaptation may aid elasmobranchs in hiding from predators and prey, though given the slow rate of change (on the scale of hours to days), elasmobranchs cannot use this to quickly mimic the benthos. One of the aims of this study was to determine if a previously untested species, the Clearnose Skate (*Rostroraja eglanteria*), is capable of changing its dorsal coloration in response to substrate color, and if the rate of this color change varies between individual skates and sexes. We assessed how background matching rates and maximum/minimum dorsal brightness varied across conspecifics and sexes when they were placed on extremely light or extremely dark surfaces. The second goal of this study was to better understand if circadian rhythm may control color change in Clearnose Skates. While it has been demonstrated that circadian rhythm impacts color change in some amphibians and crustaceans, to our knowledge this phenomenon has never to been tested in elasmobranchs. This study will help uncover if a factor other than visual stimuli can impact color change in elasmobranchs.

P1.7 | Condition of Young-of-Year Scalloped Hammerheads during Nursery Use in the Tolomato River, FL

Dylan Gore, Matthew Bernanke, James Gelsleichter

414 Studies have determined that the Tolomato River, FL is a nursery for young-of-year (YOY) scalloped hammerhead sharks (*Sphyrnale wini*). It is hypothesized that YOYS.lewini use nurseries for predation release and/or enhanced foraging opportunities. However, there are no studies that have examined the condition of scalloped hammerheads during nursery use in the Tolomato River to see if this nursery is selected for either of these purposes. Thus, this study focused on assessing the condition of YOYS.lewini as they use this nursery habitat. To achieve our goal, we caught scalloped hammerheads in the Tolomato River, using longline and hook-and-line fishing and recorded their length, weight, and girth measurements. We then used these data to assess the condition of the scalloped hammerheads. Our data suggests that scalloped hammerheads residing in this site exhibited good condition. This suggests that the Tolomato River nursery provides enough food for the juvenile scalloped hammerheads during its use. Therefore, this site likely provides multiple benefits to these individuals.

P1.93 | Variation of cranial morphology within the *Anaxyrus americanus* complex

Claudia Goss, Neil Balchan, Owen Edwards, Kaleb Banks, Guinevere Wogan

164 Broadly distributed across North and Central America, true toads within the genus *Anaxyrus* occupy a variety of diverse ecosystems and display variation in key morphological traits including body size, external coloration, and size and shape of cranial crests and paratoid glands. Within this genus, eight closely related taxa comprise the *Anaxyrus americanus* complex. Although dorsal coloration and configuration of paratoid glands and cranial crests are known external distinguishing features within this complex, we aim to characterize the interspecific and intraspecific variation of internal cranial morphological features. Utilizing micro-CT scans of museum specimen within of all eight species within in *A. americanus* complex in conjunction with 3D geometric morphometric approaches, we have mapped homologous landmark points on the skull across all eight species to characterize within- and between-species cranial trait variation. We used discriminant function analysis and principal component analysis to determine patterns of morphological

variation to determine if variation is discrete among species in this complex. Future directions of this study will integrate temperature and precipitation patterns to assess the relationship between cranial morphology and environmental gradients. The results of this investigation may provide an additional line of evidence for examining the taxonomic relationships of this radiation of North American bufonids.

27.5 | Population genomics of Flat-tailed Horned Lizards (*Phrynosoma mcallii*) across a fragmented Colorado Desert landscape

Andrew Gottscho, Dan Mulcahy, Adam Leaché, Kevin de Queiroz, Robert Lovich

290 *Phrynosoma mcallii* (Flat-tailed Horned Lizards) is a species of conservation concern in the Colorado Desert of the United States and Mexico. Our study used ddRADseq data from 45 lizards to investigate population structure, phylogeny, migration barriers, genetic diversity hotspots, and demographic history. Our analyses revealed the Colorado River as a significant geographical feature shaping population structure, with populations west of this river further divided by the Salton Sea. Phylogenetic analysis affirmed the nesting of northwestern populations within southeastern populations. The best-fit demographic model indicates Pleistocene divergence across the Colorado River, accompanied by detectable bidirectional gene flow and a severe Holocene population bottleneck. These findings emphasize the importance of management strategies aimed at preserving genetic diversity on both sides of the Colorado River and Salton Sea. We propose expanding management efforts to additional areas in the U.S. and Mexico for similar goals as those in the Rangeland Management Strategy (RMS). Additionally, we suggest regular periodic genomic sampling to monitor ongoing trends such as diversity loss, hybridization, and alterations in population structure due to habitat fragmentation, climate change, and other long-term impacts.

P2.15 | The Effects of Preservation Method on the Stomach Contents of Round Goby (*Neogobius melanostomus*) for Nanopore Diet Metabarcoding

Christian Graca

211 Understanding the diet of organisms is an important aspect of conservation biology and ecological research. However, the traditional taxonomic analysis of stomach contents has limitations because partially digested samples or species lacking conspicuous diagnostic morphological traits can make species identification difficult. DNA diet metabarcoding, which is the identification of species from stomach contents based on gene sequences, has been developed to alleviate this problem, but some issues remain. One such issue is that the effect of the preservation method used on the results of diet metabarcoding studies is unclear. My thesis investigates the effects preservation method has on the DNA metabarcoding of stomach contents in a particularly problematic invasive species in the Great Lakes region, the round goby (*Neogobius melanostomus*). Round gobies were captured during the summer of 2023 in Montrose and Diversey harbors and lakefronts in Lake Michigan, Chicago. The stomach contents were removed, homogenized, and divided into five groups: preservation in 95% ethanol at room temperature, preservation in DESS at room temperature, preservation in 95% ethanol at -20°C, preservation in DESS at -20°C, and a control group in which the DNA was extracted from fresh specimens. After four months the DNA from the treatment groups was extracted. Primers amplifying the COI and 16S genes are being tested, as are blocking primers to prevent PCR amplification of round goby DNA. Once such primers have been tested, the DNA library will be prepared and sequenced using the Oxford Nanopore MinION sequencer.

13.10 | Creating Cultural Change in Small to Medium-Sized Professional Societies: A Training Network Approach

Jasmin Graham, Lisa Whitenack, Lara Ferry, Wendy Barnard, Mikki McComb-Kobza

466 The culture of shark research faces challenges of exclusion, expense, and media bias. The NSF BIO-LEAPS Design Project entitled "Creating

Cultural Change in Small to Medium-Sized Professional Societies: A Training Network Approach” aims to foster diversity and inclusivity in the American Elasmobranch Society (AES) through the implementation of a diverse Advisory Board and training workshops as well as train-the-trainer programs. Future steps involve extending these initiatives to similar societies and seeking NSF funding for broader implementation. The first phase of the project was to recruit an Advisory Board and host a workshop to review the American Elasmobranch Society’s current policies and procedures and provide feedback and suggestions on how to improve equity and accessibility within the society. The Advisory Board offered suggestions in regards to awards and special recognitions including increasing transparency by tracking demographics of recipients, involving Equity and Diversity Committee representatives in application review, and offering bias training as well as reducing barriers by adjusting requirements and sharing judging criteria. They also offered suggestions on accessibility including ensuring event accessibility with wheelchair access, interpreters, and materials, improving communication, and addressing socioeconomic barriers with fee waivers. With regards to the bylaws, the Advisory Board made suggestions on how to integrate diversity, equity and inclusion (DEI) commitments throughout the bylaws, clarify leadership roles, and update bylaws regularly. They also offered suggestions on DEI trainings for AES members and Leadership and the Code of Conduct. We will discuss next steps of how we hope to integrate this feedback moving forward.

P1.85 | Differential Expression of Potential Cardiac Glycoside Genes in the American Toad (*Anaxyrus americanus*)

Michael Grapin, Thomas Firreno

56 Defensive toxins are found in a plethora of vertebrates and invertebrates, and have played a large role in the diversification and co-evolution of many taxa. Within the amphibian world, toads of the family Bufonidae endogenously synthesize defensive toxins. Several of these toxins (bufadienolides) belong to the broad class of cardiac glycosides. While some bufadienolides in toads have been structurally characterized due to their interest in pharmacological development, the underlying genetic and biochemical mechanisms of bufadienolide biosynthesis remains relatively understudied. Our study aimed at identifying and characterizing potential genes responsible for the synthesis of cardiac glycosides in the American Toad (*Anaxyrus americanus*). We used RNA sequencing to characterize and evaluate the bufonid parotoid gland transcriptome at 0-, 3-, 6-, 9-, and 12-hours time intervals after extracting the secretion of the parotoid gland. We then identified genes that were differentially expressed across these time points and functionally annotated them to identify potential gene candidates involved in bufadienolide biosynthesis.

P2.50 | Pesticide Impacts on Anuran Communities at Florida Gulf Coast University

Zeanna Graves, Andrew Durso

265 Urban development in southwest Florida have increased rapidly since the 1950s, while frog populations have decreased. Pesticides are sprayed on managed lands and eventually runoff into nearby waterbodies where they can impact many species. This research aims to look at the extent to which frog communities are impacted by pesticide runoff in wetlands at Florida Gulf Coast University in Ft. Myers, Florida. We tested whether wetlands that have a higher proportion of turf grass in adjacent uplands have a lower population and diversity of frogs. Every 4-8 weeks, we set groups of 30 traps for five days at a time and checked them daily. Each trap session rotated between different testing sites featuring cypress domes, man-made sites, and depressions. Captured frogs were collected to record measurements, take tissue samples, and capture pictures of tadpole mouthparts to score any abnormalities and then released back into the wetland. Water quality measurements were recorded at each site with a Sonde. A GIS buffer zone was added around each trap location to calculate the proportion of land use. Anurans were most abundant at ephemeral wetlands further from turf grass. The results of this research should help the University adjust their Integrated Pest Management (IPM) approach to minimize harm to susceptible frogs in campus wetlands.

27.2 | Saving the Toads (and How We Did It)

David Green

3 Notwithstanding widespread concern over the past 30+ years about declining amphibian populations and the many possible threats to their continuing existence, how can threatened amphibian populations actually be saved? Since 2010, Fowler’s Toads (*Anaxyrus fowleri*) in Canada have been listed federally as an endangered species based on the small number of remaining Canadian populations and evidence of an ongoing decline in their abundance, particularly at Long Point, Ontario. By 2013, loss of quality breeding habitat, attributed to the spread of invasive Phragmites reeds, was identified as a likely primary contributor to the decline in the toads’ abundance at Long Point. Ponds were dug in the marshes and tadpoles were reared in mesocosms, but neither effort had much tangible effect. In recent years, however, there have been significant changes to the landscape related to high water levels in Lake Erie. Shoreline dunes have washed out, creating open sand flats and shallow, sandy pools where the toads now breed with great success. Their abundance has risen dramatically for the first time in a decade. How to save the toads? Give them what they need.

P2.53 | Movement Ecology of Fowler’s Toads at Long Point, Ontario

David Green

470 Movements occur due to the spatial distribution of necessary resources: food, water, shelter, heat, mates, and breeding sites.

P2.80 | Investigating the Thermobiology of Sympatric Snake Species

Hailey Griffin, Christopher Howey

174 Sympatric species may differ in habitat use; although overlapping in range, they may be more adapted to different habitat within the landscape. Environmental temperatures influence physiological processes, behaviors, and ecological interactions of ectothermic animals. Given the difference in habitat use by different ectotherms, differences may also lie in available thermal opportunities for those animals; and thus, selective pressures over time may have led to differences in thermal adaptations. For this project, we measured the preferred body temperature (Tset) and metabolic thermal performance curves for three snake species: Northern Ring-necked Snakes (*Diadophis punctatus*), Eastern Milksnake (*Lampropeltis triangulum*) and Eastern Gartersnake (*Thamnophis sirtalis*). Northern Ring-necked Snakes tend to inhabit subterranean habitat or are found under cover objects within woodland areas. Eastern Milksnakes tend to be found under cover objects, but may also be found in more open habitat. Eastern Gartersnakes are largely generalists and may be found in a large variety of habitats. Snakes were captured and brought into the lab where we measured preferred body temperatures in a thermal gradient and measured metabolic rates at varying temperatures. The data obtained from this experiment will help determine whether varying thermal environments can affect the thermal physiology of different sympatric species inhabiting varying thermal niches.

6.8 | Structure and function of the backbone: morphology and modeling of neural and haemal spines in burrowing and non-burrowing labrid fishes

Olivia Guerra, Linnea Lungstrom, Mark Westneat

465 Sand diving is a burrowing behavior in which an individual conceals itself completely under substrate as a startle response, to avoid predation, or to sleep. This burrowing behavior is widespread in wrasses (family Labridae), and previous studies show that sand diving species differ from non-sand diving species in morphological traits such as body shape and depth, head shape, vertebral prezygapophyses, and neural spine overlap. Here we test ideas of vertebral force transmission by examining the diversity in the vertical septum of both sand diving and non-sand diving taxa through the analysis of the geometry and morphometrics in the neural and haemal spines of the caudal region. We develop models of the vertical septum through the exploration

of the surrounding collagen fiber membrane to visualize tension undergone by spines through backbone bending. Using the R packages StereoMorph and geomorph, we performed 2D geometric morphometrics using vertebral images of multiple species of sand diving and non-sand diving wrasses. The system of collagen fibers in the vertical septum was visualized using polarized light and inspired preliminary biomechanical models. Results show that sand divers and non-sand divers occupy different regions of vertebral morphospace, and that neural and haemal spines undergo tension within the collagenous fiber system upon backbone bending.

16.3 | Movement Ecology of the Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*)

Garrett Guzowski, Loretta Battaglia

359 Movement ecology focuses on organism movement and behavior within and between their preferred habitats. Animals move for a variety of reasons, such as anthropogenic pressure and changes in salinity and temperature. The Diamondback Terrapin, a species that inhabits coastal brackish habitats in a narrow band spanning the Atlantic and Gulf coasts, is the only brackish dwelling turtle in North America. Most research pertaining to terrapins has focused on Northern and Carolina subspecies and little information exists on the Texas subspecies. To fill knowledge gaps at the southwestern end of the terrapin's distribution, this project is focused on home range and core use area, salinity preferences, and effects of salinity shifts on terrapin movement. The study area, located north of Corpus Christi, Texas, includes Nueces River and its tidal segment in Nueces Bay, a known terrapin hotspot. Salinity fluctuations in this system are common and dependent on inflows, salinity levels may range from fresh to hypersaline. Salinity is being monitored at permanent data stations in the upstream and downstream reaches of the site, and at points in between using HOBO loggers. Terrapins are being trapped using modified chimney-fitted crab traps and marked for identification purposes to track movements along the salinity gradient. The trapping campaign began in Summer 2023 and has yielded 23 captures ranging between salinities of 15-37 ppt. Trapping and salinity measurements will continue through summer of 2024. The findings of this project will provide a framework to protect the Texas Diamondback Terrapin and their habitat in south Texas.

28.9 | Unexpected Cryptic Diversity in *Pareiorhaphis nudula* (Siluriformes: Loricariidae), in South Brazil

*Mateus Haas, Pablo Lehmann-A, Edson Pereira, Roberto Reis**

99 The sucker-mouth catfish *Pareiorhaphis* comprises 28 small-sized species inhabiting headwater streams of south and southeastern Brazil. *Pareiorhaphis nudula* from South Brazil differs from its congeners by exhibiting six main characteristics, with the most notable being the extreme reduction of dermal plates on the dorsal surface of the body. In the original description, its distribution was recorded as restricted to the Araranguá River basin. Subsequent fieldwork has revealed that this species occurs in five other neighbor drainages that share an orogenic history: Maquiné, Três Forquilhas, Mampituba, Araranguá, and Tubarão Rivers. These rivers originate in the highlands of the Serra Geral mountain range and flow to the east towards the Atlantic Ocean through ancient valleys that act as geographical barriers today. These rivers, however, have been temporarily connected during the eustatic sea level fluctuations of the Pleistocene, allowing dispersal and subsequent species differentiation. Therefore, the objectives of this study are to conduct a review of all populations to delimit the actual range of *P. nudula* and to identify undetected cryptic biodiversity. Morphological and molecular species delimitation methods are being performed based on material deposited in the fish collection of the Museum of Science and Technology at PUCRS (MCP), both historical and freshly collected. Preliminary analyses of morphological and molecular data indicate the existence of five cryptic species within the *P. nudula* species complex geographically isolated in separate coastal basins. This study will contribute to the knowledge of the ichthyofauna of southern Brazil and the conservation of these species.

6.3 | Delineation of Species within *Poeciliopsis occidentalis* sensu lato

Angela Haggard, Alanna Fulkerson, Jack Curry, Madison Nguyen, Marianna Mateos

203 Two nominal species, *Poeciliopsis occidentalis* (Baird and Girard) and *P. sonoriensis* (Girard), and some lineages known to be genetically distinct are currently combined under the umbrella, *Poeciliopsis occidentalis* sensu lato. *Poeciliopsis occidentalis* and *P. sonoriensis* were briefly described in 1853 and 1859, respectively, but have not since been reassessed. *Poeciliopsis occidentalis* is a species of conservation concern throughout its range and is the subject of extensive reestablishment efforts in its historic U.S. distribution. Efforts to identify and monitor *Poeciliopsis occidentalis* sensu lato are hampered by the co-occurrence of its sexual "parasite," the all-female asexual hybrid biotype *P. monacha-occidentalis*. Without a clear definition of the species within *Poeciliopsis occidentalis* sensu lato, conservation efforts are hindered and morphological distinction of hybrids is impossible. To facilitate further study of these fishes, the *Poeciliopsis occidentalis* sensu lato complex was investigated and broken up. Species were morphologically delineated using standard morphometrics and meristics and osteological examinations via CT scans and clearing and double staining. Lineages were distinguished following existing molecular data and confirmed via sequencing of diagnostic genes. *Poeciliopsis sonoriensis* and *P. occidentalis* were redescribed, and distinct lineages assessed as candidates for description.

24.5 | Highly convergent *Anolis* lizards exhibit divergence in fundamental life-history traits

Joshua Hall, Christopher Thawley, James Stroud

134 Evolutionary convergence is considered powerful evidence for adaptation to similar natural selection pressures. However, for many ecologically and morphologically convergent species, it remains unclear if convergence extends to more cryptic aspects of biology, especially those with major fitness consequences such as reproductive strategies. Here, by measuring key life-history traits (e.g., reproductive status, egg size, oviposition frequency, reproductive effort) across a full annual cycle comprising both reproductive and non-reproductive seasons, we discover divergence in reproductive strategies in two otherwise strikingly convergent *Anolis* lizards. The Cuban brown anole (*A. sagrei*) rapidly produces many small eggs during a concentrated summer reproductive season, while the Puerto Rican crested anole (*A. cristatellus*) produces comparatively fewer, larger eggs over a longer period. Thus, despite evolving highly convergent ecomorphological phenotypes and both being constrained to a single-egg clutch, these species exhibit marked divergence in life-history trade-off strategies. Our results indicate that ecomorphological convergence can evolve uncoupled from life-history pathways.

19.1 | Welcome and Introduction: What is Data Integration and Why Should I Care?

Brian Halstead, Jonathan Rose

73 Data integration encompasses a diverse and growing field that improves statistical inference by leveraging diverse sources of information on quantities of interest. Types of data often collected by herpetologists, including presence-only, detection-nondetection, count, capture-mark-recapture, and radio telemetry data, can often be combined analytically to improve precision of estimated quantities or allow estimation of quantities that otherwise could not be estimated. In this symposium, we will introduce attendees to many different forms of data integration useful to herpetologists (and our ichthyological colleagues as well) by providing examples of recent and ongoing research that incorporates multiple sources of data to improve inference about amphibian and reptile populations and communities. This welcome talk will introduce the topic and provide brief examples to whet attendees' appetites for the more detailed presentations to come.

11.7 | Using Spatial Modeling to Manage Atlantic Highly Migratory Species (HMS)

Erianna Hammond, Steve Durkee, Larry Redd Jr., Karyl Brewster-Geisz, Tobey Curtis

140 The Highly Migratory Species Management Division of the National Marine Fisheries Service (NOAA Fisheries) is responsible for the management of the U.S. federal swordfish, tunas, billfish, and shark fisheries in the Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea. In 2023, we published a proposed rule and fishery management plan amendment that considered changes to the timing and boundaries of four commercial long-line closed areas that have been in place for approximately 20 years. Closed areas, while effective in reducing bycatch and fishing effort, pose challenges by limiting the ability to gather fishery-dependent data critical for management needs. Additionally, the static nature of these closures contrasts with the dynamic HMS fisheries and ocean environment, necessitating an assessment of the effectiveness of time/area closures and other gear-restricted management measures. Recognizing this limitation, NOAA Fisheries developed HMS PRedictive Spatial Model (PRISM), a tool that combines observer-collected catch data with environmental variables to predict gear-specific fishery interactions, including in areas with limited or no data. We used this tool to assist in the evaluation of closed areas' efficiency and effectiveness in meeting management and conservation goals. In this discussion, we will describe the preferred area modifications. Academic researchers may be interested in this action as it provides opportunities to conduct research in areas that were previously closed to allow further data collection and determine the effectiveness of the current closed areas.

5.5 | Sticking with it: a multi-sensor tag to reveal the foraging ecology and fine-scale behavior of elusive durophagous stingrays

Cecilia Hampton, Breanna DeGroot, Benjamin Metzger, Kim Bassos-Hull, Lauran Brewster, Matthew Ajemian

377 Large, durophagous (shell-crushing) rays are hypothesized to play a pivotal role in marine food webs, yet information on their fine-scale behavioral ecology is limited due to their elusive nature and challenges with tagging these morphologically unique animals. Using a novel, minimally invasive tagging approach we investigate their movements, behaviors, and ecological interactions. Our multi-sensor device includes a CATS-CAM (Customized Animal Tracking Solutions, Ltd.) equipped with a hydrophone (HTI 96-min), an Innovasea V-9 coded acoustic transmitter, and a Wildlife Computers satellite transmitter (363-C). The package is approximately 2.8 x 7.6 x 5.1 cm, and weighs 430 g in air. The units are attached to the dorsal cephalic region of the rays via two silicone suction cups, which are placed along a recessed area between ridges of the chondrocranium, and a 24-hour galvanic timed release strap to plastic, rounded hooks on the dorsal cartilage of each spiracle. Through captive trials (N=45) at Mote Marine Aquarium in Sarasota, Florida, and field trials (N=9) in Harrington Sound, Bermuda, retention times on whitespotted eagle rays (*Aetobatus narinari*) were up to over 30 hours. IMU data suggest unique movements related to feeding, while video and audio data capture shell fracture acoustics and may be capable of revealing prey identity. Field recordings have documented ray behaviors including feeding and interactions with habitat and other conspecifics. We expect this tool to be capable of revealing in situ behaviors of multiple species of benthopelagic rays.

16.6 | Superficial Neuromast Proliferations in Tetras (Family Characidae: Subfamily Stethaprioninae)

Maxwell Hampton, Jacqueline Webb

244 The lateral line system is composed of canal neuromasts in bony canals and lateral line scales as well as superficial neuromasts (SNs) on the skin, but recent studies have shown that SN distributions are dramatically underestimated. The occurrence of SNs on the head, trunk, and tail in the family Characidae, for instance, is well-known in the Mexican tetra, *Astyanax mexicanus*. The blind, cave dwelling form has 2600+ SNs (Sumi et al., 2015), but SNs in only a few other tetras are described or mentioned in keys and species descriptions. The goal of this study was to expand our knowledge of SN

distributions in tetras of the subfamily Stethaprioninae. A total of 23 species (1-3 indiv./sp.) in 14 genera (within four tribes) as well as nine outgroup taxa in 2 other characid subfamilies and 4 other characiform families, were obtained commercially. Fish were stained with 4-di-2-ASP (vital fluorescent mitochondrial stain) to simultaneously visualize all canal and superficial neuromasts; a subset of fishes were subsequently prepared for SEM to assess SN size, shape, and physiological orientation. Hundreds to thousands of SNs in somewhat stereotyped patterns were found in all 23 stethaprionine species examined (from 300 in *Inpaichthys kerrito* 3800 in *Gymnocorymbus ternetzi*). SEM revealed that the SNs are small and vary somewhat in shape among species. SN distribution pattern varied among genera in Stethaprioninae revealing some phylogenetic signal (based on the phylogeny in Mirande, 2018) and ecological correlates, which suggests variation in the sensory ecology of these fishes.

P1.38 | Chromosomal Rearrangements as Drivers for the Diverse Nutrient Delivery Systems in Elasmobranch Reproduction

Sabrina Haney, Michale Phelps

404 The morphological and physiological transition from oviparity (egg laying) to viviparity (live-bearing) is not well understood. Literature suggests that the evolution of viviparity has evolved independently at least 15 times in elasmobranchs. Each evolutionary transition is marked by various means of delivering nutrients to young including yolk, uterine 'milk', consumption of other litter mates, continued ova production, and placenta development. I hypothesize that the development of various reproductive modes was preceded by chromosomal rearrangement events that allowed for novel genes, gene families, and regulatory networks to evolve. To investigate this proposal, we are looking at three species: elephant shark, *Callorhynchus milii*, Pacific spiny dogfish, *Squalus suckleyi*, and the bonnethead shark, *Sphyrna tiburo*, representing oviparity, non-placental viviparity, and placental viviparity respectively. I am conducting genome assemblies and annotations which will then be undergo a synteny comparison and used to compare against chromosome rearrangements to identify regions of evolutionary importance including novel genes. I am then utilizing a single-cell approach to identify cell specific expression and regulatory networks in each species uterine tissue. With this information, we can investigate the differences in how evolution of each reproductive mode has transformed the uterine tissue expression and epigenetic landscapes along with how modifications to regulatory elements may have paved a way for the evolution of viviparity to occur.

16.5 | Taxonomy and Phylogenetic Relationships of a New Heptapterin Genus with Oval Spots on the Sides of the Trunk (Siluriformes: Heptapteridae)

José Haroldo de Lima Junior, Flávio Bockmann

263 Taxonomy and phylogenetic relationships of less inclusive clades of the subfamily Heptapterinae, such as specious and widely distributed genera, exemplified by *Imparfinis*, are repeatedly neglected through the current times. The lack of a comparative framework has led to the recent descriptions of undiagnosable and improperly allocated species. At least 11 new genera have been informally proposed to mirror the phylogenetic structure of the family, one of them encompassing heptapterines with 4 oval spots on the flank, including, at least, *Imparfinis pseudonemacheir*, from the Orinoco and Ucayali River basins, and *Nannorhamdia stictonotus* (currently in *Imparfinis*), from the Madeira, Paraguay, and Ucayali River basins. The purpose of this work was to review this new genus, identifying potential new forms, in addition to describing them anatomically, also including CT-scan resources, to support a parsimony analysis. Throughout the taxonomic investigation, the two mentioned species were considered valid, while four undescribed species, with wide distribution along the main tributaries of the Amazon and Orinoco River basins, were recognized. The monophyly of the new genus is supported by six synapomorphies: the neural spine of the vertebra 6 with a lateral process; mesethmoid hook absent; dorsal surface of the quadrate concave; dorsal hypohyal weakly calcified; foramen for exit of PO1 branch on the intersection between sphenotic and pterotic; and trunk with four oval

spots. This new genus is recognized as part of a more inclusive heptapterine clade composed, at least, of Horiomyzon, Imparfinis, and Mastiglanis, plus four undescribed genera.

28.3 | Redescriptions of two nominal species previously regarded as synonyms of *Pellona ditchela* Valenciennes, 1847 (Teleostei: Clupeiformes: Pristigasteridae)

Harutaka Hata, Sébastien Lavoué

295 Within the genus *Pellona* (Clupeiformes: Pristigasteridae) in Indo-Pacific, species having 22 or more lower gill rakers and body scales with grooves overlapping centrally, have been regarded as synonyms of *Pellona ditchela* Valenciennes, 1847, a species widely distributed in the Indo-West Pacific region. However, morphological examination and mitochondrial COI genetic data of specimens identified as *Pellona ditchela* obtained throughout its distribution, revealed that this species comprises at least two species, *Pellona hoevenii* Bleeker, 1852 (distributed in western Pacific from Philippines to Indonesia and Vietnam) and *Pellona natalensis* Gilchrist and Thompson, 1908 (east coast of Africa and Madagascar). The former can be distinguished from the latter by having more pectoral-fin rays [17–19 (modally 17) in *P. hoevenii* vs. 14–17 (15) in *P. natalensis*], dorsal-fin rays [17–20 (18) vs. 15–18 (16)], and pseudobranchial filaments (21–25 vs. 17–20), longer dorsal-fin base (15.1–18.4% of SL vs. 12.2–14.5%) and pelvic fin (9.3–9.9% of SL vs. 7.8–8.8%), shorter anal-fin base (27.7–32.9% of SL vs. 33.2–35.8%), and melanophores scattered on gill rakers (vs. no melanophores on gill rakers). No specimens of these two species from India were observed, although the type locality of *P. ditchela* is Visakhapatnam (eastern coast of India). Because characters of *P. ditchela* in the original description also do not match the above two species, the nominal species *P. ditchela* seems to be a junior synonym of a species in the genus *Ilisha*.

P2.8 | Symbiosis in a New Light: Biogeography and Phylogenetics of a Bioluminescent Vertebrate-Bacterial Symbiosis

Delson Hays, Emily Neff, Alison Gould

107 The symbiotic relationships between vertebrates and their bacterial microbiomes are an increasingly appreciated field of research for macro- and microbiologists alike. In many marine fish of the mesophotic and aphotic zones, such symbioses produce bioluminescence, but the fragility, rarity, and physical inaccessibility of such taxa has prevented close analysis in the lab environment. The fish genus *Siphamia* (Kurtiformes, Apogonidae), is an outlier among bioluminescent fish taxa in that members reside in shallow reefs of both temperate and tropical ecoregions, making it far more accessible to research. In this study, we examine nuance in the association of *Siphamia* and its sole bioluminescent symbiote, the proteobacterium *Photobacterium mandapamensis*. Colonies of *P. mandapamensis* were isolated from the light organs of three different *Siphamia* species occupying three different climates, two of which have not been analyzed in the lab environment before. These bacterial isolates were screened using PCR fingerprinting and unique genotypes were sequenced using Oxford Nanopore Technology. Our findings will likely shed new light on the specificity and evolution of this host-bacterium symbiosis, with temperate and tropical fish species potentially hosting different bacterial substrains. Moreover, new substrains of *P. mandapamensis* - and potentially even a new species of the same genus - may be described from the light organs of previously-unexamined *Siphamia* species from temperate habitats. The close pairing between *Siphamia* and *P. mandapamensis* represents the first one-to-one vertebrate symbiosis to be studied extensively in the lab environment, and may become a model system for other vertebrate symbioses, especially in the deep ocean.

15.1 | The Boys are Back in Town: Insights into Smalltooth Sawfish Mating Based on Periodicity of Adult Male Movements

Lukas Heath, R. Dean Grubbs, Andrew Wooley, Dylan Yakich, Sarah Webb, Michael McCallister, Gregg Poulakis

356 Despite two decades of research on endangered smalltooth sawfish, *Pristis pectinata*, the timing and location of mating in the U.S. is still unknown. However, in recent years, internal acoustic tagging and collaborative telemetry networks have begun to reveal the wide-ranging movements of adults around Florida. Historical data show that the Indian River Lagoon (IRL), on Florida's east coast, once acted as a nursery and supported multiple life stages. To date, in the southern IRL, 29 large juveniles and adults (2.3–4.6 m stretch total length; mean = 3.8 m) have been acoustically tagged in the St. Lucie River and St. Lucie Inlet. Most individuals left the IRL, often spending winters in the Florida Keys. Large juveniles that stayed in the IRL avoided the inlet and lower river during April, while adult males with fresh mating wounds were there. Meanwhile, two adult males showed similar movements of spending winters in the Keys, but returned to Charlotte Harbor and Cape Canaveral during late April in consecutive 3–5-year time series. Adults caught in the Keys and Everglades, as well as reported to the U.S. Sawfish Recovery Hotline, have also had fresh mating wounds, most in April. Taken collectively, there is growing evidence that mating occurs during April in multiple locations throughout the southern half of Florida. Continued monitoring and tagging of adults may lead us to more of these sites, which may need to be protected to promote recovery.

1.4 | Horizontal movements of great and scalloped hammerheads in relation to commercial longline fisheries in the western North Atlantic

Vital Heim, R. Dean Grubbs, John Carlson, Bryan Frazier, Matthew Smukall, Philip Matich, Annie Guttridge, Tristan Guttridge

232 Overfishing is a major threat to sharks and the implementation of protected areas or fishery closures to reduce the interaction risk between stress-prone species and fisheries can aid in their effective management. Due to their high mobility, high capture mortality and low post-release survival, challenges of designing effective management strategies are embodied by great and scalloped hammerheads, *Sphyrna mokarran* and *S. lewini*. Here, we coupled satellite telemetry and the construction of movement models for 29 great and 22 scalloped hammerheads with the spatial analysis of species-specific capture data from the U.S. commercial longline fisheries observer programs to provide suggestions for potential time-area closures that could help improve the management of these two species in the western North Atlantic. The overlap with commercial fisheries between scalloped hammerheads and the pelagic longline fisheries was highest during spring and we found areas of increased overlap in U.S. federal waters off Cape Hatteras (North Carolina) during all seasons but summer. Great and scalloped hammerheads showed seasonally increased overlap values in federal waters off the west and east coast of Florida including year-round overlap off the Florida Keys. Our results suggest that the efficacy of these areas in preventing fisheries related mortality of the two species, if implemented as time-area closures, should be further investigated. Our results also contribute towards an increased understanding of the movements of the two species between the U.S. Atlantic and the Gulf of Mexico and aid in the identification of stocks during the assessment of conservation strategies.

P1.24 | A new species of freshwater stingray (Potamotrygoninae) from the Demerara River, Guyana.

Devya Hemraj-Naraine, Joao Pedro Fontenelle, Astrid Acosta, Fernando Marques, Nathan Lovejoy, Matthew Kolmann

89 A new species of freshwater stingray (Potamotrygoninae) is described from the Demerara River, Guyana, and is distinguished from all other regional congeners (e.g., *Potamotrygon marinae*, *Potamotrygon schroederi*, *Potamotrygon orbignyi*, *Potamotrygon motoro* and *Potamotrygon bosemani*) using a combination of whole genomic DNA sequencing, meristic, and morphometric datasets. This newly described stingray exhibits distinctive

morphological characteristics, including irregular small dark brown/black blotches along the dorsal side, a large preoral area, and increased spacing between its spiracles. Notably, it lacks the distinct dorsal ocelli observed in *P. motoro*. Compared to its other counterparts, *P. marinae* displays a shorter tail and a vivid yellow dorsal pattern, while *P. schroederi* exhibits distinct brown blotches against a dark brown/black background. Although *P. orbigny* shares similar coloration with the new species, differences in spiracle spacing and branchial basket size distinguish them. The new species coexists sympatrically within the Demerara River with the more widespread *P. orbigny*, its closest relative. Molecular analysis corroborates the new species as a distinct lineage within the Potamotrygon clade and closely related to *P. marinae* from the Eastern Guianas, *P. orbigny* from the Orinoco, and *P. schroederi* from the Rio Negro. The discovery of a new species literally next door to the capital city of Guyana, Georgetown, highlights the need for careful reappraisal of the identity of potamotrygonines from Guyana and the Guiana Shield.

P1.3 | The Effects of Dorsal Fin-Mounted SPOT Tags on the Great White Shark

Grace Hicks, Phillip Lobel

320 Is affixing a SPOT (Spatial Positioning Only Tag) tag to the great white shark (GWS) dorsal fin using a mechanical drill and drill bits the optimal method for SPOT tag attachment?

This project presents empirical evidence to examine the effects of dorsal fin-mounted SPOT tags on GWS using a drill as the mode of attachment.

Tag biofouling, wounds to the dorsal fin, potential growth defects on juvenile GWS, stress, and the appearance of hemorrhagic-like bands on the ventral side of GWS are all concerns regarding animal welfare and altering the natural behavior of GWS.

The elasmobranch dorsal fin is not analogous to that of ray-finned fishes. Fin rays are able to regenerate after an injury while the fleshy elasmobranch dorsal fin and its inner structures are unable to do this.

Tags attached using a drill can remain on GWS for multiple years. However, many of these tags can be programmed to last for less than a year. Why isn't there a release mechanism that corresponds to battery life?

Alternative methods should be developed that are less invasive and can yield better data on natural behaviors.

30.2 | Climate Change Drives Population Dynamics through Reduced Survival and Phenotypic Selection in a Vulnerable Pitviper

Eric Hileman, Sasha Tetzlaff, Matthew Simon, Gordon Schuett, Mark Davis, William Brown

145 The effects of climate change on population dynamics are poorly understood, especially for long-lived species, because studies conducted over biologically relevant timescales are rare. However, such long-term studies are critical for understanding how individual and environmental factors influence vital rates with increasing global change. Using over four decades of capture-recapture data on adult female Timber Rattlesnakes (*Crotalus horridus*), we investigated the effects of climate change on population dynamics in a color polymorphic population near the northern extent of its geographic range. Survival decreased as temperature (a 10-yr moving average) and the number of days $>12.4^{\circ}\text{C}$ (observed lower temperature limit for surface activity) increased, suggesting global warming negatively impacted survival through the cumulative effects of increasing temperature and active season length. Increased temperatures resulted in survival declines in black-morph (melanistic) and yellow-morph snakes. Although yellow morphs were more abundant early in the study, higher black-morph survival contributed to a rapid increase in the proportion of black-morph snakes, with black morphs becoming the dominant phenotype within the past decade. Increases in the proportion of black morphs were linked with increases in temperature, and to a lesser extent, decreases in precipitation. Our findings suggest climate change is contributing to decreased survival and selection for melanism, and the increased proportion of black morphs is driven almost entirely by differential survival. Reduced basking requirements of melanistic adult females may minimize depredation

risk by allowing individuals to remain longer undercover. However, additional research is needed to unravel the precise proximate factors contributing to phenotypic selection.

P2.68 | Recreating Movement Patterns of Flatback Sea Turtles (*Natator depressus*) Using Stable Isotope Analysis

Ricarda Hill, Calandra "Cali" Turner Tomaszewicz, Jeffrey Seminoff

425 Flatback sea turtles (*Natator depressus*) are a marine turtle species endemic to coastal Australia. The data deficient status of flatbacks on the IUCN Red List complicates species management and necessitates further demographic and life history research. This project is part of larger, on-going research, and coupled carbon and nitrogen stable isotope (SI) ratio analysis with skeletochronology, the study of bone growth layers, to recreate movement and diet patterns over multiple years of a turtle's life. As part of the on-going research, the humerus bones were previously analyzed for age analysis (Turner Tomaszewicz et al. 2022 PlosOne); here, we sampled a subset of the bones from stranded turtles in Eastern Australia (n=13), Northern Territories (n=8), and Western Australia (n=16) using a micromill to extract 150 samples for stable isotope (SI) analysis. Turtle body size ranged from 11.3 to 96.0 cm curved carapace length (CCL); the estimated age of the turtles was between 0 and 48 years. Samples were sent for SI mass spectrometry analysis that produced: percent carbon, percent nitrogen, and the isotopic ratios of $^{12}\text{C}:^{13}\text{C}$ ($\delta^{13}\text{C}$) and $^{14}\text{N}:^{15}\text{N}$ ($\delta^{15}\text{N}$) for each growth layer. Carbon isotope values ($\delta^{13}\text{C}$) can help to indicate potential shifts between coastal and pelagic habitats while nitrogen isotope values ($\delta^{15}\text{N}$) can show changes in trophic level. The initial results show that individual adult turtles are consistent in their foraging and habitat use patterns; but also that turtles in the same region may have different foraging strategies. These SI techniques, with previously published skeletochronology age and size data, are beginning to reveal spatiotemporal patterns of flatback sea turtle habitat use, thus informing species management and protection

P1.79 | Diving for DNA: Using environmental DNA (eDNA) as a tool to detect *Eurycea wallacei* (Plethodontidae), in understudied karst environments

Gretchen Hilt, Christopher Beachy, Kyle Piller, Matthew Niemiller

55 Developing non-invasive methodological approaches is of great importance when working with sensitive populations and species. Environmental DNA (eDNA) has become an effective tool for the study of rare, threatened, and endangered species across many aquatic and terrestrial ecosystems. Environmental DNA assays are non-destructive so they are particularly attractive for species residing in habitats that are difficult to access or sample. The Georgia Blind Cave Salamander (*Eurycea wallacei*) inhabits karst environments that are often inaccessible due to the need for cave-diving experience or simply the physical and structural inability to access the submerged groundwater systems. Monitoring population trends of species that are difficult to detect and survey may be substantially more practical with an eDNA approach. Here we conducted a field survey using an eDNA assay in highly sensitive, understudied habitat within the Floridian Aquifer. Water samples were collected from twelve sites within one cave system near Marianna, Florida. To evaluate eDNA detection thresholds across horizontal distances into each cave entrance, we sampled within the cave, at the vent of the cave, and at the surface above the vent. We amplified a fragment of the cytochrome c oxidase subunit 1 (COI) gene using a previously developed set of metazoan primers. The results from our first sampling season will be presented. Assessing the presence of *Eurycea wallacei* in different habitats of this cave system will allow for a data driven management and protection plan to be implemented.

P2.65 | Osteology of the Eastern Worm Snake, *Carphophis amoenus* (Say) (Serpentes, Dipsadidae, Carphophinae) from Virginia

Clare Hilton, Eric Hilton

501 The snake species of the genera *Contia* and *Carphophis* together form the subfamily Carphophinae of the family Dipsadidae, a relatively basal member of

the Colubroidea. The Eastern Worm Snake, *Carphophis amoenus*, one of two species in the genus, is a small (<350 mm maximum total length) species of dipsacid snake. *Carphophis amoenus* is distributed throughout eastern North America. This species feeds on worms, fly larvae, slugs, and other soft bodied invertebrates. They are often found under cover, such as logs, flat rocks, and other debris lying over soft soil, as well as burrowed into stumps and sandy soils. Little is known about the osteology of *Carphophis amoenus*, with the most recent study being an unpublished dissertation focused primarily on cranial osteology (Shepherd 1973). Here we describe the skeletal anatomy of *Carphophis amoenus* based on specimens (e.g., road kills) that were salvaged in eastern Virginia. Specimens were fixed, cleared and stained, and dissected to allow for a complete description of the skeleton. New aspects of the osteology will be presented here. For example, the distal ends of the ribs terminate in a flattened, anchor-shaped cartilaginous tip. This study will serve as a basis for future research on the anatomy of basal colubroid snakes.

35.1 | Great Hammerhead Seasonal Resource-Use in an Identified Nursery

John Hlavin, Catherine Macdonald

224 The overall population fitness of many marine species is enhanced by using nursery areas that provide critical habitat and resources to support juvenile growth to maturity or reduce risk of predation. Notably, the estuarine habitats of Biscayne Bay, Florida have been characterized as a nursery for the Critically Endangered great hammerhead (*Sphyrna mokarran*) as evidenced by juvenile relative abundance, site fidelity, and residency, despite proximity to the anthropogenic pressures of metropolitan Miami. Recent great hammerhead catch-per-unit-effort from ongoing shark survey efforts within the Bay and preliminary acoustic telemetry data of tagged juveniles have suggested a seasonal difference in juvenile great hammerhead habitat-use in the form of a movement to incorporate offshore habitats during winter months. Therefore, we tested the hypothesis that an offshore habitat expansion is evident in a corresponding shift in seasonal resource-use. Specifically, we used multi-tissue stable isotope analysis of paired bulk white muscle and plasma to assess the seasonal directionality of juvenile resource-use relative to adults. Reports that great hammerhead populations in the Western Atlantic have begun to rebuild over the past decade underline the importance of identification and management of relevant nurseries to capitalize on this promising population trajectory. By delineating the extent to which nursery habitat use expands offshore in winter, this work supports a seascape approach to nursery identification that seasonally encompasses offshore areas as a component of nursery habitats.

P1.11 | Multi-Tissue Stable Isotope Analysis of the Finetooth Shark (*Carcharhinus isodon*) in Northeastern Florida and Southern Georgia

Emily Hoeflich, Bryan Franks, Jeremy Stalker, Eric Reyier

284 The finetooth shark (*Carcharhinus isodon*) is a small coastal shark found in the western north Atlantic Ocean off the southeast coast of the United States and throughout the Gulf of Mexico. While it is known that finetooths primarily feed on menhaden and other small teleosts, little is known about the feeding ecology and habitat use of this species. Understanding these life history characteristics is crucial for commercial and recreational management of shark species, and these data for the finetooth shark is lacking. To address this, the current study proposes to use stable isotope analysis of carbon and nitrogen in white muscle and blood plasma to analyze the feeding ecology and habitat use of this species in northeast Florida and southern Georgia. Analysis of carbon will reveal information about the habitats they are feeding in, and analysis of nitrogen will allow for determination of the trophic level this species is occupying. Additionally, analysis of multiple tissue types allows for these results to be assessed on various time scales; isotopic turnover in white muscle occurs over ~6 months, while turnover in blood plasma occurs over ~30 days. Results from this project are expected to provide a short- and long-term assessment of the feeding ecology and habitat use of the finetooth shark to address the life history knowledge gap for this species.

1.1 | Exploring the genetic analysis of telomere lengths in *Carcharhinus perezii* and *Ginglymostoma cirratum* in The Bahamas and Turks and Caicos

Caroline Hornfeck, Oliver Shipley, Austin Gallagher, Alexis Janosik

282 Understanding growth and longevity of sharks is essential to assess current population status and predict how populations are predicted to change. Currently, age estimates for sharks are challenging to quantify due to lack of ossified structures and variability between intra- and interspecific structures, such as vertebrae and fin spines. Conventional aging techniques are subjective in nature and require lethal sampling, which is not ethically sound for assessing vulnerable species. As such, it is essential to implement aging estimates that are less invasive and offer resampling throughout an individual's lifetime. Molecular tools offer unique evaluation into understanding validated age in sharks because they involve less invasive sampling methods and are a technique that is applicable to all species. Two species of interest, *Ginglymostoma cirratum* and *Carcharhinus perezii*, play major ecological roles in the Caribbean Sea through nutrient transfer and are integral parts of ecosystem connectivity. The objective of this study was to use a molecular approach to study growth rates and aging through telomeres examination such that the resulting data may provide information on longevity. For this study fin clips were collected in partnerships with Beneath the Waves. Genomic DNA was extracted and run through qPCR and resulting cycle thresholds were averaged. Ct values were plotted against total length of shark individuals in a linear regression model. Statistical analysis was used to determine if there was significant difference between Ct values and total length. This study offers a unique evaluation into the age estimates for *G. cirratum* and *C. perezii* using non-destructive aging techniques.

35.4 | Space use by white sharks (*Carcharodon carcharias*) in their overwintering residency area in the western North Atlantic

Mackenzie Horton, Ashley Johnson, Nigel Hussey, John Tyminski, Chris Fischer, Brett McBride, Robert Hueter, Bryan Franks

378 The movement and migration of the white shark population in the western North Atlantic has become the subject of increasing interest to better understand areas of importance and habitat use for all life stages. Recent research is revealing information regarding broad scale horizontal movements and habitat use, however, detailed data on 3-dimensional space utilization are needed to develop and ensure sound management strategies. This project seeks to better understand the space use, and potential core habitats of white sharks while in their overwintering residency area in the Carolinas region. Regularized and most probable tracks of individual sharks were constructed using acoustic and satellite data to examine site fidelity and determine resident versus transient behaviors. Time series depth and temperature data were then used to quantify diving profiles tied to transient and resident behaviors to identify important areas or habitats and their proposed purpose. These analyses address trends in region-specific movements based on size, sex, maturity, or individual preference. Using combined tag technologies over multi-year periods allows for a robust analysis of habitat use associated movement behaviors for individual animals that contribute to the growing knowledge of the western North Atlantic white shark population. These data will provide critical information to our understanding of the ecology of white sharks in this understudied overwintering region.

27.6 | Restoration of Timber Rattlesnake Rookeries: Efficacy of Daylighting Management

Christopher Howey

37 Body temperatures, and thus physiological mechanisms, of ectothermic animals are highly influenced by environmental temperatures. Changes in body temperature lead to changes in chemical reaction rates; influencing physiological mechanisms associated with digestion, growth, bodily maintenance, and reproduction. The range of Timber Rattlesnakes (*Crotalus horridus*) extends further north than most other rattlesnake species. To maintain elevated body temperatures necessary for successful embryonic development, pregnant Timber Rattlesnakes in the northern portions of their range use rare, open

habitats known as gestation sites. Due to habitat loss and the suppression of habitat disturbance, many of these gestation sites have become overgrown with vegetation and shaded over. During 2016, 2017, and 2018, pregnant Timber Rattlesnakes were radio-located at six gestation sites; four of which were overgrown with vegetation. At each site, I monitored available environmental temperatures, canopy cover, and presence of potential predators. I determined the body temperature of females throughout the entire summer, behaviors, date of parturition, and estimated litter size when possible. During the winter 2016, I removed trees surrounding three of the six rookery sites using a targeted disturbance called “Daylighting”. As a result of the Daylighting management, operative temperatures increased, females maintained warmer body temperatures, and date of parturition occurred sooner. Further, survivorship of litters and pregnant females increased following Daylighting management. These benefits of Daylighting, however, may come at a cost of increased risk of predation. Given the success of this restoration technique, these management techniques may be applied throughout the species northern range to increase female reproductive success.

35.9 | Risky Reproduction: Long-distance Migrations of Mature Female and Gravid Oceanic Whitetips Expose Them to Fishing While Males Stay Put

Lucy Howey, Jim Gelsleichter, Yannis Papastamatiou, Matthew Witt, Edd Brooks, Lucy Hawkes, Demian Chapman

368 Managing mobile species across jurisdictions is challenging, especially when transboundary movements are associated with the most vulnerable demographic groups, such as gravid females. We examined long-term and wide-ranging horizontal movements of 66 Critically Endangered (IUCN, 2018) oceanic whitetip sharks (*Carcharhinus longimanus*) in the North Atlantic over ten years (2011-2020). We examine pop-off satellite tracking data from 13 males, 35 unconfirmed/non-gravid females and 18 gravid females (confirmed via ultrasonography). Individual tracks ranged 14-330 days. Gravid females migrate throughout the year when not aggregating in The Bahamas (June-January), use an additional 12 Exclusive Economic Zones (including the High Seas), have wide temperature ranges, potentially experience increased and additional threats to survival (e.g., fishing fleets and artisanal operations, inconsistent regulatory regimes and protections), and cross more political boundaries when compared to non-gravid females and male conspecifics. We argue that gestation related migrations heighten risks to sexually mature females, future dependent (in utero) generations, and potentially the long-term survival of the species in the Western Atlantic. These findings further highlight the vulnerability of this species and the need for cohesive, ocean basin scale, inter-jurisdictional, and High Seas management to ensure their recovery.

P2.31 | “It’s me, hi, I’m the problem, it’s me.”: A taxonomic review of the problematic genus *Istigobius*

Abigail Huber

85 The genus *Istigobius*#_msocom_1 is one of the many genera within Gobiidae with taxonomic confusion. Given the morphological and ecological similarities within species, coupled with potentially broadly overlapping distributions, many *Istigobius* specimens are easily misidentified. Indeed, preliminary COI data from public databases suggests the presence of cryptic species and misidentifications at the species level. Our study aims to investigate species boundaries within *Istigobius* by using an integrative taxonomic approach. Specifically, we examine the following questions: 1) How many mitochondrial lineages are present in this genus? 2) What are the geographic distributions for these lineages? 3) Do morphological characteristics traditionally used to diagnose species reflect genetic affinities based on COI? Voucher specimens, tissue samples, and genetic sequences from GenBank and BOLD were gathered to reexamine morphological traits and COI to infer phylogenetic relationships and quantify genetic distances between lineages. We found there are more mitochondrial lineages than described species of *Istigobius*. Species also appear geographically constrained, with distinct genetic differentiation between geographic locations. Morphological characteristics diagnosing *I. ornatus* and *I. decoratus* are supported by COI data. However, COI data do not support morphological characteristics that distinguish *I. rigilius*. Many specimens on public databases may still be misidentified.

Because of the imperfect correlation between morphology and genetic lineages, we suggest a taxonomic revision that includes a novel analysis of morphological characters, multiple genetic markers, and live coloration.

13.2 | The devil is in the details – molecular identification of guitarfishes sold as ‘pez diablo’

Bryan Huerta-Beltrán, J. Drymon, Peter Kyne, Adriana Cevallos-Garcias, Sarita Campos-León, Kady Lyons, Jason Seitz, Fabiola Zavalaga, Christian Jones, Keny Kanagusuku, Mary Gibson, Nicole Phillips

61 Mexico contains the highest diversity of amphi-American guitarfishes (genus *Pseudobatos*), with eight of the nine known species recorded. The genus has long been commercially exploited for various products in Mexico, and currently, seven species found in Mexico are threatened with extinction. These guitarfishes have been routinely sold as ‘pez diablo’ (i.e., devil fish) in Mexico since at least 1953, where they are cut, shaped, and dried to produce a devil-like appearance and offered as an alternative medicine for various diseases or as a curio item. In making a pez diablo, many morphological features are distorted, making species identification difficult. Here, we discuss the trade, use, and species composition of modified guitarfishes sold as pez diablo in the country’s capital (~322 km from the nearest coast). Modified guitarfishes (n = 33) were collected from vendors (medicinal market shops, curio stores, and online platforms) in Mexico City and its outskirts. DNA-based species identification techniques (NADH dehydrogenase subunit 2) were used to verify preliminary field identifications based on morphological characters. Initial analysis suggests that the Atlantic Guitarfish (*P. lentiginosus*) and the Speckled Guitarfish (*P. glaucostigma*) are the most commonly traded in our study. This suggests that modified guitarfishes are supplied from both the Atlantic and the Pacific Oceans to the country’s capital. This study provides novel species-level trade insight for guitarfishes sold as pez diablo in Mexico and, overall, the modified guitarfish trade that is poorly documented worldwide#_msocom_1.#_msoanchor_1

P2.44 | Environmental DNA surveys suggest possible extirpation of the Western Chicken Turtle (*Deirochelys reticularia miaria*) in Western Mississippi

Bryan Huerta-Beltrán, Luke Pearson, Joana Días, Emma Humphreys, Helen Weber, Ryan Lehman, Kylie Faulkner, Lauren Coleman, Carl Qualls, Nicole Phillips

60 The Western Chicken Turtle, *Deirochelys reticularia miaria*, is unique within the family Emydidae. *D. r. miaria* is considered threatened or a species of greatest conservation need in every state it inhabits. Currently, *D. r. miaria* is believed to be locally extinct in the state of Mississippi, with the last reported observation in 1969. To assess whether *D. r. miaria* is still present in Mississippi, environmental DNA (eDNA) surveys were conducted in Spring 2022 and 2023. A total of 80 x 3L water samples were collected from sites with suitable habitat and/or in the vicinity of historic records. In 2022, 3L water samples were collected from one site within Shipland WMA (N=10), and two locations near Hillside NWR (N=20). In 2023, 3L water samples were collected from the Morgan Brake NWR (N=20), Hillside NWR (N=20), and Panther Swamp NWR (N=10). Water samples were vacuum filtered, and eDNA extracts were analyzed using a Droplet DigitalTM Polymerase Chain Reaction platform. A species-specific assay was designed as part of this study to amplify a 104-base pair portion of the cytochrome b in *D. r. miaria*, but not in any co-occurring turtles. The limit of detection of this assay was 1.0 X 10⁻⁷ ng/μL of target DNA. However, none of the samples met the criteria for positive detection of *D. r. miaria*eDNA. Combining these results with those from traditional surveys conducted since 1969, these data support the hypothesis that the subspecies may be locally extirpated from western Mississippi.

8.8 | Phylogenomic Resolution of Lampreys Reveals the Recent Evolution of an Ancient Vertebrate Lineage

Lily Hughes, Devin Bloom, Kyle Piller, Nicholas Lang, Richard Mayden

471 Jawless vertebrates once dominated Paleozoic waters, but just two lineages persisted to the present day: lampreys and hagfishes. Living lampreys

are a relatively small clade, with just over fifty species described, but knowledge of their evolutionary relationships has always been based on either a few mitochondrial genes or a small number of taxa. Biogeographers have noted the disjunct antitropical distribution of living lamprey families. Here we present a comprehensive phylogenomic analysis of living and fossil lampreys, sampling 36 species with phylogenomic data and 46 in total with genetic data. We present new divergence time estimates based on comprehensive nuclear data and analysis of their diversification dynamics. Our analysis indicates a central role for extreme global warming during the Late Cretaceous Cenomanian-Turonian Boundary Event as a likely cause for the antitropical distribution of living lampreys, and a notable increase in lineage diversification in northern hemisphere lampreys during the Miocene corresponding with a period of global cooling.

P2.81 | The effects of different temperatures on the blood metabolites of an Old World colubrid

Norman Hunter IV, Jennifer Terry, Lorin Neuman-Lee

312 The metabolic processes of ectotherms are dependent on environmental temperature, with higher temperatures typically associated with increased metabolic rates. As infrequent eaters with large meal sizes, snakes can have extreme metabolic responses that provide a novel system for examining digestive processes. Previous examinations of the link between ambient temperature and digestive processes have used large temperature differences to produce striking results. Examining metabolic responses to more subtle changes in temperature is not only biologically relevant but of importance to conservation efforts in response to global climate change. This study was conducted with a class of undergraduate students to provide practical research experience. We examined the differences in blood glucose, corticosterone, lactate, and triglycerides post-ingestion in *Elaphe bimaculata*, a small colubrid endemic to central China. Both before and after feeding, snakes were grouped in one of two conditions: suboptimal (20°C) and optimal (22.2°C). We obtained subject blood samples at -1, 6, 24, 72, and 168 h after feeding. Using linear mixed models, we characterized the change in metabolite and hormone levels between the two groups following a meal. We predicted that snakes at optimal temperatures would have higher blood metabolite and hormone levels due to faster prey digestion. We found that blood metabolites did not differ between treatment groups, but blood glucose levels decreased significantly throughout the digestive processes. Our research provides insights into the mobilization and allocation of metabolites across a small temperature differential and has implications for future conservation efforts.

5.7 | Stock Assessment of the Angular Angelshark and Brazilian Guitarfish: What Have We Learned After a 20-Year Fishing Moratorium in Brazil?

Ingrid Hyrycena, Rodrigo Sant'Ana, Luis Gustavo Cardoso, Giovanni Arlan Torres, Rodrigo Silvestre Martins, Luciano Gomes Fischer, Bruno Mourato

228 The Angular Angelshark (*Squatina guggenheim*) and the Brazilian Guitarfish (*Pseudobatos horkelii*) are two remarkable species of elasmobranchs known to occur from the shallow nearshore waters to the slope regions of the southwest Atlantic Ocean. Unfortunately, both species are listed as critically endangered in Brazil due to high fishing pressure between the 1980s and 1990s. In the early 2000s, the government implemented drastic conservation measures to prevent a worst-case scenario, and a fishing moratorium prohibiting capture, landing, and commercialization of them has been in force since 2004. However, reports of illegal fishing, landing, and selling continued. The few official catches declared are underestimated, as discards of dead or alive animals are mandatory, and their post-release mortality rates are unknown. Bayesian catch-only models were developed to estimate the stock status for 2003 (before the fishing ban) and 2019 (after). The moratorium effects on the recovery of the stocks were evaluated throughout biomass projections, considering different scenarios of constant catches. Results showed that the biomass trajectories presented similar trends for both species, with the depletion levels estimated for 2019 to be close to 25% of the virgin biomass. The fishing moratorium slowed down the fishing pressure at that time. Nevertheless, the estimated biomass projections also suggest that both species have yet to recover and are still far from being at a

sustainable biomass level, even with low levels of constant catch scenarios. Only the fishing ban has proven to not be enough to ensure their recovery, and constant monitoring is vital.

P1.27 | What Can the Beach Tell Us? Assessment of Endangered Sharks and Rays Caught by Beach Seine Fisheries in Southeast Brazil

Ingrid Hyrycena, Jhonata Pereira Bicalho, Kaliandra Klafke, Paulo Santos dos Santos

363 Conducting detailed assessments of fisheries interacting with elasmobranchs populations is crucial to comprehend how to effectively manage the operations according to its peculiarities, and accessing traditional communities poses even more challenging due to fishers' fear of retaliation. We aimed to evaluate captures in beach seine fishing in southeastern Brazil, in order to identify species and their fate. Forty-eight operations were monitored, where sharks were represented by eight individuals of four species (1 *Squalus albi-caudus*, 1 *Squatina occulta*, 2 *Rhizoprionodon landii*, and 4 *Sphyrna lewini*) and had a low frequency of occurrence (8 operations – 16.7%). With the exception of *S. occulta*, which was released back into the water, the others were retained for its meat commercialization. Rays occurred in all operations, represented by 99 specimens of 15 species (5 *Pseudobatos horkelii*, 6 *P. percellens*, 2 *Zapteryx brevirostris*, 2 *Narcine brasiliensis*, 1 *Rioraja agassizii*, 2 *Dasyatis hypostigma*, 2 *Hypanus berthelutzae*, 14 *H. guttatus*, 1 *Pteroplatytrigon violacea*, 6 *Gymnura altavela*, 11 *Aetobatus narinari*, 1 *Myliobatis goodei*, 32 *Rhinoptera bonasus*, 13 *R. brasiliensis*, 1 *Mobula hypostoma*). Only 3 *P. horkelii* and 1 *P. percellens* were retained due to its high commercial value, and additionally, 2 *H. guttatus* were kept for personal consumption within fishers. Our results underscore the need for cautious management of these fisheries, given the distinct scenarios observed for sharks (rarely caught but heavily utilized) and rays (frequently caught but underutilized). Furthermore, attention is warranted regarding the potential post-release mortality of rays, as in 31 instances, specimens with significant injuries were observed.

P1.86 | Cottonmouth, Cold, and Metals: Using ICP-MS to Quantify Metal Concentrations in Northern Cottonmouth Blood Before and After Brumation

Aleida Iriarte, Adrian Macedo, Mary Kinsel, Jason Brown, Robin Warne

177 During winter months, Northern Cottonmouths (*Agkistrodon piscivorus*) undergo brumation in the rocky cliffs of Wildcat Bluff in Southern Illinois. Over the last two years, Adrian Macedo, a graduate of Southern Illinois University, collected blood samples from Northern Cottonmouths captured both before and after their brumation periods. These samples were then analyzed using immune system assays and tested for snake fungal disease to investigate how brumation affects a snake's immune system. To build upon this project, I will analyze these blood samples using inductively coupled plasma mass spectrometry (ICP-MS). More specifically, I will measure the blood concentration of iron, magnesium, and zinc in plasma and erythrocyte samples due to their important roles in immune systems and previous literature suggesting seasonal variation in their concentrations. A deeper analysis of the concentrations of these metals before and after brumation could provide useful insight into how snakes' immune function changes during brumation. After quantifying the metal concentrations, I will utilize statistical analyses to determine if there is a change in the average of these metal concentrations before and after brumation. Additionally, I will run an analysis to see if there is any correlation with the immune assay results performed on the same samples. This project will deepen scientific understanding of how immune systems change to withstand brumation, an already vulnerable time for snakes during which immune system responses are depressed. This work is especially relevant in the face of snake fungal disease, which can spread across individuals sharing hibernacula and threaten snake populations.

P2.74 | Mapping the Metamorphic Timing of a Presumed Nonplastic Species *Eurycea cirrigera* across their Latitudinal Range.

Noah Irwin

158 Populations of *Eurycea cirrigera* have been observed with larval period durations lasting one-season, one-year, two-years, and three-years. Further research of these phenomena will be instrumental in better understanding the uniqueness of plethodontid metamorphosis. I will be investigating the variation of larval periods across the latitudinal range of *E. cirrigera* clade K+L to better understand the driving factors that lead to variable larval periods in an animal with experimental robustness against extrinsic factors. Seven localities will be sampled split across two ecoregions: Piedmont and Coastal Plain. Measurable abiotic factors will be collected on site to investigate the impact they may have on larval period duration. Larva will be collected four times a year and photographed to collect morphometric data for the establishment of size classes. One collection in the winter and three collections in the summer will take place to account for seasonal growth. Age class will be determined through the comparison of the size classes for each site as older generations of larva are metamorphosed out of the population and new hatchlings are introduced. I predict to record variation of larval period across the latitudinal range with shorter durations at the southern sites and longer durations at the northern sites. The aims of this study are to record instances of all four larval period durations as well as investigate abiotic factors such as ecoregion effect that can only be properly investigated through a survey of this breadth.

CANCELLED - P1.80 | Impacts of Novel Contaminants on Embryo Development and Overall Health of Freshwater Turtles

Alina Isaacs

205 The introduction of novel chemical agents has resulted in well-documented detrimental global impacts in marine, freshwater, and terrestrial systems. Freshwater turtles are a dependable indicator species to detect PFAS (per- and polyfluoroalkyl substances), lead, and salinity, because they are long-lived and utilize multiple components of the environment. The primary objectives of this study are to assess the impact of these chemicals on the physiology and health of freshwater turtle, *Emydoidea blandingii*. Additionally, this study will investigate the influence of PFAS on the development of another freshwater turtle, *Chrysemys picta* embryos, including the potential feminization of male embryos due to endocrine disruptors in PFAS. I anticipate that higher levels of chemicals will yield a worsened body condition such as a lower mass to weight ratio. To evaluate this, three *E. blandingii* populations will be monitored. Water samples from each site will be analyzed for chemical concentrations and correlated to body condition. I predict that PFAS exposure will lead to the feminization of genotypic male embryos. To investigate this, experimental treatments will be conducted using *C. picta* eggs. All treatments will be subjected to male incubation temperatures and subsequently tested for levels of aromatase, estrogen, and testosterone to assess feminization. The findings of this research could contribute to the advancement of current wastewater treatment methods and quantify PFAS, lead, and salt contamination in Massachusetts waterways. Additionally, it may reveal the role of PFAS in altering the development of turtle embryos.

P1.23 | Mercury Concentrations in Sandbar Sharks (*Carcharhinus plumbeus*) from the U.S. Atlantic Coast Over Four Decades

Dakota Jacks, Michelle Passerotti, James Gelsleichter

428 It is well known that among many marine organisms the accumulation of toxic pollutants increases in top predators because of biomagnification. Many studies have demonstrated that sharks are among the marine predators that often exhibit the highest concentrations of marine pollutants. One of the most notable pollutants is the toxic, non-essential metal mercury (Hg), which has been shown to be elevated in many different shark species; however, few studies have investigated how these levels have changed over time. This study examined the levels of Hg accumulation in sandbar sharks, *Carcharhinus plumbeus*, between 1986 and 2021. This is important in determining how past

legislation that was implemented to reduce Hg pollution has impacted levels of Hg within marine wildlife. This study presents preliminary results on muscle concentrations of Hg within these samples to explore trends in Hg pollution on the U.S. Atlantic coast. Overall, the results showed a significant relationship between time and Hg concentration that trends toward lower concentrations over time. This trend is present even with factors like sex and size of organisms included. However, despite the declining trend in Hg accumulation, muscle Hg concentrations in recent years remain higher than federal thresholds for human consumption.

P1.33 | New Insights Into the Deep Sea Community Structure of Elasmobranchs and Teleosts in the Northern Gulf of Mexico

Emma Jackson, Ralph Grubbs, Charles F. Cotton

360 The Deepwater Horizon Oil spill in 2011 significantly impacted the Northern Gulf of Mexico ecosystem. Before and following the oil spill, little data regarding sea communities of teleost and elasmobranchs existed for this region. Our research set out to correct this knowledge gap and to describe community structure within three sampling regions with varying proximity to the oil spill origin and along a depth gradient from 200-2000m. Through an eight-year longline survey, community structure analysis can be described throughout time and with increasing depth. The analysis of sediment composition is coupled with the longline survey dataset to enhance ecological understanding of any shifts and relative community structures within the varying depths based on changes in organic carbon, nitrogen, and calcium carbonates. Results of this study will create accessible baseline data and be of use in future studies, especially related to ecologically impactful effects such as deep-sea mining and climate change

P1.41 | Investigating Trophic Position Estimates of Shark Plasma and Muscle Tissue Using Compound Specific and Bulk Stable Isotope Analysis

Taylor Jagolinzer, Isabella Horstmann, Hilary Close

287 Bulk isotope analysis has historically been used to estimate trophic position (TP) from shark tissue as an alternative to more invasive strategies, such as gastric lavage or stomach content analysis. Recently, compound specific stable isotope analysis of amino acids (CSIA-AA) has been identified as a more accurate method of estimating TP due to its ability to account for differences in nitrogen sources at the base of the food web. However, previous experiments demonstrate that TP estimates for shark tissue, particularly blood plasma, are lower than expected. We investigate the proposed explanation that glutamic acid, an amino acid used in TP calculations, is especially $\delta^{15}\text{N}$ -depleted in shark tissues due to the use of urea as an osmolyte. For several individuals sampled in the shallow coastal waters around South Florida, we compare TP estimates of shark white muscle and plasma tissue using different calculations, including the use of threonine, glutamic acid, leucine, alanine, and bulk isotope analysis. We further discuss trends in carbon and nitrogen isotope fractionation across shark species, sex, and sampling location. We find that TP calculations using threonine are most similar across plasma and white muscle tissue and closest to expected TP calculations, while calculations that average multiple amino acids (glutamic acid, leucine, and alanine) remain significantly lower than expected, and particularly in plasma. We propose that, in place of glutamic acid, a TP estimate using the $\delta^{15}\text{N}$ value of threonine could be appropriate for urea-producing marine species.

28.8 | Elucidating the evolutionary history of weakly-electric knifefishes (Gymnotiformes, Actinopterygii) using a species-level molecular phylogeny

Francesco Janzen, William Crampton, Mark Sabaj, Nathan Lovejoy

502 The Neotropical region contains the most diverse freshwater fish assemblage on the planet, and that some groups, such as the gymnotiforms, are still relatively poorly known from the perspective of phylogenetic interrelationships. Previous studies have only included, at most, 44.3% of nominal species known today within the order when reconstructing the evolutionary

history of Gymnotiformes. Additional analyses using these trees, such as ancestral character state reconstructions, diversification rate analyses, and time-calibration, may result in inaccurate estimations given the quantity of missing species data. The goal of our study was to produce a species-level phylogeny of Gymnotiformes using the largest number of ingroup taxa of any study to date. We constructed both maximum likelihood and Bayesian inference molecular phylogenies using nine protein-coding genes sequenced for 189 nominal species, ~70% of order Gymnotiformes. We found strong support for two large clades within the order defined by electric signal type: 1) wave-type fishes (Apterontidae + Sternopygidae) and 2) pulse-type fishes (Gymnotidae + Hypopomidae + Rhamphichthyidae). While most genera were monophyletic, several paraphyletic and polyphyletic genera indicate a need for taxonomic revisions, including *Apteronotus*, *Eigenmannia*, *Porotergus*, and *Rhabdolichops*. *Apteronotus*, in particular, will require major revisions to restore monophyly to the genus. Our results provide a well-supported, robust phylogenetic framework for future evolutionary and biogeographic analyses.

P1.2 | Investigating the potential behavior and natural history of megatooth sharks using damaged fossilized teeth

Steven Jasinski, Sidney Hostetter

484 Damage present in the teeth of sharks shows consistent patterns. This damage can be categorized and is present to varying degrees in both modern and fossil shark species. We collected data from over 2000 teeth of the megatooth shark *Otodus megalodon* and other shark species to determine variation within these teeth and provide a basis for investigating tooth damage variation in shark (Selachimorpha) teeth. Additionally, we provide hypotheses for what these damage types may represent. While taphonomy can cause damage to teeth, some types of damage are due to shark behavior, particularly during feeding. Different taxa show different types and percentages of damage, implying different feeding strategies. Teeth of megatooth sharks (*Otodus*), particularly those of *O. megalodon*, show higher rates of damage than those of other sharks, with the highest occurrence of damage occurring at the tip. However, regarding their natural history, a higher percentage of damage in *O. megalodon* teeth may also signify their retention in the mouth for longer periods with slower tooth replacement rates, allowing more damage to accumulate before teeth are shed. Tooth replacement rates are known to vary in sharks, particularly in estimates for some extinct species. This damage also suggests *O. megalodon* would have attacked large-bodied prey, but does not explicitly mean it would have only eaten large-bodied prey. Other shark species were also attaining larger body sizes around the same time as *O. megalodon* (e.g., *Alopias grandis*, *Carcharomodus*, *Cetorhinus*, *Parotodus*), suggesting abundance in numerous resources allowing these predators to grow to large sizes.

P1.34 | A Comparative Analysis of Extant Oceanic Shark Species Using Trait-Based Analysis

Elizabeth Johnson, Tamara Frank

35 Over the past few decades, scientists have been working together to mitigate human impacts on global shark populations, but deciding which species need more immediate attention can be difficult. A newly emerging approach to ecology, called trait-based ecology, may be the answer to this problem. Trait-based ecology uses traits to understand biodiversity across multiple ecosystems and identify traits that may play an important role in ecosystem functioning. While trait-based ecology has already been applied to numerous fields, a trait-based approach to shark research is still in its infancy. Only a handful of studies have been conducted on shark trait analysis, none of which have compared multiple traits across multiple species as they relate to depth. As a result, the uniqueness and evolutionary significance of traits displayed in shark species of all depths is unknown. The purpose of this study is to compare multiple traits across multiple shark species to highlight the previously unstudied functional diversity of oceanic shark species with depth. This study examines 34 quantitative and qualitative traits across 339 oceanic shark species to identify species with evolutionarily unique traits that are therefore likely invaluable to the proper functioning of their ecosystem. The results from

this study can be used by conservationists around the world to target species with unique traits in order to more effectively protect sharks and thereby maintain oceanic ecosystems.

4.4 | Spatial ecology of Pine Snakes (*Pituophis melanoleucus*) in coastal South Carolina

Alan Jones, Andrew Grosse, Scott Parker

307 Pine Snakes (*Pituophis melanoleucus*) are of conservation concern over much of their geographic range due to habitat loss, fire suppression, and unregulated collecting. Only a few studies have examined spatial ecology and habitat use of Pine Snakes, and no studies have been conducted in South Carolina. The purpose of this study is to determine Pine Snake movement patterns and habitat use, with the long-term goal of assisting conservation and management efforts. We used a combination of radio telemetry and trail cameras to quantify movement patterns and daily habitat use of four male and four female Northern Pine Snakes (NPS) from a population on the South Coastal Plain from April 2021 – July 2023. On average, male NPS occupied an area of about 185 ± 53.1 ha vs 99 ± 30.1 ha for females. Average single-day distance moved was 373 ± 50 m for males vs 307 ± 3 m for females. Snakes spent most of their time in open canopy habitats but also used areas of dense vegetation. Pine Snakes preferentially used root cavities of fallen trees or burned-out stumps as refugia and secondarily, abandoned rodent burrow systems. Individuals of both sexes spent the majority of time below ground, with about 94% of observations of males and 88% of observations of females obtained while snakes were underground. Eastern Coachwhips (*Masticophis flagellum*) were frequently observed sharing refugia with NPS. Our results suggest that NPS exists in discrete meta-populations in SC, with males traveling between population subunits during the reproductive season.

P1.6 | Efficacy of “Zeppelin” magnetic deterrents with sharks in the wild

Laura Jones, Stephen Kajiura

262 Bycatch and depredation by elasmobranchs have become an increasing concern in fisheries around the world. Bycatch occurs when a non-target species is incidentally caught, and depredation occurs when a non-target species partially or completely takes a target species before it is landed. Due to the impacts of these events, mitigation has become increasingly important. This study tested a magnetic shark deterrent, the Sharkbanz Zeppelin. The Zeppelin consists of a neodymium permanent magnet that is deployed as a sinker. A shark entering the magnetic field will induce an electric field that is detectable by their electroreceptors. This novel stimulus may deter sharks from taking the hooked fish. This study quantified the magnetic field and examined the efficacy of this deterrent with sharks in the wild. The magnetic field measured around the Zeppelin declined rapidly with distance and reached the ambient geomagnetic field at ~30-35cm from the device. The measured magnetic field was integrated into a model to predict effectiveness at different shark swimming speeds and distances from the device. Zeppelin devices and non-magnetic controls were deployed with bait in the wild and the response of free-swimming sharks was recorded. The Zeppelin reduced the number of shark approaches towards the bait in 4 species; bull, lemon, sandbar, and silky. The Zeppelin deterred sharks on 53% of their approaches, whereas the control deterred them on 10% of their approaches. Although the device may be effective at deterring sharks from bait, tests with live, struggling, hooked fish that provide more sensory stimuli are needed.

4.2 | Thermal Ecology, Activity Patterns, and Ecological Niche Modeling of Gopherus Tortoises

Julia Joos, Donald Miles

349 Almost 50% of modern tortoise species are endangered or already extinct. Niche modeling predicts extensive range contractions for many chelonian species due to climate change induced habitat loss. For example, tortoise habitat in arid environments is expected to increase in temperatures and prolonged drought reducing habitat availability. Desert-dwelling tortoises dig burrows or seek refuge in rock crevices to avoid the heat and potential risk

of overheating. There are six tortoise species in North America and Mexico (genus *Gopherus*) and they differ in genetics, distribution, morphology, body size, diet, habitat, and shelter site selection. Most *Gopherus* species have been assumed to have a similar physiology as *G. agassizii* despite differences in genetics and ecology and more recent evidence suggesting varying thermoregulatory strategies for different species. Therefore, understanding each species' specific habitat requirements and physiological properties are important to allow inferences about tortoises' potential to cope with temperature shifts and habitat alterations. Further, there is a lack of sufficient physiological data at an appropriate resolution of microhabitats to refine existing ecological niche models and improve predictions to guide conservation action for specific populations and species. Our study measures core physiological data, operative environmental temperatures, and movement and activity patterns of several species of *Gopherus* tortoises occupying differing habitats, ranging from desert habitat and arid grasslands to tropical deciduous forest habitat. We use ecological niche modeling to predict habitat suitability and potential species persistence under future climate scenarios.

16.2 | Morphological Release: How Urban Environments Shape Morphology of an Introduced House Gecko

Desi Joseph, Samuel Wilson, Guinevere Wogan

271 One hallmark of successfully introduced species is traits that aid in establishment and dispersal, such as high fecundity and enhanced vagility. Urban environments offer introduced species the opportunity to colonize empty niche spaces and take advantage of the anthropogenic landscape. Urban areas may offer abundant resources (i.e., food, water, and shelter), reduced competition and predation, microclimate availability, and act as hubs for human-mediated dispersal. *Hemidactylus turcicus*, the Mediterranean House Gecko, is one of the most widespread introduced lizards, occupying a large portion of the central and southern United States. They have limited natural dispersal and rely on human-mediated jump dispersal to spread to new areas. Previous research has demonstrated that toe pads are evolving in response to urban environments, changing shape and size to help with adherence to novel surfaces. We compared morphological traits for *H. turcicus* across the United States, since their original introduction in the 1950s. We hypothesize that *H. turcicus*'s morphology has undergone rapid adaptation due to the strong evolutionary pressures of their urban landscape. We used an integrative sampling approach with both historic museum specimens and recently collected samples to determine how overall size and toe pad morphology change across spatial and temporal axes. We landmarked our data using tpsDig2 software and the following packages in R: geomorph, Morpho, pracma shape, and car. By understanding how introduced species readily invade novel environments, particularly within the context of urban landscapes, we can better understand the mechanisms underlying the successful establishment and dispersal of introduced species.

P2.6 | Conservation Amelioration: A 30-Year Meta-Analysis of Papers Presented at the Annual Meetings from 1992-2022 Looking at the Growth of Conservation

Carylanne Joubert Maier

12 2022 marked the 30th anniversary of the meeting of the American Society of Ichthyologists and Herpetologists (ASIH) that Edwin Phil Pister refers to in his article, "Species in a Bucket," about saving the Owen's Pupfish (*Cyprinodon radiosus*), specifically stating the concern about the low numbers of conservation-related papers presented that year. Therefore, the author of this study has undertaken a meta-analysis of the research presented during the 1992 meeting through the 2022 JMIH meeting to determine the percentage of papers relating to conservation that were submitted in each year, looking for potential growth as the field of Conservation Science has grown. The papers selected to calculate the statistics were based on set categories and picked based on the titles and abstracts of the papers. The research shows increased interest in conservation throughout the 30-year period and potentially trends related to Pister's advocacy for conservation. These are the initial results of the research as part of a larger study on who cares about conservation among these societies, looking at how the diversification of scientists has contributed to better science.

36.9 | Efficacy of a novel deterrent to reduce catch of elasmobranchs in longline fisheries

Stephen Kajiura, Tanner Anderson, Kieran Smith, Cheston Peterson, Bryan Keller, Dean Grubbs

469 This study examined the efficacy of a novel electrogenic deterrent to reduce elasmobranch capture on longlines. By juxtaposing Zinc and Graphite together, the resulting galvanic reaction overstimulates the elasmobranch electrosensory system and deters sharks from biting. We evaluated the efficacy of this deterrent on piked dogfish, *Squalus acanthias*, off Massachusetts and on a suite of coastal sharks off Florida. The hooks were sequentially set with a Zinc/Graphite (Zn/Gr) treatment, a visually similar but non-electrogenic plastic procedural control, and a bare hook. For the trials targeting piked dogfish, 87.2% of hooks (n=3,339) were occupied, and piked dogfish comprised 98.8% of the catch. There was no significant difference in catch among the three treatments. For the trials in Florida, 22.3% of hooks (n=1,801) were occupied with 9 shark species, comprised primarily of the Atlantic sharpnose shark, *Rhizoprionodon terraenovae* (65.3%), and the blacktip shark, *Carcharhinus limbatus* (25.2%). The number of sharks caught on the two control treatments did not differ, but significantly fewer sharks were caught on the Zn/Gr treatment (14.5%) compared to the plastic procedural control (38.4%) and the bare hook (47.1%). This translates to a 62.2-69.2% reduction in sharks caught on the Zn/Gr treatment. Because the gear was selective for elasmobranch fishes, very few teleosts were caught which precluded statistical testing. The Zn/Gr treatment remains to be tested with pelagic fisheries to establish whether it is a viable option to reduce shark bycatch and increase the profitability for fishermen in commercial fisheries.

16.8 | The Genetic And Environmental Mechanisms Underlying Color Polymorphism And Visual System Plasticity In Bluefin Killifish

Ratna Karatgi, Becky Fuller

167 Sensory environments can strongly influence selection on many organismal traits and affect the evolution of signaling modalities and sense organs. Organisms frequently optimize signal modalities and perception mechanisms to the sensory background; however, this can be challenging when there is variation in the sensory environments. Aquatic lighting environments are exceptionally heterogeneous because of the filtering effects of depth and dissolved organic substances, making it challenging for organisms to adapt consistently. Consequently, aquatic species must navigate a complex sensory landscape, where their visual perception and signaling strategies must readily respond to environmental changes. To elucidate the genetic and environmental contributions to variation in traits involved in signaling and signal perception, I study the bluefin killifish, which inhabits springs and swamps with variable lighting environments, exhibiting fin color polymorphism and plasticity, visual system variation. Using bulk RNA sequencing, I elucidate the gene expression differences underlying variation in fin coloration and the visual system in fish originating from a spring and a swamp river. To examine potential limiting factors to putatively adaptive plasticity in fin coloration, I explore the effects of microhabitat variation during development on the extent of plasticity in adult fin coloration. By examining the relative contributions of genetic and environmental factors to trait variation, this study will shed light on the evolutionary forces shaping phenotypic diversity in complex, non-model system organisms.

P1.96 | Morphological Characterization of Biofluorescent Skin Glands in Lungless Salamanders (Genus *Plethodon*)

Michael Kardos, Isabella Klenk, Matthew Price, Sarah Woodley

48 Biofluorescence has recently emerged as a widespread phenomenon among amphibians. Biofluorescent cutaneous glands are abundant in lungless salamanders (family *Plethodontidae*), though little is known about the morphology and function of these glands. In this study, we used microscopy, histology, and behavioral techniques to better understand the morphology and function of biofluorescent skin glands in Red-legged Salamanders (*Plethodon shermani*). We describe patterns of biofluorescent gland localization, size, and density for the first time in this species. Specifically, we found

that biofluorescent glands are concentrated on the ventral surface, especially in the ventral tail. We also reported sexual dimorphism in these glands, with males possessing larger glands at a greater density in their ventral tails than females. We then employed confocal fluorescence microscopy to visualize the structure of biofluorescent glands at the tissue level and to predict the identity of the fluorophore responsible for biofluorescence in these glands. We used transmission electron microscopy to visualize the ultrastructure of biofluorescent skin glands. Finally, we performed behavioral experiments to determine if biofluorescent glands play a role in courtship and/or scent-marking behavior. With these studies, we aim to determine the function of biofluorescent skin glands in *Plethodon* salamanders.

26.2 | Evolutionary Morphology of Snake Hemipene Spines Informed by Puncture Mechanics

Rachel Keeffe, Bingyang Zhang, Phillip Anderson, Patricia Brennan

193 The genitalia of squamate reptiles differ from other amniotes in that they develop paired intromittent organs called hemipenes. Hemipenes are morphologically diverse, varying in number of lobes, relative size, and the presence or absence of complex features like calyces, flounces, and calcified spines. Hemipene spines differ in size, shape, density, and position along the length of the hemipene. Despite this diversity, no studies have tested the functional properties of different spine morphologies. It is assumed that spines puncture into the vaginal tissue during copulation to secure the hemipene in place and aid in sperm transfer success, but this assumption has not been investigated in detail. Here we describe for the first time the puncture mechanics of different hemipene spine shapes. From CT scans of 7 snake species representing 4 families, we isolated 12 spines of different morphologies and produced 3D mesh files that were then 3D printed in resin. Using the 3D models of the spines, we performed serial compression tests into polydimethylsiloxane silicone polymer at increments of 10 degrees until puncture was impossible. We found that the range of successful puncture angles differed based on spine shape. Our results will help us understand the evolutionary forces driving snake genital evolution and will provide a broader context for the role of genital spines in other animals.

CANCELLED - 23.2 | Inferring age at maturity in a freshwater turtle when reproduction, age, and growth are imperfectly observed.

Matthew Keevil, Jacqueline Litzgus, Doug Armstrong, Njal Rollinson

402 Age and size at maturity are important life-history parameters and determinants of lifetime reproductive output, generation time, and potential population growth. Attainment of maturity is intrinsically linked to somatic growth rate, which varies with biotic and abiotic conditions, so that size and age at maturity often mediate population responses to environmental change. However, variation in age at maturity can be difficult to quantify when reproduction is imperfectly observed or age is uncertain. For long-lived species observed using mark recapture, both sources of uncertainty are frequently present. We integrated biphasic somatic growth models with imperfectly observed reproductive events during nesting surveys of Painted Turtles (*Chrysemys picta*) in Algonquin Park, Ontario to estimate the timing of first reproduction in females. For males, we combined growth data with claw length, a secondary sexual characteristic that changes at maturity, to estimate when males attain maturity. Individual age was obtained from individually varying growth models by projecting backwards to size-at-hatching. Because hatching occurs during a limited period in autumn, birth year was parameterized using a discrete distribution to integrate seasonality in hatching to seasonal variation in growth as parameterized in the growth model. We used the resulting joint model of hatching, growth, and observed reproduction to estimate the distribution of size-at-maturity for this population.

P1.82 | The Relationships Between Terrestrial Salamanders and Leaf Litter Invertebrates: An Investigation of Food Web Dynamics in a Bottomland Hardwood Forest

Maggie Keller, Christopher Beachy

206 Terrestrial salamanders function as dominant predators in forest floor communities because of their large population densities and voracious appetites. The impact they have on the community structure of their prey (leaf litter invertebrates) is appreciable. I will investigate these relationships in a bottomland hardwood forest where *Plethodon mississippi* is the prevailing salamander species. I will accomplish this by conducting an unrestricted field experiment using coverboard arrays and leaf litter collection. Three types of coverboard plots will be utilized: control, removal, and addition, where the salamanders found under boards in the removal plots will be taken out and put in the addition plots. Leaf litter samples will be collected from each plot monthly. Invertebrates will then be extracted using a Berlese funnel trap and identified to examine how community structure changes when different densities of salamanders are present.

25.7 | Spatiotemporal distribution and site fidelity of the reef manta ray (*Mobula alfredi*) in Dungonab Bay, Sudan

Steven Kessel

47 Reef manta ray (*Mobula alfredi*) populations along the Northeastern African coastline are poorly studied. Identifying critical habitats for this species is essential for future research and conservation efforts. Dungonab Bay and Mukkawar Island National Park (DMNP), a component of a UNESCO World Heritage Site in Sudan, hosts the largest known *M. alfredi* aggregation in the Red Sea. Here, a total of 19 individuals were surgically implanted with acoustic tags and tracked within DMNP on an array of 17 acoustic receivers. Two individuals were also equipped with satellite archival and one with a satellite positioning tag. Together, these data are used to describe approximately two years of residency and seasonal shifts in habitat use. Tagged individuals were detected within the array on 96% of monitored days and recorded an average residence index of 0.39 across all receivers. Detections were recorded throughout the year, though some individuals were absent from the receiver array for weeks or months at a time. Generalized additive mixed models showed a clear seasonal pattern in presence with the highest probabilities of detection occurring in boreal fall. The models indicated that *M. alfredi* presence was highly correlated with increasing chlorophyll-*a* levels and weakly correlated with the full moon. Satellite tag data and offshore acoustic detections recorded individuals moving up to 125 km from the Bay. However, all these individuals were subsequently detected in the Bay, suggesting a strong degree of site fidelity at this location.

P2.47 | Reproductive output of forested ephemeral wetland-dependent amphibians across a modified landscape

Ethan Kessler, John Crawford, Miles Corcoran, Andrew Kuhns, Michael Dreslik

65 Forested ephemeral wetlands (FEW) support diverse communities of habitat specialist species across the eastern United States, including wetland-breeding amphibians (WBA). Due to their reliance upon FEW for breeding habitat, the location of FEW on the landscape influences population dynamics and distribution of WBA. Generally, FEW are difficult to detect due to their small size and position under the canopy, however, recent technological advances provide the ability to remotely detect FEW with great accuracy. Improved FEW detection methods enable a better understanding of how FEW characteristics and distribution influence WBA presence and abundance. We counted egg masses of two widespread WBA species, Spotted Salamanders and Wood Frogs, at 231 FEW on public lands in southern Illinois using a double observer methodology from 2020–2023. We then used local and landscape characteristics to predict egg mass abundance for each species. We found egg mass counts were highly correlated between observers for each species, but the presence and abundance of egg masses were not highly correlated between the two species. For Spotted Salamanders, we found a positive effect of wetland size on egg mass abundance but found no effect of canopy cover within a 200 m buffer. Conversely, for Wood Frogs we found no effect of

wetland size, but egg mass abundance was positively associated with canopy cover within 200 m of FEW. Results from this study will provide a foundation for the estimation of WBA across broad geographic scales using discrete maps of FEW.

15.4 | Potential differences in learned responses to consistent olfactory stimuli in two reef shark species

James Kilfoil, Gabrielle Krohn, Eric Clua, Serge Plane, Kirk Gastrich, Michael Heithaus, Aaron Wirsing

281 There is growing evidence of the important role learning plays in shark foraging, but few studies have examined the relationship between learning and foraging behavior in free-living settings. We addressed this knowledge gap by experimentally contrasting responses of blacktip reef (*Carcharhinus melanopterus*) and sicklefin lemon (*Negaprion acutidens*) sharks to an olfactory-only feeding stimulus – baited remote underwater video stations (BRUVS) – that were either spatially randomized (as a control) or offered repeatedly at the same location in the lagoon of Tetiaroa, French Polynesia. Relative to their response to the randomized BRUVS, blacktip reef sharks appeared to sensitize to the repeated treatment, exhibiting increasing relative abundance following introduction of the cue (MaxN at deployment) and decreasing arrival times as the experiment progressed. By contrast, sicklefin lemon sharks responses were either consistent across control and treatment BRUVS over time or suggested potential habituation (as evidenced by declining MaxN in response to the spatially repeated exposure). Accordingly, our findings advance our understanding of shark cognition by highlighting that sensitized learning responses to stable feeding cues can develop even when the olfactory attractant is not accompanied by a reward, while also indicating that shark responses to these cues can be species-specific.

11.1 | Genome-Wide SNP Discovery and Phylogeography of the Small Yellow Croaker *Larimichthys polyactis* from the Yellow and East China Seas

Jin-Koo Kim, Yu-Jin Lee, Chenhong Li

125 The small yellow croaker (*Larimichthys polyactis*) distributed in the Yellow Sea (YS) and East China Sea (ECS), is one of the most important fishery resources. Various studies have analyzed the most effective management measures for the small yellow croaker, including morphology, and molecular marker. However, the population structure has differed according to the type of marker used in the analysis. Therefore, it is necessary to clarify the population structure of this species at the genomic level. We analyzed the population structure of 48 small yellow croakers collected from three locations in the YS (Dandong, Yeonpyeong-do, Yeonggwang) and one location in the ECS (Jeju Island) using the multiplexed ISSR genotyping (MIG-seq) method. In all, 58,340,434 raw reads were obtained, and 42,587,565 were identified after filtering. Phylogenetic analysis using 88,672 SNPs showed that two Dandong individuals (No. 1 & 8) were separated far from the remaining locations, and two Dandong individuals (No. 2 & 3) were also slightly separated. On the other hand, the results of structural analysis based on 3,997 SNPs demonstrated the optimal delta K when K = 5. Three of the five genotypes appeared evenly in all locations, but two genotypes were identified only in four Dandong individuals (No. 1 & 8, No. 2 & 3). Our results support previously published hypotheses and suggest that there may be at least five spawning stocks in the YS and ECS, which subsequently mixed randomly with the exception of two stocks in the northern YS.

P1.88 | Digging up dirt on Pine Snakes (*Pituophis melanoleucus*): using environmental DNA to detect presence of an elusive and enigmatic species

Peyton Kinavey, Scott Parker, Michelle Barthet

212 The Pine Snake (*Pituophis melanoleucus*), is listed in the South Carolina Wildlife Action Plan as a “species of greatest conservation need” but little is known about their current abundance and distribution within SC due to their low population density and secretive lifestyle. Commonly used presence/absence survey methods such as drift-fence trap arrays may fail to reliably

detect Pine Snakes even when they are present in a given habitat. We developed novel primers to detect Pine Snakes using environmental DNA (eDNA) in an effort to increase the efficacy of detecting these snakes in critical habitats. eDNA is becoming increasingly used to aid traditional ecological survey techniques for identification of rare and endangered species. Pituophis-specific primer pairs targeting the NADH dehydrogenase subunit 4 (ND4) gene were developed and assayed for specificity and sensitivity in laboratory and environmental application. Specificity tests using skin and tissue samples confirmed selective amplification of Pituophis compared to samples obtained from eight different reptile species occupying the same habitat as Pine Snakes. Sensitivity assays resulted in a Limit of Detection threshold of 25 pg of tissue or skin DNA. eDNA samples were collected from three ~200-hectare sectors within a study site on the South Carolina Coastal Plain containing a known Pine Snake population, to test the effectiveness of primers in detecting Pine Snake presence and distribution. Our results may enhance Pine Snake conservation efforts by providing an efficient, non-invasive tool to assist in detecting presence of Pine Snake populations statewide.

P1.97 | Metabolic Rates of Red-backed Salamanders Inhabiting Burned and Unburned Landscapes

Brandon King, Christopher Howey, Vincent Farallo

162 Ectothermic organisms, such as Red-backed Salamanders (*Plethodon cinereus*), internal body temperature is impacted by their external environment. Organisms may attempt to maintain preferred body temperatures that presumably coincide with optimal temperatures for various physiological processes. Further, the ability for an organism to survive within a thermal landscape is constrained between upper and lower critical thermal temperatures. As thermal habitat is manipulated, animals with specific thermal tolerances/preferences may be forced to either adapt, survive at sub-optimal temperatures, or move to other areas of the landscape to maintain thermal preferences (i.e., the Bogert effect). The objective of this experiment was to determine how Red-backed Salamander metabolic rates may be affected in burned and unburned thermal environments. Red-backed Salamanders were collected from multiple burned and unburned sites. Metabolic rates were measured at 5, 10, 15, 20, 25, 30, and 32.5° C. Following metabolic trials, we also measured thermal preference (Tset), critical thermal maximum (CTmax), and critical thermal minimum (CTmin) for each animal. Preliminary data suggest that differences in metabolic rates may exist, but there may be no difference in Tset, CTmax, or CTmin among the two sites. Through these results, we might be able to understand how and why the changing of thermal environments affects ectothermic organisms’ metabolic capabilities.

36.6 | Understanding Spotted Eagle Ray (*Aetobatus narinari*) Population and Distribution in Roatán and Utila, Honduras

Katie King, Gabriela Ochoa, María Brevé, Alberto Mejía-Paniagua, Adriana Sierra, Grace Horberry

494 Spotted eagle rays (*Aetobatus narinari*) are an endangered species facing a multitude of threats. In addition, little is known about the seasonal movements of this ray species. In the Bay Islands of Honduras, photos of spotted eagle rays taken by citizen scientists have been collected in the first study on spotted eagle rays in Honduras. This project was facilitated by the following organizations: IILI, Roatán Marine Park, and the Whale Shark and Oceanic Research Center. These photos are used to fingerprint each ray’s pelvic fins to create a photo-ID database and document sightings of the same individuals in Roatán and Utila, Honduras. The citizen science initiative resulted in 334 submissions of spotted eagle ray sightings across Utila and Roatán. The dates of the photos collected ranged from 2003 to 2024. A total of 183 individual rays were fingerprinted with 35 of these individuals being resighted, resulting in a resighting rate of 19.1%. 35 rays were resighted in the Bay Islands of Utila and Roatán at least once, with several rays being seen over ten times. Time between resightings ranged from a few days to over 5 years, or 2,039 days. No individual rays were seen on both islands, indicating that the populations may not travel between Roatán and Utila. The continued monitoring of spotted eagle rays is vital to better understand this precious

elasmobranch species. Additionally, consistent regulations and management need to be established across the Caribbean to prioritize the conservation of this endangered species.

P1.5 | Understanding Spotted Eagle Ray (*Aetobatus narinari*) Population and Distribution in Roatán and Utila, Honduras

Katie King, Gabriela Ochoa, María Brevé, Alberto Mejía-Paniagua, Adriana Sierra, Grace Horberry

482 Spotted eagle rays (*Aetobatus narinari*) are an endangered species facing a multitude of threats. In addition, little is known about the seasonal movements of this ray species. In the Bay Islands of Honduras, photos of spotted eagle rays taken by citizen scientists have been collected in the first study on spotted eagle rays in Honduras. This project was facilitated by the following organizations: IILSI, Roatán Marine Park, and the Whale Shark and Oceanic Research Center. These photos are used to fingerprint each ray's pelvic fins to create a photo-ID database and document sightings of the same individuals in Roatán and Utila, Honduras. The citizen science initiative resulted in 334 submissions of spotted eagle ray sightings across Utila and Roatán. The dates of the photos collected ranged from 2003 to 2024. A total of 183 individual rays were fingerprinted with 35 of these individuals being resighted, resulting in a resighting rate of 19.1%. 35 rays were resighted in the Bay Islands of Utila and Roatán at least once, with several rays being seen over ten times. Time between resightings ranged from a few days to over 5 years, or 2,039 days. No individual rays were seen on both islands, indicating that the populations may not travel between Roatán and Utila. The continued monitoring of spotted eagle rays is vital to better understand this precious elasmobranch species. Additionally, consistent regulations and management need to be established across the Caribbean to prioritize the conservation of this endangered species.

P1.22 | The impacts of wear on morphology and draw force of shark teeth

Maya King, Lisa Whitenack

169 For millions of years, sharks have been consistently replacing their teeth. Yet their teeth are mechanically strong, helping to avoid breakage or even fracture. Tooth replacement is generally understudied and is hypothesized to be due to constant wear on the teeth from use, as this would potentially decrease the efficiency of the tooth. This study provides an analysis of how tooth wear can impact tooth morphology and draw force in three species of sharks. Draw testing was performed on individual teeth from *Carcharhinus plumbeus*, *C. leucas*, and *C. limbatus*. Draw testing of each tooth consisted of 48 draws per tooth into a standardized teleost prey item. The force of each draw was recorded every eighth draw. After each set of 8 draws, each tooth was photographed under a microscope, providing evidence of wear or breakage along the cutting edges as well as the tooth's apex. Visible wear occurred over the course of 48 draws, but wear was species-dependent as well as dependent on the location on the tooth itself. While some *C. leucas* teeth did not show a change in draw force throughout testing, both *C. plumbeus* and *C. limbatus* had increased draw force throughout testing. On average, *C. limbatus* showed the most change, with an average increase of 8 N over 48 draws. Further study concerning shark tooth replacement could help to close the knowledge gap between tooth wear and tooth replacement.

31.5 | Habitat characteristics of terrestrial environments for vernal pool breeding amphibians

Mark Kirk, Casey Bradshaw-Wilson, Kelly Pearce

54 The protection of aquatic breeding habitats (e.g., wetlands, vernal pools) has been long acknowledged as essential for amphibian conservation. However, only recently have scientists and conservationists acknowledged the importance of the terrestrial environments surrounding the aquatic breeding habitats. Terrestrial environments provide important overwintering and foraging habitats for many adult amphibians. Vernal pool habitats are especially sensitive to terrestrial habitat change, such as deforestation. Since 1995, we have monitored annual breeding migrations of spotted salamanders

(*Ambystoma maculatum*) and wood frogs (*Lithobates sylvaticus*) to five vernal pools in Northwest Pennsylvania. However, we only began monitoring the habitat characteristics of the surrounding forest environment within the past few years. Specifically, we have been monitoring habitat characteristics and amphibian dispersal distance along three forest transects occurring at 30, 60, 90, and 120 m intervals from the vernal pools. I will present results on 1) the terrestrial distribution of migrating spotted salamanders and wood frogs, 2) surface and subterranean temperatures of the terrestrial forest floor, and 3) microclimatic characteristics of the terrestrial forest floor. Our results have important implications for protecting the terrestrial environment of amphibians, as we quantified the amount of core forest habitat needed for protecting 95% of the population for each species. Our results also have important climate change implications, as indicated by the presence of subterranean, microclimatic conditions that may provide refugia from rising temperatures for these species.

10.6 | Comparison of Gill Morphology of *Eurycea cirrigera* Across Larval Development

Abby Klahs, Christopher Beachy

111 Larval salamanders possess the unique ability to adapt the shape of their gills in response to changes in water conditions. The size and complexity of the gill structures, therefore, can be an indicator of individual health as well as environmental health. The external gills of larval salamanders facilitate gas exchange and oxygenation, and a larger surface increases this process. Therefore, we want to study the changes in their gills not only in different water conditions but also to control for variation across their larval development period. To explore the degree of plasticity in gill structure, we collected *Eurycea cirrigera* larvae and, using a novel method, photographed their gills from a dorsal and frontal perspective. To control for water quality and flow, we collected the larval salamanders from the same stream in Louisiana, which allows us to determine if the age of larvae, which correlates to size, impacts the gill structures. We hypothesize that smaller larvae will have a smaller proportion of gill to snout-vent-length (SVL) than larger larvae. The larger individuals have a smaller surface area to volume ratio, which decreases the efficiency of oxygen exchange. To compensate for their growing body size, it is also necessary to allocate energy towards growing their gills to increase respiration. We also hypothesize that larger larvae will have more complex gill structures than smaller larvae to increase the surface area of the respiratory organ.

29.4 | High survivorship of sandbar sharks (*Carcharhinus plumbeus*) following catch and release in a rapidly growing land-based fishery in Massachusetts

Jeff Kneebone, Connor White, Caroline Collatos, Nick Whitney

293 Directed land-based recreational catch and release fishing for sandbar sharks (*Carcharhinus plumbeus*) is a popular activity along Massachusetts shorelines during the summer months. We documented the fishing gear and techniques used to catch and release 67 sandbar sharks ranging from 113 – 187 cm fork length (140 ± 17) from locations on Cape Cod and Nantucket, MA. Post-release fate was monitored using a custom-designed tag float package, consisting of an acceleration data logger (ADL) and satellite and VHF transmitters, that was secured on the left side of the dorsal fin with a galvanic timed release. All packages were recovered, with 65 recording data over monitoring periods ranging from 0.15 to 9.98 days (2.67 ± 2.08). Depth, tailbeat period (TBP), pitch, and roll time series data analysis showed all tagged sharks were alive at the time of detachment, yielding a 100% survival rate. Behavioral recovery was estimated to occur at 1.33 – 17.18 (6.36 ± 3.52) hours post-release based on trends in TBP. Premature ADL releases were observed 27 times (45%), with 15 (55.5%) of these releases significantly associated with sandbar sharks rolling to their left side (tag side) during detachment. These results provide strong evidence that incidental mortality from this land-based shark fishery is extremely low and should have a minimal impact on the ongoing recovery of the sandbar shark population in the Atlantic and Gulf of Mexico. Additionally, they suggest sandbar sharks could be affecting tag detachment by rubbing the tag against the substrate.

29.5 | Hooked on Collaboration: Investigating Shark Post-Release Mortality with a Conservation-Minded Aquarium and Fishing Industry Partners.

Ryan Knotek, Jeff Kneebone, John Mandelman, John Chisholm, Tobey Curtis, Nick Whitney

254 The Association of Zoos and Aquariums (AZA) supports wildlife conservation through its programs, grants, and accreditation requirements, creating a strong focus on species preservation and animal welfare in AZA-accredited institutions. As an accredited institution, the New England Aquarium (NEAq) shares this focus but also has a long history of fisheries-based research in which we answer questions to promote more sustainable fishing practices that reduce collateral fishing mortality. This research often involves collaboration with fishers and managers who trust us to be honest brokers of the data and make recommendations firmly supported by science. These responsibilities are reflected in some of our NEAq institutional values, including: "We lead with science," "We balance (ocean use and preservation)," and "We work at the speed of trust." Much of our fisheries work has focused on elasmobranch post-release mortality (PRM), which can be crucial to estimating overall mortality in stock assessments and developing effective management measures. This requires us to work directly with fishing captains to investigate PRM under realistic fishing conditions and practices, ensuring results reflect the fishery while actively engaging industry members in the research and outcomes. Here, we summarize our PRM work, focusing on our most recent findings from a cooperative investigation of porbeagle shark (*Lamna nasus*) PRM in the Northeast U.S. bottom trawl fishery. Despite perceived tension with some of the messaging commonly found in zoos and aquariums, we believe this collaborative work with the fishing industry is crucial for responsible management of elasmobranchs and a valuable part of ocean conservation.

CANCELLED - P2.57 | Survival Challenges of Giant Gartersnakes in Agricultural Floodplains: Assessing the Impact of Agrochemicals

Laura Kojima, Brian Halstead, Andrew Rypel

448 The giant gartersnake (*Thamnophis gigas*) is an imperiled snake species that has greatly declined in its native habitat. These declines are attributed to >90% loss in historical wetland habitats from agriculture conversion. Giant gartersnakes are strictly endemic to the California Central Valley, where agriculture is now dominant. Because of severe population declines, this species is currently classified as "threatened" under both federal and state endangered species listings. Extant populations of giant gartersnakes now inhabit highly-managed agriculture floodplains (rice fields) in the Sacramento Valley. Previous studies indicate that survival of the snakes is correlated with availability of rice agriculture; thus rice agriculture currently supports the snake population. It is increasingly important to better understand how to optimize these habitats for snakes, and to explore whether current agricultural practices are negatively impacting the snake in any way. We aim to identify other inhibitors of survival that there are no current data for, specifically, the presence of organochlorine pesticides and frequently applied herbicides. Organochlorine pesticides including the DDX group have been detected in biota in this region yet have not been examined in giant gartersnakes despite being in the class of endocrine disrupting chemicals. Giant gartersnakes occupy a high trophic position. When combined with high longevity, and site-fidelity to areas often maintained by agrochemicals, they are likely candidates for pesticide accumulation. Given their diminishing numbers and listed status, it is crucial to identify if endocrine disrupting chemicals and other agrochemicals are contributing to inhibited reproduction and survival.

24.3 | Paleodrainages Drive Beta Diversity in Eastern North American Lungless Salamanders

Kenneth Kozak, Tom Radomski

288 Historical processes have shaped contemporary ecological communities. Studies have found that past climatic conditions shape contemporary diversity, however, the impact of other dynamic processes acting over deep timescales have been less thoroughly investigated. We evaluated competing historical and contemporary explanations for beta diversity across communities of

eastern North America using Dusky Salamanders (genus *Desmognathus*). Within this clade of lungless, semi-terrestrial amphibians, we partitioned beta diversity among 122 communities. Paleodrainage explained the greatest variance in compositional (i.e., taxonomic) beta diversity, but had non-significant effects on phylogenetic beta diversity, indicating that patterns of contemporary beta diversity are not driven by cladogenetic events resulting from shifts in drainage patterns occurring over the last 5.3 million years. Our results demonstrate that ancient stream capture events play a key role shaping contemporary patterns of beta diversity even in semi-terrestrial taxa.

11.5 | Population Structure and Species Delimitation in the Wehrle's Salamander complex

Shawn Kuchta, Elizabeth Kramer, Kimber Boyles

297 Species are the fundamental unit of biodiversity studies, but many species complexes are difficult to delimit, especially those characterized by complicated patterns of population structure. In this talk, I will report on a recent molecular systematic investigation of the *Plethodon wehrlei* group, which has recently experienced a taxonomic revision. To quantify patterns of genetic variation, we collected genetic data from 319 loci averaging 1300 base pairs in length. Biallelic single nucleotide polymorphisms (SNPs) were randomly selected from 316 of these loci for some analyses. We examined patterns of genetic structure using FEEMS and STRUCTURE and found that all of the recognized species formed separate genetic clusters; however, *P. wehrlei* and *P. punctatus* were relatively weakly differentiated, and STRUCTURE identified three separate clusters within *P. jacksoni*. Several species tree methods all recovered the same topology, with *P. dixi* sister to the other taxa. We evaluated the candidate species using BPP and the genealogical divergence index (gdi). While BPP delimited all candidate species with strong support (all posterior probabilities = 1.0), the gdi only strongly supported two species, both of which have only been recently described. I will briefly discuss the difficult problem of species delimitation in groups that form species via range fragmentation.

26.8 | Size and Shape of the Gymnotiform Brain: A Tale of Two Metrics

Shannon Kuznar, James Albert

285 In vertebrates, brain structure is often associated with environmental attributes associated with habitat and diet. Two metrics are commonly used to examine brain structure, relative sizes and shapes of individual brain regions. We present analyses of sizes and shapes of brain regions in Neotropical electric fishes (Gymnotiformes), using CT imaging and 3D geometric morphometrics. The heads of whole specimens were contrast-stained with Lugol's iodine solution and CT-scanned at 20µm micrometers to generate 3D volumetric models of the brain. We studied relative sizes of nine brain regions, defined on structural and developmental criteria, and used principal components analysis (PCA) to quantify the contributions of these regions to the overall disparity in size and shape using a set of 23 fiducial (putatively homologous) landmarks. PC1 of size describes differences in the relative volume of the cerebellum, at the expense of the forebrain telencephalon and midbrain tectum. For shape, the degree of rostral expansion of the corpus cerebellum contributes the most to PC1, highlighting the importance of cerebellar size and shape. PC2 in both analyses describes shifts in ontogenetic development, in relative size of the electrosensory lateral line lobes, and in degree of dorso-ventral flexion on the rostro-caudal axis. Several brain regions exhibit correlations of size to habitat and trophic traits of these fishes. There is greater separation among phylogenetic groups within the PCA plots for shape and size, indicating the earlier establishment in aspects of brain shape (among genera and families), while the size of brains regions is better explained by ecology.

7.2 | Intraspecific Communication in *Dascyllus albisella* (Pomacentridae)

Salomé Laboury, Eric Parmentier, Phillip Lobel

34 Lots of animal species are known to show individuality in their acoustic communication. This variation in individual male signatures can be decisive for female choice. The damselfishes are known for their prolific sound production

during courtship (i.e., signal jump) and spawning (i.e., mating sounds). However, it is unknown whether males of this family have individually distinguishable sounds. We investigated the variability in the reproductive sounds of seven male *Dascyllus albisella* at Johnston Atoll, Central Pacific Ocean. Acoustic analysis confirmed that courtship sounds differed from mating sounds. An analysis of the variation between and within individuals indicates a high consistency of both sounds among individuals. It appears that males of *Dascyllus albisella* do not use individual signatures in a reproductive behavioral context. This species can produce two stereotypical signals associated with courtship and spawning behaviors. Both sounds are highly consistent among individuals, meaning signals cannot provide individual signatures.

P1.68 | Characterization of small-scale net fisheries off the coast of Guyana

Rovindra Lakenarine, Netra Chhetri, Neha Chhetri, Yuying Zhang, Jesse Senko

13 Fish stocks have declined rapidly over the past half-century due to the increased demand for seafood and unsustainable fishing practices. The incidental capture of non-target species (bycatch) is a pervasive issue in fisheries management and has led to population declines in non-target species worldwide. The fisheries sector in Guyana currently supports the livelihoods of over 10,000 Guyanese and contributes approximately 2% to the country's GDP. Bycatch is believed to be a major threat to Guyana's marine fisheries, especially the small-scale sector, due to a lack of management infrastructure and limited data and monitoring. Here, we assessed bycatch in Guyana's artisanal gillnet and Chinese seine fisheries through vessel observations and semi-structured interviews with local fishers. Most of the discarded species documented had no commercial importance to the fisheries in Guyana. Although no statistical difference was observed among the bycatch rates in the gillnet and Chinese seine fisheries, the latter generally had more discarded individuals, most of which were juveniles. The Shannon-Weiner diversity index showed a greater diversity of bycatch species in the gillnet fisheries compared to the Chinese seine. Jaccard's similarity index indicated a low similarity among the gear types. Even though most fishers were aware of bycatch, they did not view it as a major issue and were not interested in reducing their discards. We recommend a collaborative approach in exploring solutions to ensure the ecological and socioeconomic sustainability of the fisheries sector.

10.3 | Illuminating the Genes Responsible for Bioluminescence in Fishes using Comparative Genomics

Meghan Larson, Matthew Davis, W Smith, Ed Wiley

255 Bioluminescence, the production and emission of light from a living organism, is a fascinating phenomenon that is documented in over 700 genera of animals across the tree of life, with the vast majority living in the ocean. Among fishes, bioluminescence has repeatedly evolved in deep-sea and primary nocturnal lineages of sharks and ray-finned fishes that possess a variety of bioluminescent organs, photophores, and lures. However, little to nothing is known about the genetic pathways associated with the production and emission of light in vertebrates that do not have symbiosis with bioluminescent bacteria. The primary focus of this study is to use comparative genomics to investigate the genetic mechanisms of bioluminescence in vertebrates which has yet to be uncovered. The objectives of this project are to (1) assemble the transcriptomes of targeted deep-sea fishes that are intrinsically bioluminescent; and (2) use comparative genomics to search for candidate genes involved in the production of luciferin and/or luciferase in bioluminescent fishes.

29.6 | Molecular analyses reveal life history insights in a data limited species: possible evidence for philopatry in sixgill sharks (*Hexanchus griseus*)

Shawn Larson, Riley Pollom, Samuel May

350 Sixgill, *Hexanchus griseus*, tissue samples were collected over the course of an 18-year period from 2002 through 2019 from Puget Sound, Washington, a known sixgill pupping ground and nursery. Tissue samples were collected

opportunistically from a variety of sources. In two cases, dead adult females were dissected, and tissue samples and metadata were also taken from unborn pups. DNA was extracted from a total of 286 individuals resulting in a final Single Nucleotide Polymorphic (SNP) dataset of 274 individuals genotyped at 681 informative biallelic loci, optimized for relatedness-based and neutral population genetic structure analyses. We found no genetic structure across time and space suggesting a single interbreeding population. Relatedness among the litters of unborn pups from two stranded pregnant females resulted in both full or half siblings with multiple fathers (three in one or four in another) confirming polyandry in sixgills. Close-kin relationships were identified between 47 pairs of individuals of unknown origin. First order relationships (i.e., full siblings or parent-offspring) were identified from samples in four distinct year classes. All of these individuals were classified as subadults, indicating likely full sib pairs. We identified 38 second-order kin pairs (half siblings) that spanned most years of the dataset. Many were between individuals sampled a decade or more apart. It is unlikely that these pairs were half siblings from the same litter. We therefore conclude that these close kin pairs may provide evidence of philopatric behavior of females returning to give birth multiple times in Puget Sound.

30.1 | Climate Mediates Color Morph Turnover in a Species Exhibiting Alternative Reproductive Strategies

Matthew Lattanzio

178 Sexual selection is considered the primary driver of morph turnover in many color polymorphic taxa, yet the potential for other factors (like climate) to contribute to polymorphism maintenance and evolution remains unclear. Appreciation for a role of environmental conditions in the maintenance and evolution of color polymorphisms has grown in recent years, generating evidence suggesting that color morphs linked to sexual selection may also diverge in climate sensitivity. Focusing on the three color components contributing to the male tree lizard (*Urosaurus ornatus*) color morphs, I reveal a marked concordance between patterns of turnover over space and time, with a general affinity of orange- and yellow-colored males to hotter, more variable conditions, and blue colored males to wetter, cooler conditions. An assessment of long-term turnover in the blue color component in response to recent climate change over the past 60 years reinforces these findings. Overall, behavioral asymmetries attributed to sexual selection likely expose competing morphs to divergent environmental conditions in heterogeneous habitats, creating opportunity for natural selection to shape climate sensitivities that also drive turnover in morph color composition. Ultimately, these processes may favor stark asymmetries in morph persistence over the coming decades.

P2.77 | Active Regulation of Ultraviolet Light Exposure Overrides Thermal Preference Behaviour in Eastern Fence Lizards

Matthew Lattanzio, Dane Conley

69 Over a century of ecophysiological studies on lizards have perpetuated the assumption that basking and shuttling movements between sun and shade function solely for temperature regulation. However, these behaviours also modulate exposure to ultraviolet (UV) wavelengths that are essential for maintaining physiological homeostasis as well as ensuring proper growth and development and enhancing long-term fitness. An alternative hypothesis is that lizards also actively regulate their UV exposure. In this scenario, UV needs may even override temperature needs (or vice-versa), generating asymmetries in the ability of a lizard to regulate both conditions equally. We test this hypothesis using field and laboratory data collected on adult Eastern Fence Lizards (*Sceloporus undulatus*). We found that *S. undulatus* actively regulate UV exposure and prioritize UV over temperature, favoring body temperatures much higher than preferred values to sustain preferred UV exposure. In stark contrast, temperature had no reciprocal impact on UV regulation behaviour. Our field data support these patterns, suggesting that lizards may even seek out hotter environments despite thermal costs to enhance UV exposure. We conclude that *S. undulatus* actively regulate for UV as well as temperature. Thus far, outside of zoos and private hobbyists, appreciation of the importance of UV for ectotherm survival and reproductive success has been

minimal. Ongoing work in our lab is geared towards addressing this deficit and inspiring other labs to do so as well. Ultimately, these efforts are vital to improve our understanding of the factors shaping the evolution of ectotherm photoregulation behaviour in nature.

P1.15 | A Preliminary Analysis of Mercury in Sharks of the Guana Tolomato Matanzas Estuary

Morgan Lattomus, James Gelsleichter

389 The Guana Tolomato Matanzas Estuary (GTM) provides essential habitat to several ecologically and economically important species, including serving as nursery habitat to a variety of shark species, most notably the scalloped hammerhead (*Sphyrna lewini*). Spanning the Northeastern Florida coast, it is home to over 50 endangered or threatened species and hosts several habitat restoration projects due to the GTM Estuary's ecological significance. Due to its proximity to developed areas along the coast, it can be threatened by human influences, such as pollution. While the negative effects of human interaction with the environment are of growing public interest, the effect of pollution in the GTM Estuary has not been well studied. Therefore, the overall purpose of this project is to examine pollutant exposure in species residing within the GTM Estuary, specifically that of mercury (Hg) and per- and poly-fluoroalkyl substances (PFAS). The toxic metal mercury has been shown to accumulate in marine taxa and poses significant health risks to marine organisms and the humans that consume them. This presentation will discuss preliminary mercury data in a variety of shark species and their prey, including sandbar sharks (*Carcharhinus plumbeus*), bull sharks (*Carcharhinus leucas*), and scalloped hammerheads, which was then analyzed in the context of the guidelines set by the EPA (0.3 mg/kg of wet-weight) and the FDA (1 mg/kg of wet-weight).

P1.49 | The Effect of Water Quality Parameters on Trematode Prevalence and Intensity on Fish in the Plant Park Stream

Claude Lee, Emily Durkin

476 Trematode parasites can have very complex lifecycles that include aquatic free-swimming stages that can be impacted by water quality. This study examines the potential relationships between water quality parameters and trematode parasites on fish in the Plant Park stream. Fish are trapped, identified, and then visually examined for *Clinostomum* spp. metacercariae from three sites across the stream with estuarine input from one end and natural spring input from the other. Water quality parameters are also recorded at each site (pH, salinity, temperature, dissolved oxygen, and turbidity). The highest parasite prevalence was recorded from the fish collected at the midpoint site of the stream (prevalence = 0.038%, pH = 7.3, salinity = 1.65, temperature = 25.6, DO = 69.3, turbidity = 2.38). It is possible that the midpoint of the stream provides ideal conditions for the parasite. However, all infected fish so far have been sailfin mollies (*Poecilia latipinna*), and the majority of *P. latipinna* have been collected from the midpoint site. Thus, it's also possible that the parasite has a preference for *P. latipinna* or that this fish species is more susceptible to infection. Continued data collection will help decipher between a water parameter preference or a host preference in this parasite. Future studies will consist of using molecular techniques to determine the particular species of trematode and investigate why its prevalence is so low.

14.4 | Application of Morpho-Molecular Approach to Taxonomy of *Limnichthys fasciatus* (Pisces: Creediidae)

Yu-Jin Lee, Jin-Koo Kim

124 The family Creediidae is composed of 8 genera and 18 species worldwide. These species are commonly called "sand divers" because they burrow into shallow sand substrates. Among them, *Limnichthys fasciatus* has known to be an anti-equatorial species, which may contribute to its high regional endemism. Although it has potentially high cryptic diversity due to its unique ecological traits, there have been few integrated studies of this species based on morphology and genetics. Here, we reevaluated the morpho-molecular interrelations among *L. fasciatus* from three locations in the Western Pacific (Korea, Japan, and Australia). Molecular analysis showed that *L. fasciatus*

comprised at least four lineages, which were identified as cryptic species based on Kimura-2-parameter (K2P) distance > 6%. It showed a deep divergence larger than generally known interspecific genetic ones. In morphology, all lineages showed similar traits, including the numbers of fin rays and vertebrae, shape of the lateral line, and saddle pattern. However, we found small but significant differences in some morphological characters via bone staining and/or micro-computed tomography (CT). Our observations suggest that there are three additional new species within *L. fasciatus* in the Western Pacific.

21.4 | Captive Deployment of a Novel Tag to Collect Oxygen Utilization from Free Swimming Sharks

Andrea Leontiou, Jonathan Cohen, Aaron Carlisle, Jennifer Wyffels

100 In sharks, like many other fishes, the gills are the primary site of oxygen uptake for aerobic metabolism. Studies on shark oxygen consumption rates provide insight into many physiological processes; swimming efficiency, bioenergetics, and overall fitness. Being able to quantify oxygen use at the gills will make it possible to eventually determine whole body metabolic rate from a single point measurement taken at the gill and by extension make it possible to eventually calculate accurate field based metabolic rates. These field based rates in turn will be more representative of an animal's actual metabolic demands through different environments and behaviors. In this study, we worked with the team at a Ripley's Aquarium holding facility to deploy a novel tag capable of collecting oxygen consumption data at the gills of a male Lemon Shark (*Negaprion brevirostris*) held in captivity. The shark was fitted with a tag package containing two oxygen sensors, and an accelerometer. The package itself was clamped on his fin, and he was allowed to swim freely for 45 minutes. Dissolved oxygen concentration in the gill exhalent varied with different movement and respiration types – ram ventilation vs. buccal pumping, showing the layers of data available with this approach. We show that it is possible to continuously measure oxygen use at a single gill on a free-swimming animal. These data set the ground work for better methods of collecting metabolic rates from gill breathing animals in the wild, and demonstrate the value of research/aquarium partnerships.

26.1 | ParthenoGenius: A Heuristic for Inferring Presence and Mode of Facultative Parthenogenesis in Reptiles and Elasmobranch Fishes Using Genetic Data

Brenna Levine, Warren Booth

16 Facultative parthenogenesis (i.e., asexual reproduction by females that normally reproduce sexually) was historically thought to be a reproductive syndrome specific to captive animals, but recent studies have demonstrated that it also occurs in wild squamates, crocodylians, birds, and elasmobranch fishes. However, testing for facultative parthenogenesis has been limited due to a gap in functionality and practicality of current methods used to analyze genetic and genomic data for evidence of parthenogenesis. We developed a user-friendly and intuitive heuristic for inferring presence and mode of facultative parthenogenesis from genetic and genomic data sets: ParthenoGenius. ParthenoGenius is an open-source Python program that compares maternal and offspring alleles in the context of sequencing error rates to test for parthenogenetic origin of offspring and infer the mode of facultative parthenogenesis. To gauge its accuracy and reliability, we tested ParthenoGenius on simulated data sets, published empirical data sets, and two novel empirical data sets. ParthenoGenius generates the same conclusions as those reported by published studies that used complex and computationally-intensive methods for inferring parthenogenesis. ParthenoGenius can be run on a personal computer, generate accurate results in seconds, and is accessible to even novice command-line users. Given its ease of use, intuitive logic, minimal computational requirements, and independence from assumptions of often unknown population allele frequencies, ParthenoGenius will facilitate rapid screening of reptile and elasmobranch genomic data sets for facultative parthenogenesis from both captive and wild populations, promising to further our understanding of its frequency and causes.

P1.47 | Ontogeny of the skeletal system of *Schizolecis guntheri* (Siluriformes: Loricariidae) (Miranda-Ribeiro 1918): homologies and phylogenetic implications

Jonatas Lima-Pereira, Mário de Pinna

319 Loricariidae is one of the most diverse families in Siluriformes, occupying the majority of freshwater environments in South America. Substantial progress has been made in recent years on the knowledge about the diversity and phylogenetic relationships of the family. Despite that, the ontogeny of Loricariidae remains mostly unexplored. This situation is a severe knowledge gap, because the interaction between development, phylogeny and evolutionary patterns is essential for a full view of the process of biological diversification. This project aims to offer a descriptive-comparative study of the skeletal development of *Schizolecis guntheri*, which will be the first of its kind with any Hypoptopomatinae, one of the most important subgroups of Loricariidae. We conducted a comprehensive analysis of an ontogenetic series of *S. guntheri* for osteological observations on the basis of numerous cleared and double-stained specimens. Results shed light on problems of relevance not only for Loricariidae, but also in some cases for in Siluriformes as a whole, and for the first time offer a picture of the hierarchical timing and relative pace of phenotypic differentiation in the family.

P2.7 | Do invasive lionfish avoid spearfish removal by migrating to the deep? Evidence from otolith microchemistry

Aly Liu

222 The invasion of Indo-Pacific lionfish (*Pterois volitans*) throughout the western Atlantic, the Gulf of Mexico, and the Caribbean has led to declines in the biodiversity, biomass, and abundance of native coral reef fishes. These ecological consequences have been thoroughly documented in shallow zones of the reef; however, little is currently known about how lionfish interact with deep-reef ecosystems, which may serve as refuges for lionfish avoiding spearfish removal by SCUBA divers in the top 30 meters. Thus, deep lionfish populations are potentially serving as a near-infinite source of replenishment for shallow populations. The microchemistry of calcium-carbonate fish otoliths has emerged as a powerful tool in examining fish ecology, as the elemental compositions of these "ear stones" reflect the chemistry of the water in the fish's environment. I am analyzing the oxygen stable isotopic signatures of a sample of lionfish otoliths collected across the entire depth range of reefs in Curaçao using micromilling and isotope ratio mass spectrometry (IRMS). Specifically, variations in $\delta^{18}O$ from the core to the rim of the otolith indicate changes in water temperature, and presumably depth, from settlement to adulthood. This approach provides insight into whether lionfish migrate between deep and shallow reefs throughout their lives or remain in their deep refuge, how frequent and long these migrations are, and ultimately whether they are susceptible to surface removal by spearfishing. Effective management plans will require a holistic understanding of this invasive predator's vertical migration patterns and where they are on the reef at various life history stages.

16.1 | Enchis, Zeros and Harlequins, oh my: What can reptile morphs tell us about humans?

Stephen Lchetto

126 Herpetoculture, the practice of keeping reptiles as pets, is an ideal window through which to view the intersection of biology and culture. Human-animal interactions is a research direction gaining traction in various academic disciplines, such as anthropology, folklore, sociology, and psychology. It has even spawned its own discipline, dubbed anthrozoology. In this presentation, I will analyze findings of an ethnographic study of pet reptile owners in both a physical and digital context, paying particular attention to the concept of reptile morphs, which are genetic mutations created through selected breeding to produce color variants. I will discuss the role of morphs in promoting the popularity of herpetoculture and how they can be used as a pedagogical tool for the average reptile owner. I will also discuss why people prefer one type of morph over another. This study argues that reptile morphs constitute material culture, or cultural objects resulting of human modification of the environment. Morphs are also commodities, or products that have exchange value. As a

result, morphs have facilitated the acceptance, even preference, for reptiles among many members of the public. Morphs also serve as a mechanism to ensure the further propagation of given reptile species at the hands of humans; thus, morphs have agentive effects on human behavior.

36.4 | Bioactive Properties of Venoms from Three Stingray Species against Mammalian Tumor Cells

Carl Luer, Cathy Walsh, Craig Douppnik

173 Stingray venoms (SRV) and the mechanisms responsible for their bioactivity are poorly understood. Animal venoms are complex mixtures of bioactive compounds possessing diverse structures and functions with a variety of molecular targets and potential for pharmacological applications. Crude SRVs were obtained by scraping venom gland tissue from grooves along the midventral ridge of spines from Atlantic stingrays (*Hypanus sabinus*), spotted eagle rays (*Aetobatus narinari*), and cownose rays (*Rhinoptera bonasus*). Harvested cells and tissue were gently homogenized to release venom compounds, which were separated from cellular and tissue debris by centrifugation. Aliquots of the resulting supernatants were lyophilized and analyzed by electrophoresis or stored at -80 C for bioactivity assays. The effects of SRV on two different tumor cell types, a non-adherent human T lymphocyte tumor cell (Jurkat E6-1) and a chemically induced murine fibrosarcoma (WEHI-164) were examined. Using the MTT cell growth assay, SRVs from all three rays demonstrated concentration-dependent growth inhibitory effects on Jurkat E6-1 cells, while the WEHI-164 cells were insensitive to the highest SRV concentrations tested. Following 24-hour exposure to either spotted eagle ray or Atlantic stingray venoms, Jurkat E6-1 cells were assayed for apoptosis and necrosis using flow cytometry, resulting in a concentration-dependent decrease in healthy cells and concomitant increase in apoptosis. The percentage of cells demonstrating necrosis (dead cells) did not increase with increasing SRV concentration, indicating the 24-hour treatment period preferentially induced apoptosis. Future investigations include characterization of SRV proteins and their molecular targets for potential use in biomedical applications.

20.4 | Evaluating the Capacity of Larval Fish to Adapt to Ocean Warming; Local Adaptation and Heritability of Thermal Performance Curves.

Alexis Lundquist, Darren Johnson

181 Ocean warming poses an ongoing threat to many species. To anticipate how populations will respond over multiple generations, we need to understand the genetic capacity of thermal responses to evolve and the processes that promote genetic variation. One potential source of such variation is local adaptation to environmental conditions. For example, if individuals inhabiting cooler waters tend to have cold-tolerant genotypes and individuals inhabiting warmer waters have warm-tolerant genotypes, then local adaptation could promote genetic variation in the population as a whole. We tested for local adaptation of thermal sensitivity in populations of California Grunion. We collected the gametes of northern and southern populations of Grunion and reared their embryos and larvae in a common laboratory environment. Larvae were reared across temperatures reflecting their natural range and we measured growth and mortality. Southern populations were much more sensitive to temperature and had a higher capacity for growth under higher temperatures. Mortality was lowest at intermediate temperatures and northern and southern populations did not show a strong difference in thermal sensitivity of mortality. When examining the effects of temperature on biomass production (combination of survival and growth), we found that southern populations indeed have a higher thermal optimum than northern populations. Grunion experience gene flow at large spatial scales and our results suggest that adaptation to local temperature conditions can increase overall heritability in thermal sensitivity by 25 to 75%. Local adaptation may thus increase the population-wide capacity for evolutionary adaptation to climate change.

P2.13 | The Effects of Bone Deformity on Swimming Performance in Lumpfish, *Cyclopterus lumpus*

Taylor Lunningham, Stacy Farina, Elizabeth Fairchild, Jessica Robinson

491 Presently, there have been no studies on the impact of bone deformities, such as hyperostosis, on the biomechanical performance of the vertebral column and associated structures of fishes during swimming. However, the stiffening of the vertebral column influences locomotion in significant ways. Therefore, the goal of this study is to track the occurrence of hyperostosis in lumpfish (*Cyclopterus lumpus*) to better understand the frequency and conditions in which bone deformation occurs in this species. Observations were made with video analysis of 105 juvenile lumpfish from a total of 1,500, raised as cleaner fish for salmonid farms, in a flow-through seawater system at the University of New Hampshire Coastal Marine Laboratory in May 2024. This seawater is pumped into tanks where a smaller 200-L round tank were used for filming. 20 fish were added to the smaller tank both with visual abnormalities and normal. After every 5-6 fish 5-6 individuals were added to keep 20 fish per video trial to keep a regular rearing density. Each of the groups of lumpfish were observed by 10-second video intervals and then immediately euthanized for X-ray and Ct-scanning extreme deformity. Using ImageJ, we noted the distance traveled over time for video analysis of speed and movement. We found bone deformities in lumpfish that had clear visible asymmetry and/or condensed body forms. Lumpfish are integral to aquaculture systems as they create healthier environments for farmed fish. If deformities negatively affect lumpfish their effectiveness may decrease.

25.8 | Blood Mercury in Juvenile Shark Species Sampled in Three Georgia Salt Marshes

Kady Lyons, Allyson Stiles, Devin Dumont, Lisa Kovalanchik, Kylie Rock, Scott Belcher

97 Estuaries are transitional environments that are exposed to a number of anthropogenic impacts, including heavy metal contamination from human activities. However, few studies have examined heavy metal distribution within Georgia's estuaries, particularly with regards to mercury accumulation in fishes that play key roles as predators such as sharks. Blood mercury was measured in several native species in three Georgia estuaries with varying levels of anthropogenic impact (Wassaw Sound-high, Ossabaw Sound-medium, and Doboy Sound-low). There was a strong species-specific effect in blood mercury concentrations, with no apparent effect of estuary location; however, due to uneven sampling size only Bonnethead could be statistically evaluated. Blood mercury concentrations in Atlantic Sharpnose (*Rhizoprionodon terraenovae*) were the highest followed by Blacktip Shark (*Carcharhinus limbatus*), Bonnethead (*Sphyrna tiburo*), and Sandbar Shark (*Carcharhinus plumbeus*). While shark blood was intended to be used as a proxy for local exposure to mercury, other factors, such as migratory behavior, diet and age present hurdles for assessing local contamination in sharks found in Georgia waters.

9.6 | Dive Tourist Attitudes Towards and Perceptions of Shark Conservation

Catherine Macdonald, Lindsay Humbles, Julia Wester

337 In recent decades, shark tourism has become an increasing focus of research and conservation attention. Participation in shark tourism has been proposed (and contested) as a tool for challenging stereotypes and changing negative public perceptions of sharks while generating revenue to support species conservation. Some studies have attempted to assess whether these experiences meaningfully affect the knowledge, attitudes, or behavior of participants. In this study, self-identified shark divers (n=204) were surveyed to better understand their attitudes and perceptions related to sharks, shark tourism, and conservation. Results allow for direct comparisons with a previous survey (n=640) of the American public to explore how shark diving tourists may differ on these measures relative to others. Improving our understanding of shark diver perceptions of the threats facing sharks, the potential or actual benefits and harms of shark tourism, and how shark tourism management might be improved can contribute to better evaluating the potential effects of shark diving on tourists.

2.5 | Morphological Diversity of the Oral Lures of Stargazers (*Uranoscopidae*)

Leo MacLeod, Katherine Bemis, Stacy Farina

154 The family Uranoscopidae, commonly known as Stargazers, are found worldwide in tropical to temperate oceans. Stargazers are ambush predators that bury into the sediment until only the eyes and dorsal region of the mouth are visible. While buried, members of three genera (*Uranoscopus*, *Kathetostoma*, and *Genyagnus*) use water flow to flick a lure out of the mouth to entice prey closer. In this study, we examined the extreme morphological diversity in the lures of two of these genera (*Uranoscopus* and *Kathetostoma*). The lure is attached to a membrane on the inside of the lower jaw and is diverse in size, shape, and colour. For example, in some species, the lure is black with a simple thread shape, while in others it is an orange filamentous pom-pom. We describe the variation both within and between species and discuss use and challenges of the lure as a phylogenetic character.

P1.53 | The Deep-Water Freckled Stargazer, *Xenocephalus egregius* (*Uranoscopidae*): New records, photographs, and mitochondrial genome

Leo MacLeod, Matthew Girard, Katherine Bemis

157 The Freckled Stargazer, *Xenocephalus egregius* (*Uranoscopidae*) is the only member of its genus found outside the Western Pacific. The distribution of *X. egregius* has generally been recorded as the northern Gulf of Mexico to Georgia. However, recently (2006–2023) the NOAA Northeast Fisheries Science Center Bottom Trawl Survey and fisheries observers collected seven specimens of *X. egregius* from North Carolina to New Jersey. Using these new specimens and the holdings of *X. egregius* at the National Museum of Natural History, Smithsonian Institution, we expand the geographic distribution, increase the known maximum size, provide new photographs of live coloration, and describe the ontogenetic changes in the anatomy of the species that have made identification difficult in the past. We also compared our northern *X. egregius* COI barcode region to that of others in the Gulf of Mexico and found them to be the same. In addition, we test a 1961 hypothesis that there is a positive correlation between collection depth and specimen size. We found that the new northern records have a strong correlation of size and depth, while the Gulf of Mexico specimens have a more moderate relationship. This study highlights the importance of collecting new specimens from fisheries surveys, and their impact on increasing our understanding of fish diversity and distribution.

10.4 | Evolution of Rhodopsin in Flatfishes (*Pleuronectiformes*) is Associated with Depth and Migratory Behaviour

Esme Macpherson, Frances Hauser, Alexander Van Nynatten, Belinda Chang, Nathan Lovejoy

332 Visual signals are involved in many fitness-related tasks and are therefore essential for survival in many species. Aquatic organisms are ideal systems to study visual evolution, as the high diversity of spectral properties in aquatic environments generates great potential for adaptation to different light conditions. Flatfishes are an economically important group, with over 800 described species distributed globally, including halibut, flounder, sole and turbot. The diversity of flatfish species and wide array of environments they occupy provides an excellent opportunity to understand how this variation translates to molecular adaptation of vision genes. Using models of molecular evolution, we investigated how the light environments inhabited by different flatfish lineages have shaped evolution in the rhodopsin gene, which is responsible for mediating dim-light visual transduction. We found strong evidence for positive selection in rhodopsin, and this was correlated with both migratory behaviour and several fundamental aspects of habitat, including depth and freshwater/marine evolutionary transitions. We also identified several mutations that likely affect the wavelength of peak absorbance of rhodopsin, and outline how these shifts in absorbance correlate with response to the light spectrum present in different habitats. This is the first study of rhodopsin

evolution in flatfishes that considers their extensive diversity, and our results highlight how ecologically-driven molecular adaptation has occurred across this group in response to transitions to novel light environments.

2.4 | A combined morphological and molecular approach to understanding the evolution and habitat transitions of the anglerfishes and allies.

Alex Maile, W Smith, Matthew Davis

348 The anglerfishes and their allies constitute a diverse group with over 400 carnivorous species, renowned for their extraordinary hunting behavior employing a modified first dorsal-fin spine to lure prey, along with adaptations such as “pseudo-walking,” bioluminescence, and sexual dimorphism. Understanding their evolutionary history has proven challenging, as previous studies using DNA sequence data or morphological traits have produced inconsistent and contradictory results. In this study, we present a comprehensive phylogenetic framework for the evolution of anglerfishes and allies, employing ultraconserved elements (UCEs), mitochondrial genomes, and morphological characters to investigate habitat and depth changes. Our findings reveal a monophyletic anglerfishes and allies, positioned as the sister group to the pufferfishes and allies within a broader acanthuriform radiation. Goosefishes emerge as the stem anglerfish lineage, forming a sister clade with frogfishes + batfishes, and coffinfishes + deep-sea anglerfishes. We examined the evolution of the anglerfishes and allies through a combined molecular and morphological framework to infer habitat transitions.

CANCELLED - 11.11 | Pharmaceutical Presence and Potential Health Effects in Nurse Sharks *Ginglymostoma cirratum* in Florida, USA

Christopher Malinowski, Jennifer Rehage, Nick Castillo, Shakira Trabelsi, Tomas Brodin, Justin Perrault, Nicole Stacy, Carolyn Cray, Jeny Soto Cordova, Lisa Reidy, Kristin Kahl, Sebastian Gomez, Lauren Tracy, Ethan Dewald, Camille Demairé, Jake Beretta, Mikki McComb-Kobza

374 In recent years, pharmaceuticals have become a major concern as a class of emerging contaminants. They get into the environment via industrial (e.g., pharmaceutical manufacturing, landfill leachate) and domestic (e.g., human and animal excretion of unmetabolized pharmaceuticals, wastewater treatment plants) sources and have been measured in numerous freshwater and marine systems worldwide at concentrations that pose a threat to aquatic systems. Little remains known about pharmaceutical drugs in Florida coastal marine ecosystems, although recent studies have shown that Bonefish *Albula vulpes* and Redfish *Sciaenops ocellatus* have high concentrations of certain drugs in their blood and tissues. Little data exist on the presence of pharmaceuticals in sharks and other upper trophic level species, and it remains unknown what effects these drugs have on exposed species. For our study, we collected blood samples from nurse sharks *Ginglymostoma cirratum* in the Florida Keys to screen for the presence of pharmaceutical and illicit drugs, and also to measure possible physiological health consequences. To date, the primary pharmaceutical drugs we have confirmed the presence of include Quinidine (antiarrhythmic and anti-parasite), N-Desmethyltapentadol (opioid analgesic), Venlafaxin (anti-depressant/anxiety), and Levetiracetam (antiepileptic).

P1.31 | Migratory Patterns of Highly Migratory Shark Species Under a Changing Climate

Maria Manz, Oliver Shipley, Robert Cerrato, Robert Hueter, Alisa Newton, John Tyminski, Bryan Franks, Tobey Curtis, Christopher Fischer, Keith Dunton, Jeff Kneebone, Bradley Peterson, Brittney Scannell, Jon Dodd, Michael Frisk

199 Despite growing evidence suggesting species redistribution with respect to climate change, few studies have investigated how changes in the physical oceanic environment may impact migration timing due to a lack of large-scale longitudinal datasets. Here, we take a multimodeling approach to identify the environmental drivers initiating southern migrations of blacktip (*Carcharhinus limbatus*), dusky (*Carcharhinus obscurus*), sand tiger (*Carcharias taurus*),

sandbar (*Carcharhinus plumbeus*), common thresher (*Alopias vulpinus*), and white sharks (*Carcharodon carcharias*) from summer foraging grounds in the Western North Atlantic Ocean. We then predict how migratory timing from three pre-defined regions will respond under future ocean conditions. We illustrate that photoperiod and sea surface temperature are important environmental variables initiating these sharks’ southern migrations. Our model predictions suggest delayed departure dates from summer habitats under elevated sea surface temperatures, indicating they would remain in their northern habitats for longer in the year (~13 days on average) with a 1.79 – 2.01°C increase in sea surface temperatures. Sandbar sharks had the largest delay in the onset of their southern migration, whereas sand tigers showed the least amount of change under elevated sea surface temperatures. However, the influence of photoperiod may reduce the overall effects of elevated temperature. Our results show future shifts in the migratory timing of six apex predator species in response to climate change, which may alter local intraspecific interactions and ecosystem dynamics.

8.5 | An Island in a Sea of Sand: the endemic amphibians and reptiles from Angola’s Serra da Neve inselberg

Mariana Marques, Diogo Parrinha, Manuel Lopes-Lima, Arthur Tiutenko, Aaron Bauer, Luis Ceríaco

196 Serra da Neve, an isolated inselberg in southwestern Angola, Namibe Province, southwestern Angola, rises to 2489 m above sea level and is surrounded by extensive areas of arid habitats. This extinct volcano harbors a well-preserved Angolan miombo forest (*Brachystegia* spp.) and a diverse but still poorly known herpetofauna. In the last few years, surveys at Serra da Neve led to the discovery of one new species of amphibian and seven new species of reptiles. Given the area of Serra da Neve (630 km²) and its number of strictly endemic species, this inselberg is one of the most endemic-rich areas in southern Africa, especially in terms of reptiles. While some of these endemics are phylogenetically closely related to species occurring in the neighbouring areas, others have their closest relatives in the highlands of East Africa. In this presentation we will give an overview of these discoveries, compare the inselberg fauna with that of the surrounding habitats, and discuss its phylogeographic affinities and threats to its conservation.

P2.82 | A Herpetological Hidden Gem –The Carnegie Museum of Natural History “Alcohol House”

Mariana Marques

197 Usually unnoticed by the public who visit the Carnegie Museum of Natural History, the Alcohol House is one of the museum’s oldest and most impressive treasures. Built in 1907 to house CM fluid collections, the Alcohol House host a scientifically important and unparalleled collection that has been growing for more than 100 years, and actively being used by researchers, both locally and internationally. The herpetological collection is taxonomically and geographically organized in thousands of jars and tanks through the architectonically unique three-floored building, making this historical site an outstanding biodiversity library for the study of Herpetology. With more than 250,000 specimens waiting to be studied, the Alcohol House doors are open to researchers and students. The CM Herpetological collections holds the largest collection of freshwater turtles in the world. The overall collections have specimens representing species from various parts of the world, including South America, Africa, Europe, and Asia, but around 70% of their holdings are from the U.S. This poster aims to invite all herpetologists to learn more about this historical and scientifically heritage, waiting to be discovered in Pittsburgh.

32.2 | Seasonal Variability in Trophic Niche Partitioning Patterns among Coastal, Highly Migratory Sharks in the Mid-Atlantic Bight

Benjamin Marsaly, Noah Motz, Tess Avery, Deena Hansen, Matthew Breece, Edward Hale, Aaron Carlisle

382 Competition theoretically results in the partitioning of resources (e.g., habitat, diet, etc) among species with similar patterns of resource use. However, the temporal component of these dynamics is rarely investigated, and little is

known about how partitioning varies over time and space, especially among highly migratory species which are characterized by their extensive seasonal movements. Here, we used stable isotope analysis on multiple tissues with different turnover rates to investigate the presence of trophic niche partitioning among sympatric, coastal migratory sharks in the Mid-Atlantic Bight, as well as the seasonal variability of these patterns. We collected muscle, red blood cells, and plasma from six mid to upper trophic levels sharks at two distinct locations in the Mid-Atlantic Bight: Sandbridge Shoal, VA, and Hen and Chickens Shoal, DE. Isotopic niches were inferred from nitrogen and carbon isotope ratios, and the overall degree of overlap was estimated at the assemblage level for each tissue at each location, allowing for comparison of isotopic niches structure across different periods and locations. Each species' degree of specialization was also estimated at the individual and population level to investigate variability in trophic ecology that could influence the degree of potential competition and resulting partitioning. Unraveling the trophic niches and the intricacies of interspecific relationships among migratory marine predators is important to improve our understanding of their ecological roles, as well as to better predict how marine communities respond to the environmental change resulting from anthropogenic activities.

23.39 | Tracking Reticulated Flatwoods Salamander (*Ambystoma bishopi*) Recovery in Response to Habitat Restoration

Amanda Martin, George Brooks, Houston Chandler, Kelly Jones, Brandon Rincon, Carola Haas

238 The degradation and loss of suitable breeding habitat can be a major driver of amphibian declines. In the southeastern United States, fire suppression has resulted in overgrown wetlands (i.e., high canopy cover and low herbaceous groundcover) that no longer serve as suitable breeding sites for amphibians. Over the past thirteen years, extensive habitat restoration efforts have been conducted at Eglin Air Force Base (Eglin) located in the Florida Panhandle to improve Reticulated Flatwoods Salamander (*Ambystoma bishopi*) breeding habitat, but the response of salamander populations has yet to be quantified. Here, we used dynamic, spatially-explicit occupancy models to 1) document trends in occupancy over time, and 2) evaluate the key drivers that influence occupancy probability. Additionally, we quantify the degree of connectivity between breeding sites on the landscape to help managers identify the appropriate spatial scale for habitat restoration and recovery planning. Overall, the total acreage of suitable habitat has increased three-fold on Eglin in recent years. As a result, the total number of wetlands occupied by flatwoods salamanders has more than doubled. Specifically, the average number of ponds with larvae detected each year on Eglin has increased from 3.7 within the first decade of monitoring to 10.1 within the decade post-treatment. Furthermore, our results confirm that spatial connectivity among wetlands and availability of suitable habitat are the best predictors of salamander occupancy. Therefore, conservation and management actions should focus on improving habitat quality, especially prioritizing areas with high densities of wetlands.

11.14 | Preliminary Analysis of Tiger Shark (*Galeocerdo cuvier*) Age, Growth, and Maturity in the Western North Atlantic Ocean

Danielle McAree, Michelle Passerotti, John Carlson, Jill Hendon, Jeremy Higgs, Alena Anderson, J Drymon

101 The tiger shark (*Galeocerdo cuvier*) is a large, highly migratory predator with a circumglobal distribution. In the western North Atlantic Ocean (WNA), tiger sharks occur year-round in the Gulf of Mexico (GoM) and southern U.S. Atlantic and are occasional visitors as far north as Nova Scotia. Like many other shark species, WNA tiger sharks were heavily exploited throughout the 1970s and 1980s, leading to significant declines in abundance. Although several studies have suggested their numbers are increasing, tiger sharks have never been formally assessed in the U.S. as a single species and the stock status is unknown. Reliable, updated estimates of life history parameters are critical for informed management of this species in the WNA. Therefore, the objectives of this study are to 1) determine the combined and sex-specific growth parameters of WNA tiger sharks and 2) determine the size and age at maturity of WNA tiger sharks. Between 2005 and 2023, tiger sharks ($n = 243$)

were collected from the U.S. GoM and Atlantic coast via fishery-independent and fishery-dependent sampling. Vertebral centra were extracted from each fish for aging. Tiger sharks ranged in size from 56-360 cm fork length, with females significantly larger than males ($p = 0.003$). The male-to-female ratio was 0.91:1 and did not significantly differ from a 1:1 ratio ($X^2 = 0.412$, $df = 1$, $p = 0.521$). Findings from this study will inform future management actions to ensure sustainability of the WNA tiger shark stock.

13.4 | Mitigating Shark Depredation in Snapper-Grouper Fisheries Via Novel Deterrent Devices

Michael McCallister, Lauran Brewster, Thomas Ostendorf, Stephen Kajjura, John Carlson, Matthew Ajemian

403 Shark depredation is a growing problem in recreational snapper-grouper fisheries across the southeastern US, yet there has been little effort to mitigate these negative interactions in the region. Since 2022, our team has been conducting a scientific evaluation of the 'Zeppelin,' a novel magnetic shark deterrent that is incorporated into a sinker specifically designed for bottom fishing. Field testing of the device is being conducted in federal waters off the Florida Atlantic coast, a region previously deemed a shark depredation "hotspot", through a combination of fishery independent and dependent sampling. Fishery independent sampling has consisted of paired bottom-fishing trials with the deterrent and a control device, on both natural and artificial reefs, to assess the efficacy of the device in reducing depredation, as well as its potential impacts on overall target catch composition. Interactions with gear are being captured using established video methods with catch rates, predator composition, and depredation compared between control and deterrent gears. Statistical analysis showed no significant difference in catch rates and species composition between controls and deterrents, although sharks have only been caught on controls. We have observed a range of potential depredators in the vicinity of our fishing gear on approximately 51% of trials. Thus far, we have recorded six depredations, including three depredations by bull sharks (two control and one deterrent), two depredations by goliath grouper, and one by a gag grouper. We are continuing to increase our sample sizes to develop sufficiently robust data sets for statistical analyses of deterrent effectiveness.

35.3 | Detecting Western North Atlantic White Sharks (*Carcharodon carcharias*) with baited underwater video cameras and environmental DNA

Mikki McComb-Kobza, Christopher Malinowski, Nigel Hussey, Daniel Madigan, Joseph Tagne, Robert Hueter, Brett McBride, Chris Fischer, Cindy Gonzalez, Baudisse Postaire, Demian Chapman

353 The goal of this study was to confirm the presence and identification of white sharks (*Carcharodon carcharias*) in the Western North Atlantic and assess the efficiency of multiple non-invasive techniques including baited remote underwater videos (BRUVs) and environmental DNA alongside directed fishing. Sampling occurred from 2019-2022 in waters from Nova Scotia, Canada to South Carolina, USA. BRUVs are among the most effective non-invasive techniques for visual sampling of elasmobranchs in confirming species presence, individual identification, sex, and in calculation of catch per unit effort (CPUE) for relative abundance estimates. White sharks shed genetic material into surrounding water from mucus and feces and non-invasive molecular techniques offer powerful tools to confirm the presence of species of interest. Water samples at BRUV deployment sites were collected for white shark environmental DNA (eDNA) sequencing and analysis. There was a total of 267 BRUVs deployed with 126 corresponding eDNA water samples collected. Genomic DNA was extracted from fifteen *C. carcharias* tissue samples obtained during the study period and used to design the assay and used as a positive control for normal PCR and the qPCR tests. White sharks were caught on hook and line, confirmed on BRUV footage and filters were considered positive for the presence of white sharks and our controls produced negative results.

5.1 | Top-Down Effects of Juvenile White Shark (*Carcharodon carcharias*) Aggregations on Prey Communities

Zachariah Merson, Matthew Barnes, Christopher Lowe

275 Southern California serves as a nursery habitat for juvenile white sharks (JWS), which form aggregations up to 40 individuals for weeks to months. At aggregations, JWS eat a variety of nearshore prey, but benthic elasmobranchs are the greatest proportion of the diet. We examined how these aggregations influence the larger prey community using eDNA from seawater samples and hypothesized that aggregations would have a smaller proportion of targeted prey species within the broader community. Monthly surface water sampling was conducted at three aggregation and two non-aggregation sites from May 2022 to April 2023. We used the MiFish-U and MiFish-E universal primers to amplify eDNA samples, then assigned taxonomy using a California Current reference library. The beta diversity between aggregation sites was significantly lower than between non-aggregation sites, despite much greater distance between aggregations than non-aggregations. Generally, the contribution of each prey group to JWS diet scaled linearly with proportional decrease at aggregation sites compared to non-aggregations. Benthic elasmobranchs particularly were a significantly smaller proportion of the community at aggregation sites, primarily driven by bat rays (*Myliobatis californica*) and round rays (*Urobatis halleri*). Additionally, bat rays had a significant interaction between aggregation status and season, and was negatively correlated to relative JWS abundance measured by acoustic telemetry. Our results suggest a top-down effect of JWS aggregations on prey communities, and prey species responses include spatial and temporal avoidance of aggregation sites.

19.2 | An Overview of Data Integration Methods to Estimate Species Distributions and Range Dynamics.

David Miller, C. Lane Scher, Riley Mumma, Evan Grant

94 New and growing data streams provide exciting opportunities to improve and refine our understanding of how biodiversity is distributed across landscapes and how communities are responding to global change. However, judicious use of these data requires that we understand and account for the unique limitations of different data types collected under different sampling designs. Traditional distribution modeling methods tend to pool data sources, limiting the ability to account for intricacies of how different data are collected. Recently, data integration methods have opened the door to approaches that more accurately account for sampling effort, data type, and observational errors for multiple data types. In this talk, we will provide an overview of integrated species distribution models and how they can be applied to commonly available data for amphibians and reptiles. We will review the primary challenges that come with modeling observational error and linking different data types. We will then show how these challenges can be addressed using an integrated modeling approach. We argue that data integration methods open up new and exciting opportunities to build collaborations, address pressing management concerns, and improve our understanding of the distribution and dynamics of ecological communities.

33.6 | Phylogenomics, classification, and diversification of Eupercaria, the new bush at the top

Elizabeth Miller, Rose Faucher, JoJo West, Giorgio Carnevale, Aintzane Santaquiteria, Emily Troyer, Carole Baldwin, Mark Westneat, Guillermo Ortí, Lily Hughes, Kory Evans, Ricardo Betancur, Dahiana Arcila

Here, we present novel phylogenomic hypotheses for Eupercaria, a clade within the spiny-rayed fishes (Acanthomorpha) with similar diversity to passerine birds or placental mammals, including charismatic groups such as wrasses, puffers, anglerfishes, darters, basses, and butterflyfishes. The systematics of this group have long been plagued with uncertainty, largely due to short internodes associated with early rapid radiations (hence the 'new bush at the top'). Using >1000 exons obtained through target capture approaches, we built concatenation- and species-coalescent trees comprising 1,051 species. Our taxonomic sampling covers 80% of families and 40% of genera in Eupercaria. These trees are the basis of an updated classification that preserves long-standing ordinal names. In this talk, I will cover the correspondence between

our topologies and other recent trees, as well as the differences in philosophy among alternative classification schemes. We also present a new set of divergence time estimates based on an expanded set of fossil calibrations that suggest the role of the K-Pg on fish diversification is far from resolved.

P2.51 | Loud but Overlooked: Pacific chorus frogs as reservoirs for disease in Sierra Nevada alpine habitats

Kira Miller, Thomas Smith, Vance Vredenburg

77 Amphibians are declining worldwide, in large part due to chytridiomycosis: a cutaneous amphibian disease caused by the fungal pathogen, *Batrachochytrium dendrobatidis* (Bd). However, susceptibility and resistance to Bd infection varies among amphibian hosts. In the Sierra Nevada, endangered mountain yellow-legged frogs (*Rana sierrae* and *Rana muscosa*) are highly susceptible to Bd infection. In contrast, the co-occurring Pacific chorus frog (*Pseudacris regilla*) is far less susceptible and likely acts as a Bd reservoir host. Although *P. regilla* are one of the most abundant and widespread amphibians in western North America, this species and its interactions with Bd are understudied. We investigate and compare Bd infection prevalence and intensity between these two amphibian species in the Sierra Nevada. From July to September 2023, we visited 24 alpine lakes that were occupied by *R. sierrae*, *P. regilla*, or by both amphibian hosts. We collected swab samples from individual frogs at each site, and used a qPCR assay to quantify Bd infection (i.e. Bd load). Bd infection prevalence for both amphibian species was relatively high, ranging between 60-100% at each site. Observed adult *P. regilla* infection intensities trended higher than that of adult *R. sierrae*, though this difference was only significant at sites where both species co-occurred. A second, ongoing component of this project will characterize skin microbial communities of each anuran host and relate compositional differences to Bd infection intensity. A stronger understanding of Bd prevalence and infection in *P. regilla* may have implications for recovery planning of disease-susceptible species.

3.2 | Assessment of Density, Spatial Distribution and Movement Patterns of *Plethodon cinereus* (Eastern Red-backed Salamander) Using Spatial Capture-Recapture

Ryan Miller, Maisie MacKnight, Jennifer Deitloff, Jillian Fleming

283 Spatial capture-recapture is a promising method for estimating population vitals and have been used in many studies on population dynamics. These studies help improve the understanding of how species respond in different environments. The eastern red-backed salamander, *Plethodon cinereus*, is terrestrial, lungless, and is common in Eastern North America. *Plethodon cinereus* is small in size and can be easily found and studied in forest ecosystems. This species is known to be territorial. However, the extent of territoriality of males and females, and how salamanders spatially disperse has not been thoroughly examined in Pennsylvania. The goals of this study are to (1) estimate population density and (2) describe differences in (a) spatial distribution and (b) movement patterns between males and females of *P. cinereus* in central Pennsylvania. We used spatial capture-recapture methods to address these goals and test the following hypotheses. We hypothesized that (1) males have larger foraging areas than females and (2) both sexes display site fidelity by staying within the same plot and area within plot. Our study location included 6 plots of 50 coverboards each in central Pennsylvania where this species has previously been found. Individuals were marked with a unique four-color code through injection of Visible Implant Elastomer tags. Our density estimates were lower than what other researchers using similar methods have found. We also found that males and females used a similarly sized area within a plot and that individuals (regardless of sex) tend to use the same coverboards over time.

P1.4 | Characterizing seasonal whale shark habitat and distribution in the western North Atlantic Ocean using species distribution modeling

Hunter Milles, Eric Hoffmayer, Martin Arostegui, Simon Thorrold, Camrin Braun

90 The whale shark, *Rhincodon typus*, is the world's largest fish and is distributed worldwide in tropical and subtropical waters. Nevertheless, much about whale shark ecology remains enigmatic outside well-studied coastal aggregations, particularly in the northwest Atlantic Ocean. We examine whale shark occurrences from 1974 to 2023, encompassing the northernmost known sighting in the Bay of Fundy, south to the North Brazil Current on the northern coast of South America, including the Caribbean Sea and Gulf of Mexico. We integrate sightings (n=2006) and pop-up satellite archival transmitting tag data (n=4880) to develop species distribution models from: only sightings data, only electronic tag data, and an equal-weight data-pool. We made seasonally-averaged model predictions of habitat suitability across the study region from 1993-2023. Tag-based and data-pooled models suggested sea surface temperature (29.5% and 35.2% relative influence, respectively), sea surface height (23.8%, 29.2%), and bathymetry (21.5%, 12.0%) as the most influential drivers. Conversely, the sightings data model indicated bathymetry (46.6%), sea surface temperature (22.0%), and sea surface height (16.2%) as the most influential environmental drivers. All models predicted high habitat suitability along the southern U.S. east coast at all times of year. High suitability extended to offshore Massachusetts during summer and autumn months. Our results highlight the cryptic distribution of whale sharks in the northwest Atlantic Ocean, among the fastest-warming oceanic regions. The results of this study mark a critical step toward understanding potential climate impacts on this charismatic species, as well as more effective marine spatial planning and dynamic ocean management efforts.

1.5 | Sexual segregation and spatial ecology of the little gulper shark in the Gulf of Mexico: evidence for essential deep-sea habitat?

Brian Moe, Charles Cotton, Joseph Travis

395 *Centrophorus uyato* has perhaps one of the most conservative life histories of all sharks. Females live up to 70 years, don't mature until nearly 55 years and until reaching 86% of their maximum length, and produce just a single pup per reproductive cycle. This leaves them extremely susceptible to increases in fishing pressure or other anthropogenic stressors. Over a 20-year period, *Centrophorus* species declined by as much as 95% after the introduction of deep-water trawls to the NSW fishery, with mature individuals now exceedingly rare. In the northeastern Gulf of Mexico, however, *C. uyato* is subjected to minimal bycatch by commercial US fisheries, though that may change in the future. In this study we present evidence for two essential habitats which should be the focus of proactive management or conservation plans. *Centrophorus uyato* was found to ontogenetically segregate, with immature individuals consistently clustering around the northern slope of the mouth of DeSoto Canyon over a near decade long survey period, suggesting DeSoto Canyon may be an important pupping or nursery ground for *C. uyato*. While immature individuals did not segregate by sex, mature individuals did. In general, mature abundance increased moving further west. But, perhaps the most striking pattern is the occurrence of mature females almost exclusively along the western margins of the study area, near Mississippi Canyon. Given the limited lifetime fecundity of this species, Mississippi Canyon may be the most critical habitat area for proactive management of *C. uyato*, should they become subjected to commercial fishing mortality.

P1.70 | Review and update of the fossil history of billfishes (Istiophoriformes, Xiphioidei)

Miguel Montalvo, Eric Hilton

194 The billfishes of the suborder Xiphioidei (Istiophoriformes) are instantly recognizable acanthomorph teleosts, bearing fused premaxillae forming an elongate non-protrusible rostrum (i.e., the "bill"), small rasp-like teeth, and long fusiform bodies. Extant billfishes are split into two families, Istiophoridae (the marlins, sailfishes, and spearfishes) and Xiphiidae (the swordfish), and

range from the middle Miocene to the present. The late Paleocene family Hemingwayidae is the earliest taxon recognized as belonging to Xiphioidei; there are two other families of billfishes, Palaeorhynchidae and Blochidae, that range in age from the early Eocene to early Miocene but are of unclear relationship to the Xiphioidei. Fierstine's 2006 publication on the fossil history of Xiphioidei has been instrumental to billfish paleontology in part because of its review of the group's taxonomy. Recent and ongoing research has contributed significant new systematic and biogeographic knowledge about the group by adding observations from fossil assemblages in Asia, Oceania, and South America. In this presentation we will examine recent advancements in the field, provide an overview of billfish fossils and fossil site locations, and further review the literature of the fossil record of xiphioid fishes.

P1.83 | Synergistic Effects of Road Salt and Invasive Leaf Litter on Amphibian Community Dynamics

Amanda Montgomery, Thomas Anderson

201 Road salt intrusion and invasive honeysuckle are increasing ecological concerns in freshwater habitats. Amphibians are sensitive to these stressors due to their permeable skin. Salinization can lead to increased mortality, behavioral changes, and reduced growth. Invasive honeysuckle (*Lonicera maackii*) has been found to cause mass mortality in amphibians. Road salt and honeysuckle are likely to overlap in habitat, such as disturbed and edge habitats, which are both utilized by amphibians. If these stressors were to synergistically interact, it could lead to a higher increase in mortality and behavioral changes. These negative impacts could ultimately lead to a shift in amphibian community dynamics. We investigated the synergistic effects of road salt and honeysuckle on the predator-prey interactions of small-mouthed salamanders (*Ambystoma texanum*) and gray treefrogs (*Hyla versicolor/chrysocelis*). Larval *A. texanum* (predator) and *H. versicolor/chrysocelis* tadpoles (prey) were placed in cattle tanks with a control, honeysuckle, salt, or combined treatment. Half of the cattle tanks contained only *A. texanum* larvae and the other half contained both *A. texanum* larvae and *H. versicolor/chrysocelis* tadpoles. Survivorship of tadpoles and *A. texanum* larvae were monitored along with larvae body size and mass. The results are pending, but we expect that *A. texanum* individual honeysuckle and salt treatments will experience reduced predation success, increased mortality, decreased growth, and decreased mass. Additionally, we expect that *A. texanum* combined treatments (honeysuckle and salt) will experience the same effects as individual treatments but to a greater extent due to synergistic effects.

7.1 | The Effects of Food Web Manipulations on an Amphibian Intraguild Predation Module

John Moore, Thomas Anderson

166 Food webs are structured based on a complex and dynamic system of interactions between their component members. Top and intermediate predators can produce strong direct and indirect effects on prey communities through predation or release from competition. However, these interactions are strongly context dependent and may themselves be influenced by biotic and abiotic factors. I investigated how different food web configurations altered an intraguild predation module consisting of intraguild predator *Ambystoma tigrinum*, and intraguild prey *A. texanum*. I manipulated mosquitofish presence and tadpole presence/species in outdoor mesocosms. Mosquitofish presence significantly influenced total *A. tigrinum* survival and whether any *A. texanum* survived. Tadpole treatment significantly influenced relative head width of *A. tigrinum* but did not otherwise influence their morphology or survival. Mosquitofish presence did not affect the survival, morphology, or larval period of *Rana sphenoccephala*. *Pseudacris maculata* survival was too low (0-14.6%) to statistically analyze. A two-way interaction between tadpole treatment and month influenced phytoplankton abundance via temporary species-specific effects. Chlorophyll levels were significantly higher in the presence of *R. sphenoccephala* in May, but this effect disappeared in June once all tadpoles had metamorphosed. Future work should consider how further food web manipulations – such as density or phenology – could further alter the persistence of complex communities in ephemeral habitats.

13.5 | The effectiveness of an electronic pulse device to deter shark depredation

John Morris, Valerie Hagan, Demian Chapman

318 Fisheries management legislation and shark protections in some jurisdictions has led to a recovery of some shark populations around the world. However, these management successes have become problematic for some commercial and recreational fishers that lose their targeted teleost catch to shark depredation (i.e., sharks taking or damaging caught fish). Electronic pulse (EP) devices are currently being tested as deterrents of shark bycatch in pelagic longline fisheries and might also deter shark depredation. To test the effectiveness of EP devices as shark deterrent in a depredation context we exposed 10 adult bonnethead sharks (*Sphyrna tiburo*), temporarily housed in Mote Marine Laboratory's large animal research facility, to baits attached via rod and reel to an (Active) EP device and a visually identical non-EP control (i.e., the same EP device without a battery). A total of 254 exposure trials using the EP device or non-EP device were conducted, with trials being suspended if the bait was not consumed after 10 minutes. The EP device deterred feeding in 51% of trials, while 93% of control baits were taken. When bait was taken, the average time for the shark to feed when using the active EP device was 388 seconds compared to the 131 seconds for the control. Thus, EP devices can deter sharks from feeding and delay feeding, both of which could help reduce the incidence of depredation if these devices are used in fishing operations where landing takes place quickly after hooking (e.g., recreational angling, pole-and-line tuna fishing, artisanal handlining).

3.3 | Characterizing the Trophodynamics of the Ecological Community of Oyster Aquaculture Reefs

Noah Motz, Brendan Campbell, Rileigh Hudock, Edward Hale, Aaron Carlisle

357 Oyster aquaculture is considered one of the most sustainable forms of animal protein production for its low carbon footprint and associated ecosystem services. Among these services, the habitat provision of juvenile fishes and motile macroinvertebrates to aquaculture structures has implications on commercial and recreational fisheries but is poorly understood. The aquatic community surrounding an experimental aquaculture oyster reef deployed in summer 2023 in Delaware Bay was surveyed using eel traps and beach seines to understand the habitat provisioning services associated with off-bottom oyster aquaculture. Fishes and invertebrates were identified, measured, weighed, and processed for stable isotope analysis (SIA). The weights and masses were used to assess the body condition factor through Fulton's K. The carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotope data were used to characterize how resource use varied within the developing community. Through isotopic analysis, we found evidence of low trophic level species relying on both autochthonous (benthic) and allochthonous (pelagic) primary production while inhabiting the reef. Isotopic niche, used as a proxy for ecological niche, varied throughout the sampling period as the environmental parameters and phytoplankton community changed. For many of the species surveyed, niche widths and resource use changed throughout the seasons, leading to differences in body conditions. For primary consumers, such as anchovies (*Anchoa* spp.) these changes are likely attributed to changes in the phytoplankton community through the seasons. Overall, through SIA we found that resource use and competition varied throughout the sampling season, leading to differences in body condition of fishes utilizing oyster aquaculture reefs.

P1.1 | Harnessing Aquaria Collections of Elasmobranchs to Study Reproductive Biology

Kat Mowle, Linda Penfold

231 There are over 1200 species of elasmobranchs, and the reproductive biology of many species is still poorly understood. Studying reproduction in this taxon can be challenging, especially understanding the influence of environmental factors on endocrine drivers of reproduction. For this reason, aquaria collections of elasmobranch species are a crucial resource for studying and understanding the seasonal and longitudinal reproductive biology of sharks and rays. To monitor the health and welfare of their animals, aquaria vet staff

regularly conduct exams on individual animals, which frequently includes the collection of blood samples for analysis. These samples can be analyzed using enzyme-linked immunoassay for reproductive hormones that can provide information on reproductive biology, including age of sexual maturity and the timing of gametogenesis for both sexes. To generate accurate results, assays must be analytically and physiologically validated for each species, with analytical validation ensuring antibody relevance and no interfering matrix effects and physiological validation ensuring biological relevance of the results. Here we confirm analytical and biological validation of sex steroid assays for four elasmobranch species: sand tiger shark (*Carcharias taurus*); leopard shark (*Triakis semifasciata*), manta ray (*Mobula birostris*), whitespotted bamboo shark (*Chiloscyllium plagiosum*), sandbar shark (*Carcharhinus plumbeus*) and whale shark (*Rhincodon typus*). Data gleaned from these ex-situ validations can be directly applied to in-situ conservation work, which we are currently undertaking with one of the species, the sandbar shark (*C. plumbeus*) in South Florida.

9.4 | Estimating the Species Composition of US Shark and Ray Fisheries

Christopher Mull, Elizabeth Babcock, Ana Martins, Luke Warwick, Demian Chapman, Aaron MacNeil

400 Shark and ray fisheries landings have decreased over the past decade. While more than 300 species are caught in global fisheries, reliable species-specific landings information is scarce as statistics are often reported as aggregate categories (e.g. "sharks, skates, and rays, nei"). Aggregate data masks important species-specific trends, complicating stock assessment efforts and obscuring the ecological footprint of fishing. Generating reliable species-specific landings estimates across the globe is critical for effective fisheries management. Here, we present an estimate of species-specific landings based on the FAO Fisheries Capture Production Database and national databases. Aggregate landings were allocated to species based on taxonomy, fishing area, and estimates of fishing pressure. US shark and ray landings are dominated by skates. Our results provide species-specific trends in fisheries landings and will assist with estimating biological reference points across all landed shark and ray species. These refined landings estimates will improve stock assessments and strengthen the implementation and enforcement of conservation initiatives such as CITES.

14.8 | A Taxonomic Revision of Pirate Perches (Percopsiformes: Aphredoderidae) Reveals Five Species and Widespread Sympatry

Tyler Muller, Andrew Simons

467 Pirate Perches, *Aphredoderus*, are a widespread lowland fish native to the Eastern United States in the Atlantic Slope, Great Lakes, Mississippi River Valley, and Gulf Slope. These were treated as subspecies on either side of Appalachia with intergrades in the Southern Atlantic and Eastern Gulf drainages. We re-evaluated the systematics of *Aphredoderus* and found morphological and genetic support for five distinct species. In the previously proposed intergrade zone, we found evidence of sympatry in four of these species.

19.3 | All Data Welcome: Integrating All Available Data into Species Distribution Models

Riley Mummah, C Scher, David Miller, Evan Grant

379 Integrated species distribution models allow multiple data streams to be integrated into a single model to estimate species occurrence or intensity, while accounting for the uncertainties and biases in each dataset. To date, most models have integrated only a small number of datasets and have used a variety of phenomenological frameworks (e.g., MaxEnt, random forests, maximum likelihood) for estimation and inference. We have built a framework using hierarchical Bayesian models which allow any number of datasets to be integrated within a single model. Our framework accommodates multiple data types (e.g., presence-only, detection-nondetection, counts), addresses the biased sampling process in participatory datasets by accounting for

heterogeneous effort, and can be applied in both continuous and discrete space. We are thus able to produce maps of the estimated distribution and abundance of the Arizona toad (*Anaxyrus microscaphus*) across its full range by integrating eight datasets of varying type and reliability. Further, we compare our framework with alternative model approaches to identify in what scenarios our framework performs best in the reduction of bias and increase in precision. Our approach aids in identifying sampling priorities and areas of highest concern for species conservation using all available data streams and is designed to be generalizable and customizable to meet data, structure, and management needs.

P1.89 | Effects of Chinaberry on Foraging in Gulf Coast Toads (*Incilius nebulifer*)

Marion Mundy, China Hale, Amy Lowe, Michael Pena, Madicella Stockton, Chris Distel

431 Invasive species are known to reduce amphibian population sizes, but many mechanisms remain unclear. *Melia azedarach*, the Chinaberry tree, is a common, invasive, ornamental plant with insecticidal properties. Insects are the primary prey of adult anurans, including *Incilius nebulifer* (Gulf Coast Toad). Therefore, it can be inferred that the presence of invasive Chinaberry has a negative effect on the foraging success of toads due to a lack of prey available for the frogs to consume. We placed toads in enclosures with different Chinaberry treatments, which may repel or kill insects, and measured changes in toad mass over time. Toads in enclosures with native plants grew as expected, while Chinaberry treatments had varying impacts on toad growth. These results are similar to previous work with other anuran species and reiterate the complex roles that invasive species can play in the ecological communities of amphibians within their native ranges.

22.3 | Sexually Dimorphic Features in Species of the Flatfish Genus *Lophonectes* Günther, 1880 (Pleuronectiformes: Bothidae)

Thomas Munroe

394 The bothid genus, *Lophonectes* Günther, 1880 (Pleuronectoidei: Bothidae), was created for *Lophonectes gallus* Günther, 1880, a small flatfish described from specimens collected in marine waters off southeastern Australia. *Lophonectes* was later distinguished from other bothid genera by the presence in mature males of two sexually dimorphic features: possession of several, elongate, anterior dorsal-fin rays and presence of well-developed cephalic tubercles on the snout and a bony knob just ventral to the symphysis of the lower jaw. Mature female *L. gallus* also possess several elongate anterior dorsal-fin rays, but these are much shorter and fewer in number than those occurring in mature males. Additionally, females lack robust cephalic spines and bony knob that feature so prominently in mature males. A second species, *L. mongonuiensis* (Regan, 1914), described from New Zealand waters, exhibits similar patterns of sexual dimorphism in elongate dorsal-fin rays and cephalic tubercles. Earlier authors suggested that differences in the length of elongate dorsal-fin rays could distinguish these two species, but these earlier observations were only of a qualitative nature. To date, no study dealing with these fishes has quantitatively evaluated the elongate dorsal-fin rays (or other morphological characters) to determine the extent and consistency of sexual dimorphism in these species, and whether differences in sexually dimorphic features have diagnostic value for identifying species in this genus. This study provides a quantitative evaluation to determine if dimorphic morphological features of mature adults of these two species of *Lophonectes* demonstrate sufficient differences to be useful as diagnostic characters.

31.4 | Tagging for Tomorrow: The Integral Role of PIT Tags in Understanding and Conserving Biodiversity

Joshua Murauskas, Brian Beckley

453 Passive integrated transponder (PIT) tags, originally developed for tracking inventory, pets, and livestock, have become indispensable in the study of aquatic and terrestrial species' survival and behavior. First repurposed in the 1980s to evaluate threatened wild salmon populations, their

use in ecological research has increased significantly: over 53 million tags have been deployed in salmonids alone, with tagging now extending to a wide array of species globally. This presentation will introduce the fundamentals of evaluating survival and behavior using PIT tags, their implementation in regulatory contexts, and the benefits and drawbacks of the technology. These findings are pivotal for the American Society of Ichthyologists and Herpetologists, bolstering its mission of scientific study amid challenges such as habitat degradation, heavily modified ecosystems, pollution, and climate uncertainty, which collectively present profound risks to North America's native ichthyofauna and herpetofauna.

1.3 | Quantifying Maternal Investment and Life History Correlates in Matrotrophic Elasmobranchs

Annais Muschett-Bonilla, R. Dean Grubbs

435 The diverse reproductive strategies of elasmobranchs pose an unknown amount of risk to pregnant females from the level of embryonic maternal investment. This study aims to investigate reproductive patterns in matrotrophic histotroph secreting elasmobranchs and quantify how maternal investment is distributed amongst gestational stages. In a phylogenetic comparative study, correlations between mode of embryonic nourishment and life history trade-offs will be investigated to identify potential costs associated with each mode. The patterns of evolutionary transitions between modes of embryonic nourishment in all major groups of elasmobranchs will be assessed to identify how complex, high investment reproductive modes evolve.

Mature female *Hypanus sabinus* have been collected throughout all stages of gestation with seines, gillnets, and otter-trawls independently and in collaboration with Fish and Wildlife Research Institute's Fishery-Independent Monitoring Program. These specimens are euthanized and dissected to remove developing embryos and ova for organic dry weight procedures and to quantify embryonic maternal investment at all stages of gestation.

A comprehensive literature review of modes of embryonic nourishment, life history characteristics, and habitat are conducted utilizing published peer-reviewed papers, books, databases (FishBase, Shark-References, etc.), articles, and unpublished data. Independent contrasts and phylogenetic generalized least squares regression will test for correlations between mode of embryonic nourishment and life history and character states will be mapped utilizing existing trees from Stein et al. 2018.

[[HTTPS://ESPACE.LIBRARY.UQ.EDU.AU/VIEW/UQ:352338](https://espace.library.uq.edu.au/view/uq:352338)]

P1.94 | Neurodevelopmental Impacts of Organophosphates on Late-stage Amphibian Larvae

Santoshi Mutyala, Delanie Crabtree, Sara McClelland

286 Organophosphates pesticides are specifically made to target the nervous system of insects. Unfortunately, these pesticides can also be found in the habitats of non-target organisms, including amphibians. Much research has been done on acute exposures to organophosphates, however exposures to low and environmentally realistic concentrations of these pesticides are less well studied. In this study, we wanted to get a better understanding of the impacts that organophosphate pesticides have after a prolonged chronic exposure to environmentally realistic concentrations of an organophosphate. To do this, Northern Leopard Frog (*Lithobates* [*Rana*] *pipiens*) tadpoles were exposed to either a vehicle control or to 1 µg/L of the organophosphate malathion for approximately 20 weeks in a blind, controlled laboratory study. We are analyzing the changes to the neurodevelopment by examining brain morphology. By studying brain morphology, we get a better understanding of how these common environmental pollutants impact the nervous system of tadpoles and we are more likely to improve how we apply pesticides. This research could help in the conservation efforts of herpetofauna worldwide.

18.5 | The Impact of Physical Stress and Residency Status on Territorial Behavior in Two Species of Terrestrial Salamanders

Abigail Nagl, Todd Watson, Alicia Mathis

486 Following exposure to increased predation risk, prey individuals often take measures to decrease their visibility to predators. For territorial species, such measures include decreasing high-visibility behaviors involved in territorial defense. The costs and benefits of contests over territories are typically affected by whether the contestants are territory owners (residents) or intruders into the territory of other individuals. We tested the hypothesis that status as a resident or intruder influences behavior following simulated predator attacks for two species of terrestrial salamanders, *Plethodon angusticlavius* and *P. serratus*. We simulated snake attacks in the laboratory by grasping focal individuals (resident or intruder in each trial) with forceps for a 2-min period and an allowed subsequent 20-min recovery period. Aggressive, submissive, and chemosensory behaviors were recorded for both residents and intruders. The data for residents and intruders were analyzed separately, and statistical comparisons were between stressed and nonstressed individuals. For both species, stress did not affect behaviors of residents, but intruders decreased aggressive posturing after being stressed, which is consistent with different costs and benefits of territorial contests for residents and intruders. For *P. angusticlavius*, residents had generally high levels of aggression regardless of stress treatments, indicating that residents show strong territorial defense even in the face of high predation risk. In contrast, *P. serratus* residents had generally low levels of aggression regardless of stress treatment, which is consistent with lower overall activity (in the current study as well as others) for this species.

29.2 | Photo-identification survey and movement of Sand tiger shark *Carcharias taurus*, at Ogasawara Archipelago in Japan

Masayuki Nakamura, Keisuke Kondo, RMCS member

23 The Ogasawara Archipelago is an oceanic island that has never been connected to land, and its very unique eco system has registered as world natural heritage. Sand tiger sharks (STS) inhabit only this Archipelago in Japan and their key aggregation site attracts tourist divers. Since 2018, RMCS has been conducting photo-identification survey of STS at Ogasawara Archipelago, images of STS were sourced from diving shops, tourist divers and targeted survey. Photo-identification survey has identified 109 individuals (51 males, 57 females and 1 unknown) on right flank, 108 individuals (56 males and 52 females) on left flank, and 65 individuals (28 males and 37 females) on both flanks. Among the identified on the right flank, 64 individuals were re-identified (29 male and 35 females). There are seasonal and gender differences in the observation results, decreased in summer (August-September). Movement between the Mukojima, Hahajima and Chichijima was confirmed. Based on images of pregnant and postpartum individuals identified, the estimated time of giving birth was late March to early May. In February 2020, we captured five STSs (one male and four females) and attached pop-up tags (PAT) and ultrasonic transmitter (V16). Two PAT tags were retrieved and their data sets were obtained for 342 and 274 days. The maximum water depth was 149.5m and 206m, and water temperature ranged from 17.4 to 29.9°C and 19.5 to 30.0°C, respectively. We revealed that STS in Ogasawara Archipelago has a unique ecology compared to other regions. Continued research will be necessary for conservation.

P2.75 | Thermal Preferences of the Southern Two-lined Salamander Across Its Latitudinal Range

Jasmine Nasser, Christopher Beachy, Christopher Murray

329 Amphibians are ectotherms and can respond to changes in temperatures in the environment by behavioral thermoregulation in thermal gradients (Huey and Tewksbury, 2009; Brattstrom, 1979). Ectotherms behaviorally thermoregulate to exploit thermally diverse environments while maintaining control over certain physiological processes (Feder, 1982). Many species regulate body temperature behaviorally by selecting appropriate microhabitats (Spotila, 1972). In salamanders, thermal biology is still widely unknown and the literature on

this topic is small compared to other ectothermic organisms. When studying salamander thermoregulation, they are exposed to artificial thermal gradient temperatures that are not found in the field and are often considered not to thermoregulate as well as other ectothermic animals (Spotila, 1972). I will investigate the behavioral thermoregulation of the plethodontid salamander *Eurycea cirrigera* using their thermal preferences as an indication of their thermoregulatory behaviors and test if these behaviors, like thermal preference, are genetically or environmentally derived.

11.13 | Spawning Phenology of Pacific Sand Lance (*Ammodytes personatus*) and Arctic Sand Lance (*A. hexapterus*)

Laurel Nave-Powers, Luke Tornabene, Alison Deary, Matthew Baker

253 The Pacific Sand Lance (*Ammodytes personatus*) and Arctic Sand Lance (*A. hexapterus*) are important forage fish in the Pacific Northwest of the United States. There is a large knowledge gap for their larval life stage, and most information on spawning phenology is based on Pacific Sand Lance. Spawning phenology effects when fishes are found as well as the survival of the larvae and could be shifting with climate change. This study assessed the spawning phenology of Pacific and Arctic Sand Lance by analyzing a ~20 year dataset of plankton surveys from 2000 to 2022. Specifically, we examined the distribution and standard lengths of larvae caught for both species from the months of May through September. Length-frequency distributions were used to back-calculate peak time of spawning. Based on the length-frequency distributions, we found that Pacific Sand Lance spawn earlier in the fall and Arctic Sand Lance spawn later in late fall/early winter. We also found more larval Pacific Sand Lance in late spring and early summer compared to Arctic Sand Lance, reflecting this difference in spawning time. Our results show that spawning phenology is closely tied to temperature and latitude. Given the effect that climate change has on changing spawning phenology in other marine species, we hypothesize a general shift in spawning to earlier in the year for both species over time. Understanding the spawning phenology of these species and how they are changing in response to a warming ocean is critical for the monitoring of these important forage fishes.

22.1 | Challenges and solutions in converting phylogenies to taxonomies in ray-finned fishes (Actinopterygii)

Thomas Near, Christine Thacker

104 Classification of the tremendous diversity of ray-finned fishes (Actinopterygii) began with the designation of taxonomic groups based on morphological similarity. Starting in the late 1960s morphological phylogenetics became the basis for the classification of Actinopterygii but failed to resolve many relationships, particularly among lineages within the hyperdiverse Percomorpha. The introduction of molecular phylogenetics led to a dramatic reconfiguration of actinopterygian phylogeny. Refined phylogenetic resolution afforded by molecular studies revealed an uneven diversity among actinopterygian lineages, resulting in a proliferation of redundant group names in Linnean ranked classifications. We present an unranked phylogenetic classification for actinopterygian fishes based on a summary phylogeny of 830 lineages that includes all currently recognized actinopterygian taxonomic families and 287 fossil taxa. We provide phylogenetic definitions for 90 clade names and review seven previously defined names. The new classification is free of redundant group names and includes only one new name among the 97 clades, yielding a comprehensive classification that is based explicitly on the phylogeny of ray-finned fishes that has emerged in the 21st century and rests on the foundation of the previous 200 years of actinopterygian systematic research.

P2.11 | How many species of darters (Percidae: Etheostomatinae) are there?

Thomas Near

106 Darters are a clade of 234 valid and recognized species of freshwater fishes that comprise a large portion of the aquatic biodiversity hotspot in southeastern North America. The first four darter species were described

between 1818 and 1820 and the five most recently described species of darters were published between 2020 and 2023. A number of darter species were discovered as a byproduct of phylogeographic studies and ambitions to build molecular phylogenetic datasets that include all species of darters. I explore the undescribed diversity of darter species using molecular phylogenetics and meristic data in an operational ichthyological species concept. This work demonstrates there are at least 58 delimited new and undescribed species of darters, which comprises 19.9% of the total species diversity of darters. These undescribed species are not phylogenetically clustered, but include species of *Allohistium*, *Ammocrypta*, *Etheostoma*, *Nothonotus*, and *Percina*. A protocol is presented to efficiently and thoroughly deploy genomic and phenotypic data to delimit and formerly describe species of darters that can be applied other lineages of fishes. An understanding of species diversity of darters is fundamental for efforts aimed at conserving their biodiversity and comparative evolutionary studies.

11.10 | Assessment and Prospects for the Impact of Invasive Fish on Native European Amphibians

Oksana Nekrasova, Oleksii Marushchak, Mihails Pupins, Andris Čeirāns, Arturs Škute, Kathrin Theissinger, Jean-Yves Georges

185 The emergence of invasive species presents significant threats to native biodiversity, aggravated by climate change and human activities. Particularly concerning is the transcontinental spread of invasive predatory fish species like *Perccottus glenii* and *Lepomis gibbosus* into European wetlands, local freshwater biodiversity. To assess the potential impacts by 2050 and 2090 of these predatory fish on European amphibians, we conducted GIS modeling based on Species Distribution Models (SDMs). Our models forecast: 1) an increase in the range of the thermophilic invasive fish species; 2) significant declines in most native amphibians' natural ranges by 2090; 3) native European amphibians will face increased pressure from invasive fish as breeding habitat loss intensifies. The predicted increase in habitat overlap between the invasive *P. glenii* and two native newts, *Triturus cristatus* and *Lissotriton vulgaris*, is particularly concerning in Eastern Europe, where it is expected to rise from 44% to 66% by 2090. Field observations reveal that these predators injure adult newts and consume their eggs and larvae, contributing to population declines of protected amphibian species. Consistent with our findings, field monitoring in Latvia and Ukraine confirms decreased newt occurrences where these alien fishes expand. Creating Geographically Isolated Wetlands (GIW) is crucial for amphibian conservation, as they harbor greater diversity and abundance while preventing predatory fish expansion. Urgent action is needed to protect amphibians, particularly newts, through reconstruction of GIW and simultaneous control of invasive predators. We thank for the projects EMYS-R (<https://emysr.cnrs.fr> [<https://emysr.cnrs.fr>]) under the BiodivRestore ERA-NET Cofund (GA N°10100377), PAUSE (ANR-23-PAUK-0074), Mobile complex 16-00-F02201-000002, Nr.lzp-2021/1-0247.

7.4 | Tradeoffs Between Growth and Overwintering Preparation in Response to Photoperiod in Gray Treefrogs: A Potential Ecological Trap

Troy Neptune, Diana Koester, Michael Benard

51 Global warming is disrupting the reliability of photoperiod as a cue of seasonal changes in temperature. Temperate and Arctic species are especially vulnerable to the mismatch between photoperiod and temperature because winters are more rapidly warming in these areas. Yet we know little about the costs of physiological overwintering responses to photoperiod. We raised gray treefrogs (*Hyla versicolor*) under three photoperiods (early, average, and late) from egg development through the juvenile stage in a warm growing environment. By the end of the experiment, juveniles were under photoperiods simulating late June, late September, and early November (early, average, and late, respectively). Treefrogs under the late-season photoperiod metamorphosed faster and at smaller sizes compared to treefrogs from the average-season photoperiod. Treefrogs under the late-season photoperiod had both higher concentrations of glycogen in liver tissue and larger livers compared to juveniles from the other photoperiods. This resulted in treefrogs with much greater total liver glycogen reserves, based entirely on photoperiod. Juveniles under a late-season photoperiod also exhibited a lower critical

thermal minimum compared to juveniles from the early-season photoperiod. Collectively, treefrogs under the late-season photoperiod had much greater cryoprotectant reserves (i.e. more "antifreeze") and increased cold tolerance compared to treefrogs under other photoperiods. But treefrogs under the late-season photoperiod had reduced juvenile growth, indicating a potential cost to these physiological overwintering strategies. Importantly, these strong responses to photoperiod were not eclipsed by warm growing conditions, implying an ecological trap where temperature is not strong enough to override the effects of photoperiod.

20.5 | Navigating Chilly Depths: Examining the impact of an extreme environment on skull evolution of the icefishes (Notothenioidei)

Mayara Neves, Howan Chan, Kory Evans

354 Antarctic notothenioid fishes are a prime example of a vertebrate adaptive radiation within a marine setting under extreme environmental conditions. Emerging from a shared ancestor around 22 million years ago, the notothenioids are remarkable in the evolution of antifreeze glycoproteins, which played a crucial role in allowing these originally bottom-dwelling fishes to endure and adjust to temperatures plummeting to the freezing point of seawater. While elaborate craniofacial modifications have accompanied this adaptive radiation, little is known about how these morphological changes have contributed to the evolutionary success of notothenioids. Here, we analyze the skull of 55 notothenioid species and 92 perciform species using micro-CT scanning and three-dimensional geometric morphometrics to show that diversity in skull shape is best explained by divergent selection with respect to habitat. Bathydraconidae and Channichthyidae exhibit the greatest morphological disparity compared to other notothenioids and closely related Perciformes. There was an accelerated rate of morphological evolution within the nine icefish families, revealing that their swift diversification coincided with the development of comparatively elevated levels of morphological integration. While conventional studies often indicate that extensive integration might limit phenotypic evolution, icefishes emerge as a rare example where increased integration could potentially enhance evolutionary diversification. We propose that the evolution of heightened levels of phenotypic integration in icefishes could be considered a pivotal innovation, facilitating their morphological evolution and subsequent adaptive radiation.

15.3 | The Effects of Anthropogenic Electromagnetic Fields and Geomagnetic Displacement on the Behavior of Big and Longnose Skates

Kyle Newton, Natalie Donato, Taylor Chapple, Sarah Henkel

248 To mitigate the effect of climate change, the demand for marine renewable energy infrastructure is increasing worldwide. These facilities convert the kinetic energy of offshore wind, waves, or currents into electricity that is transported to shore through alternating current (AC), or direct current (DC), subsea cables. Energized cables emit magnetic fields radially into the surrounding seawater and induce secondary electric field artifacts. Thus, anthropogenic electromagnetic fields (EMFs) can alter the local geomagnetic landscape and may impact the behavior of EMF sensitive elasmobranchs that use the geomagnetic field (GMF) to navigate.

This project "magnetically displaced" big (*Beringraja binoculata*) and longnose (*B. rhina*) skates to determine their response to GMF navigational cues. We exposed skates to an AC and DC mock-subsea cable to determine their response to fluctuating and constant EMFs. We exposed skates to GMF displacement combined with EMF to understand how EMF-AC and EMF-DC impacts GMF mediated behaviors. Experiments were recorded on video and 3D pose estimation software was used to track the velocity, body angle, and spatial use of skates to quantify their behavioral response to magnetic stimuli.

Big skates exposed to GMF and EMF were more active and showed the greatest changes in spatial use, velocity, and body angle. Conversely, longnose skates were less active overall but showed significant magnetic stimulus-specific changes in their movement kinematics. Thus, congeneric

skates exposed to GMF and EMF showed stimulus- and species-specific changes in their behavior. Future studies will leverage these results to interpret the response of elasmobranchs to EMF in the field.

7.3 | Heterospecific Oophagy of Anuran Eggs by American Bullfrog (*Rana catesbeiana*) Tadpoles

E. Nicholson, Lee Fitzgerald

216 There is much we do not know about vulnerability to predation for anuran eggs and how predation on anuran eggs may structure anuran communities. Predation by conspecific and heterospecific tadpoles may be one of the greatest threats to anuran egg survival. Tadpoles of introduced species like the American Bullfrog (*Rana catesbeiana*) could thus reshape anuran communities through this predator-prey interaction. Though there are historical records of heterospecific oophagy of anuran eggs by American Bullfrog tadpoles, it remains unclear what this behavior's extent is and whether it may be a threat to native anurans in the introduced range of American Bullfrogs. To further understand this threat's potential and gain insight into implications for conservation, we sought to determine if American Bullfrog tadpoles in later development stages consume more heterospecific anuran eggs than American Bullfrog tadpoles of earlier developmental stages. We also assessed whether there are differences in predatory pressure exerted by American Bullfrog tadpoles on heterospecific anuran eggs between different anuran species and taxonomic groups. We conducted experimental trials in which *R. catesbeiana* tadpoles were exposed to 10 heterospecific anuran eggs. For each heterospecific anuran in the experiment, we included two treatments of predatory tadpole development (tadpoles of Gosner stages 28-32 and tadpoles of Gosner stages 33-37) and replicated these treatments 10 times. Our preliminary results indicate development is a key factor for American Bullfrog tadpoles to consume heterospecific anuran eggs. In addition, some anuran eggs are not threatened by predatory bullfrog tadpoles, but Ranid eggs are frequently consumed.

P1.75 | Facultative Arboreality in Garter Snakes of the genus *Thamnophis*: A New Record and Review of the Behavior

E. Nicholson, Ian Meloni, Steven Lovelace, Lee Fitzgerald

208 While conducting field research in southwestern New Mexico, we observed what we believe is the first record of arboreality in a Black-necked Garter Snake (*Thamnophis cyrtopsis*). Though this observation was not surprising, it prompted us to review arboreal behavior in the genus *Thamnophis*. Our literature review was supplemented with data from iNaturalist. As more arboreal snakes are known to have longer relative tail length, we measured the tail: body ratio of various *Thamnophis* species and other snakes of more or less previously recorded arboreality. Our review shows that *T. cyrtopsis* is at least the ninth species of *Thamnophis* to exhibit arboreality. Garter snakes have fairly high tail to body length ratios and may thus be predisposed to arboreality. We are conducting phylogenetic comparative analyses to further elucidate the phylogenetic influence on the propensity for arboreality. In any case, arboreality in garter snakes is infrequently observed. Garter snakes may be predisposed to arboreality, which can be regarded as instances of facultative arboreality. It appears thermoregulation is the most common explanation for the behavior, but protection from predators and flooding, foraging, and mating are all documented causes of the behavior as well. Our results indicate *Thamnophis* snakes do not fit as nicely into their traditional "terrestrial" category as once thought. They can perform facultative arboreality for various reasons.

15.6 | Applications of Automated Visual Tracking for the Kinematic Analysis of Aggregation Behavior in Leopard Sharks (*Triakis semifasciata*)

Andrew Nosal, Kayleigh Bajarin, Josh Gailey, A-bel Gong, Caroline Saple, Tristan Walter, Iain Couzin

300 A major priority in the field of behavioral ecology is to resolve the interplay between the social and non-social forces underlying group dynamics, and how the collective properties of animal groups emerge from the movements

of individuals. Aggregation behavior has been widely documented in elasmobranch fishes (sharks, rays, and skates), and yet, as with other taxa, the mechanisms governing this group behavior remain poorly understood. Advances in computer vision and drone technology have revolutionized the study of animal group behavior and are poised to take the field in new and exciting directions. Using a 15-minute drone video clip as an example, this presentation will describe how we tracked >200 leopard sharks (*Triakis semifasciata*) aggregating off La Jolla, California, using an automated visual tracking system called TRex. We will demonstrate the value of this tracking system in generating individual, uninterrupted swimming paths for each shark. Applications include visualizing the structure of the aggregation by mapping variation in swimming speed, density, body alignment, and path tortuosity, as well as inferring underlying movement rules by quantifying attraction, repulsion, and alignment interactions of individual sharks with their nearest neighbors. Additionally, we will present some opportunistic applications, including quantifying serial behavior exhibited by sharks, such as 'roll-chafes,' 'head-snaps,' and 'body-shakes,' and the propagation of startle responses in the aggregation. These methods will be applied to additional drone video clips of shark aggregations, to determine how individuals' movement patterns may vary with differently sized aggregations.

5.6 | Network Analysis of Decadal Acoustic Detections Reveals Partial Migration in a Large Marine Predator (*Carcharhinus leucas*)

Jasmine Nyce, Matthew Smukall, Curry Cunningham, R. Grubbs, Debra Abercrombie, Maurits van Zinnicq Bergmann, Tristan Guttridge, Andrew Seitz

191 When individuals within a population exhibit diverse migratory behaviors, including partial migration, the risk of mortality to the species is spread over space and time, which may impact population fluctuations and increase resilience to external pressures. Despite the acknowledgment of partial migration in many fish species, exploration of partial migration and contingents of elasmobranchs has received less attention. Bull sharks (*Carcharhinus leucas*) are a large-bodied, upper trophic-level species that exhibit a range of site fidelity and long-distance seasonal migrations throughout the Western North Atlantic (WNA). This study aims to investigate the role of behavioral contingents on the partial migration of bull sharks in the WNA population. We analyzed passive acoustic detections of bull sharks ($n = 67$) tagged at multiple sites on the U.S. East Coast and The Bahamas from 2009 to 2023. A hierarchical cluster analysis was conducted using individual sharks' network parameters, including regional occupancy, transitions, and network connectivity, to determine emergent group behaviors. Group-level movement dynamics were then examined with network analysis to understand the regional occupancy and transiting movement patterns among the grouped behavioral contingents. Demographic data and tag sites were compared with a diversity index describing individual-level network connectivity and heterogeneity in broad-scale habitat use. Preliminary analysis revealed that multiple migrant and resident contingents may be present in the WNA bull shark population. This study will provide insights to fill data gaps in understanding the population-level movement behavior and partial migration of large bull sharks in the WNA.

11.15 | Sound Production in *Ensatina eschscholtzii*

Mary O'Donnell, Christian Brown, Stephen Deban

499 Vocalization in salamanders is a rare behavior, but has been reported in more than seven species across several families. Researchers noted certain individuals within the represented species are more prone to this behavior, and it has been suggested that vocalization plays a predator-deterrent role. While two species of lungless plethodontid salamander have been documented to vocalize, the mechanism by which sound is produced in a lungless species was undetermined. One *Ensatina eschscholtzii* oregonensis individual collected near Arcata, California repeatedly engaged in vocalization while being handled. Using high speed videography, we determined that sound production occurred during depression of the buccal floor as it inflated with air. A high pitched squeak was generated through an apparently closed mouth. By preventing the movement of air into the nares using an amphibian-safe water

soluble gel, sound production was eliminated. From this, we conclude that sound production in this species is produced by rapidly and forcefully drawing air into the buccal cavity through nares to produce a squeaking sound.

21.1 | A case study on the successful exhibitory of juvenile white sharks at the Monterey Bay Aquarium

John B. O'Sullivan, Manny Ezcurra, Ann Greening

102 Historically, white sharks (*Carcharodon carcharias*) were regarded to be the unicorn of exhibit species: compelling but impossible. When the Monterey Bay Aquarium built its new Open Sea Exhibit in 1996, designers incorporated exhibit requirements they felt would be important for yet-to-be-displayed elasmobranch species. With advances in construction materials and life support technology allowing for larger public aquarium exhibits, and with similar improvements in captive husbandry collections, transport, exhibitions techniques, husbandry, and veterinary care, and with investments in offsite holding, aquariums have provided new opportunities for captive elasmobranch research. Here, we review our methods and published results that allowed for the successful exhibit and captive research on young-of-the-year white sharks between 2004 and 2008. In addition to the unique ex situ research opportunities afforded by having these elasmobranchs on exhibit, their presence and the accompanying public education and policy advocacy programs initiated by the Aquarium contributed to wider appreciation of an often-maligned species, and in tangible public awareness and conservation benefits for white sharks.

6.5 | Exploring Variation in Species Richness using Active and Passive eDNA Sampling Approaches

Camden Oathout, Kyle Piller

172 Environmental DNA (eDNA) is a novel sampling technique for evaluating fish assemblages. Due to its infancy as a sampling technique, there have been several different methods employed to collect water samples. Environmental DNA sampling is often limited to water samples from a single time-period on a particular day, essentially representing a snapshot in time. Little is known regarding the degree of temporal variation of eDNA across a 24-hr period from a single site. In this study, we examine fine scale temporal variation of eDNA by collecting water samples over a 24-hour period at the Tangipahoa River (Louisiana) using both active and passive sampling approaches. Active sampling involves taking water samples from predefined areas every hour for 24 hours. Passive sampling includes the deployment of a sampling device that remains stationary in the same area for 24 hours. All of these water samples are filtered on glass microfiber filters, extracted, PCR amplified (12S mtDNA), and Illumina sequenced using a pre-defined protocol. Passive sampling detects 53 species, whereas, on average, active sampling detects far fewer species (mean= 22, range 2-57) from a single hourly sample. These results highlight the need to consider passive sampling approaches for studying fish assemblages based on eDNA, as our data indicates there is a substantial amount of species richness variation from any single actively collected sample.

25.3 | Changes in sex steroid hormone levels and reproductive organs reflect the breeding status of zebra sharks in Okinawa Churaumi Aquarium

Jo Okamoto, Kiyomi Murakumo, Ryo Nozu, Rui Matsumoto, Jennifer Wyffels, Kady Lyons

113 Okinawa Churaumi Aquarium (OCA), located in a subtropical region, utilizes natural seawater without temperature adjustment for animal rearing. OCA promotes captive breeding and ex-situ conservation of threatened elasmobranch species such as the zebra shark, *Stegostoma tigrinum*. This study focused on monitoring changes in plasma concentrations of sex steroid hormones, follicle diameter, and gonad size to assess the annual reproductive cycle of male and female zebra sharks, as part of the *S. tigrinum* Augmentation Recovery (StAR) project. Blood samples were collected monthly from the captive zebra sharks. Plasma was extracted from blood samples and measured hormone levels were compared to water temperature fluctuations. Additionally, ultrasonographic imaging of reproductive organs was

conducted to compare with hormone data. In mature female zebra sharks, Estradiol-17 β (E2) levels were inversely correlated with water temperature and corresponded with follicle development and regression. Testosterone (T) levels elevated during the egg laying period. In mature males, the size of reproductive organ exhibited a strong correlation with the beginning time of mating behavior, follicle diameter, and hormone levels change in females. These results show water temperature fluctuations are an important key for the reproductive status of this species and a high positive being indicator as the trigger of gonadal hypertrophy. Aquarium techniques and these studies are expected will contribute to reintroduction efforts into the wild environment. Thus, aquarium research will be able to contribute to their in-situ conservation of this species, especially in areas where the species has been locally extirpated.

35.5 | Ecological Forecasting of *Carcharodon carcharias* Habitat Suitability in the Northwest Atlantic

Kyle Oliveira, Benjamin Tupper, Megan Winton, Gregory Skomal, Damian Brady, Nicholas Record

370 As an apex predator in most of the environments it occupies, the presence of white sharks, *Carcharodon carcharias*, is vital to understanding how the species will impact ecosystem health and how we as humans may interact with the species. Utilizing environmental covariate data, modeled prey distribution layers, presence points for *C. carcharias* compiled from multiple data sources, and downscaled ocean climate projections, we create a presence-only model that projects habitat suitability likelihood of white sharks in the northwest Atlantic. Prior to the reveal of the forecast, we poll audience members to draw a forecast of their own given the future covariate data presented. The "human forecast" offers a unique opportunity to compare the maximum entropy (MaxEnt) model to human perspectives on covariate impact on habitat suitability. Using the MaxEnt ecological forecast, we can then identify areas that may be suitable habitat for *C. carcharias*. The projections created offer valuable insight into where we can expect white shark distribution to change in the coming decades, as well as how different sources of data influence these predictions. Thus, providing data to bring forward to interested parties and policy makers to prepare for a compatible future between humans and *C. carcharias*. With intensifying climate change altering the ocean and adjacent communities, understanding whether an apex predator will reoccupy a region can be vital information for those who depend on lower trophic levels for sustenance and livelihood.

20.2 | Marine biodiversity: Why the third dimension matters

Hannah Owens, Carsten Rahbek

430 To date, broad-scale marine biodiversity studies have largely focused on two-dimensional patterns, usually limited to observations of surface or near-surface conditions. However, the growth of depth-structured environmental and biodiversity data allows us to examine the relationships between the diversity of open-ocean fishes and the environments in which they live. In this study, we compared biodiversity patterns inferred from 2D and 3D data sources, including species occurrences and environmental data. Specifically, we used correlative niche models to generate Atlantic Ocean biodiversity maps of three families of interest—Belontiiformes, Gadiformes, and Scombriformes—in two and three dimensions. We then tested classic hypotheses regarding correlations between biodiversity and latitude, depth, and temperature using the two sets of models, and compared the results. While our 2D model results explained more of the available variance, our 3D models are better able to predict biodiversity patterns. These seemingly contradictory results highlight that even though a 2D approach may appear satisfactory, it falls short of capturing the true complexity of the open ocean, emphasizing the critical importance of depth in understanding marine ecosystems.

14.11 | Examining Factors Contributing to the Decline of Peripheral *Ambystoma* Populations Along the Ohio River

Morgan Page, Anna Humphrey, Jayme Waldron

398 The Ohio River and its tributaries have experienced extensive urbanization and industrialized agriculture over the last century. The associated loss of floodplain habitat has led to the decline of local amphibian populations.

Habitat loss may be especially consequential for populations at their range edge, as peripheral populations are especially sensitive to environmental perturbations. These conditions create an ideal study system for identifying drivers of the species decline. Small-mouthed Salamanders (*Ambystoma texanum*) meet their range edge along the Ohio River in West Virginia, and have experienced population declines along this periphery despite maintaining relatively stable core populations. I surveyed for *A. texanum* at historical locations and at randomly selected wetlands with suitable habitat in south-western West Virginia. I used unbaited and light-baited minnow traps to conduct presence-absence surveys at 12 wetlands. I used these data within an occupancy framework to model extirpation as a function of contemporary habitat structure and historical land-use change. The results of this study identify mechanisms contributing to the species decline in this region and provide insight into factors that may be crucial to their persistence in fragmented landscapes.

20.6 | Reproduction in Ricefishes (Beloniformes: Adrianichthyidae)

Lynne Parenti

58 The Japanese Ricefish or Medaka, *Oryzias latipes*, is a teleost model organism. It is one of 43 valid species in the family Adrianichthyidae, order Beloniformes. Over half of the species are endemic to the island of Sulawesi at the center of the Indo-Australian Archipelago. Morphology and molecular data corroborate monophyly of the Beloniformes and of the broader Atherinomorpha. Diagnostic reproductive morphological characters of atherinomorphs include a unique testis and egg. Atherinomorphs have many correlated reproductive modifications. These include internal fertilization, viviparity, hermaphroditism, and formation of sperm bundles and spermatophores. All ricefishes are oviparous or ovoviviparous. Embryo-retention is facultative. Females may carry clusters of eggs outside the body from fertilization to hatching. Pelvic brooding is a further specialized reproductive mode. It characterizes at least four species of ricefishes from Sulawesi. After spawning, a plug forms inside the female gonoduct. The plug anchors egg-attaching filaments and secures the cluster of fertilized eggs until hatching. Ovulation is suppressed during brooding. Elongate pelvic fins of females protect the cluster of embryos. Evolution of reproductive modes in ricefishes may be interpreted within a phylogenetic and biogeographic framework. Phylogenetic hypotheses of the pelvic brooders and of the miniature, highly autapomorphic ovoviviparous species, *Oryzias setnai*, reflect the conflict between morphology and molecules. Explanations for this conflict are varied. They include differences in taxon-sampling and long-branch attraction.

4.3 | Activity, Foraging, and Growth of Amphibians in a Warming World

Brady Parlato, Michael Benard

219 Among ectotherms, rising temperatures are expected to promote longer active periods, increased foraging, and faster growth if they fall within tolerance ranges, but may constrain activity if thermal limits are surpassed. We assessed how rising temperatures influence the activity, foraging, and growth of amphibians in two experiments to improve our understanding of how climate change shapes ectotherm behavior and physiology. First, we raised juvenile wood frogs in growth chambers for 10 days in three temperature treatments: cool (12–18°C), average (19–25°C), and warm (26–32°C). Frogs consumed more crickets and defecated more frequently in warmer treatments, but did not differ in final mass. These findings are consistent with previous work indicating that, within tolerance ranges, amphibians can modify their behavior and physiology to accommodate changes in metabolism associated with temperature shifts. Second, we raised wood frogs in outdoor pens under two temperature treatments: ambient temperatures or temperatures increased by open-top warming chambers. Frogs were monitored using trail cameras. In the summer, frogs in ambient and warmed pens displayed similar patterns of diurnal and nocturnal activity, and mass did not differ. While the time of day when frogs were active was similar between treatments, there were more frog detections in warmed pens relative to ambient pens. Although climate change may not be expanding their daily activity windows, some amphibians may become more

active within these windows. Thus far, our work highlights the importance of elevated temperatures linked to climate change in increasing the daily activity and foraging of some ectotherms.

34.5 | The Genus *Holaspis* Gray, 1863 (Squamata: Lacertidae) in Angola: A Tale of Forgotten Specimens and Disappearing Forests

Diogo Parrinha, Mariana Marques, Francisco Gonçalves, Arthur Tiutenko, Aaron Bauer, Luis Ceriaco

186 The members of the Afrotropical lacertid genus *Holaspis* are strikingly specialized lizards, adapted for gliding in forest canopies. Two species are currently recognized within the genus: *H. guentheri* from West and Central Africa, and *H. laevis* from East Africa. The currently known southern limits of *H. guentheri* are the northern Angolan Guineo-Congolian habitats, which are remnants of forests connecting the country to West/Central Africa. The oldest record of the species in Angola, dating back to the nineteenth century, is based on a currently lost specimen from Caconda, southwestern Angola. Caconda lies on the Angolan Central Plateau, which is part of the Great Escarpment of Southern Africa. The loss of this specimen and its geographic context led most authors to disregard it, leaving its taxonomic identity dubious until now. The rediscovery of two additional historical specimens from Caconda in the Natural History Museum, London allowed us to confirm the presence of the genus in the region, prompting targeted surveys and examination of additional material. Our surveys failed to locate any *Holaspis* near Caconda. The region has alarming rates of deforestation, raising the possibility that this population may be already extinct. The reexamination of the extant Caconda specimens and comparisons with *H. guentheri* and *H. laevis* revealed consistent morphological differences that suggest that the Caconda population may represent a distinct taxonomic unit. These findings and their implications are discussed in the biogeographical context of the highlands of western Angola, a recognized hotspot of diversity and endemism for several taxonomic groups.

P2.35 | Ichthyology Collections of the Portuguese Oceanographic Campaigns in Former Colonial Territories

Diogo Parrinha, Leonor Soares, Alexandra Cartaxana, Maria Alves

426 The Missão de Biologia Marítima (Lisboa, Portugal) and its successor institutions were responsible for conducting oceanographic campaigns in the former Portuguese colonies in Africa, during the decades of 1950–1960. The primary objective was to advance the systematic study of marine resources in these territories, leading to the collection of thousands of specimens of marine fauna, most notably fishes. In the late 1970s, the collection faced understaffing and neglect, remaining largely unknown and inaccessible to the scientific community since then. In this work, we provide a comprehensive description of the dataset resulting from the revision and digitization of the ichthyology collections, currently deposited in the Museu Nacional de História Natural e da Ciência, Universidade de Lisboa. The collection comprises 3130 occurrence records totaling more than 8000 specimens, collected mostly between 1951 and 1970 in Angola, Cape Verde and Mozambique. It has a wide taxonomic coverage with representatives of more than 700 species, including 9 type specimens for 3 nominal taxa: *Cubiceps niger*, *Tylosurus acus rafale* and *Chromis lubbocki*. Gathered in a colonial context and overlooked over time, this collection can now be made available to the scientific community once again, and promote scientific cooperation between Portugal and the now independent countries. This work emphasizes the value of Portuguese natural history collections and the crucial role of revision and digitization initiatives in enhancing their accessibility and use.

34.1 | Of Time and Turtles

Matt Patterson

460 My name is Matt Patterson, I am a wildlife artist but even more specifically, I am a turtle artist! This past year two books were released for which I illustrated. THE BOOK OF TURTLES and OF TIME AND TURTLES. Both published by HarperCollins and written by national bestselling author, Sy Montgomery. TBOT is picture book that celebrates turtles with amazing facts, extreme

abilities, evolution and conservation. This book has so far won 6 national awards. OTAT is the chronicle of the three years Sy and I spent immersed (sometimes literally) in the world of turtles. We worked with a turtle rehabber rescuing injured turtles, often ones with injuries from roads. We worked with a nest protection group protecting nests of five species, (permitted by the state) three of which are endangered or threatened. We also did cold stunned sea turtle rescue on Cape Cod and we visited the Turtle Survival Alliance's Survival Center learning and volunteering with endangered turtles they care for in their facility. Along the way, we learned about amazing turtles and the people who work to protect them. My talk would discuss our work with these groups and turtle adventures we had.

P1.54 | Biogeography of Dragonfishes and their Allies (Stomiiformes)

Allison Peck, Leo Smith, Matthew Davis

220 Dragonfishes and their allies (Stomiiformes) are a species-rich lineage of deep-sea pelagic fishes that have a worldwide distribution and several adaptations that evolved for living in an open ocean environment. In this study, the evolutionary relationships among Stomiiformes are inferred from a combination of ultraconserved elements (UCEs) and protein-coding gene fragments providing new insights into their evolutionary history. We use this evolutionary framework in combination with a study on the biogeographic patterns of stomiiforms to investigate whether dragonfishes follow known patterns associated with pelagic areas of endemism across the world's oceans. A Bayesian inference of biogeographic history with the stomiiform phylogeny is also performed to explore biogeographic patterns of dragonfishes through time.

P2.41 | Analyzing Animal Diel Activity with the Adapted Hunt Drift Fence Technique (AHDriFT)

Jamie Penny, Timothy Krynak, Nathan Byer

444 Monitoring sensitive wildlife species is a persistent and ongoing need for effective conservation, and a variety of approaches – ranging from active trapping to passive camera-based monitoring – have been developed for this purpose. Across these approaches, however, small and elusive species – including snakes and small mammals – are frequently difficult to study. A recently-developed wildlife monitoring approach – the Adapted Hunt Drift Fence Technique (AHDriFT) – allows for continuous monitoring of small and elusive wildlife species at low cost and effort. We have recently leveraged a growing partnership between Cleveland Metroparks, the Ohio State University, the Cuyahoga Valley National Park, and Summit Metroparks to deploy AHDriFT arrays across the Cuyahoga Valley to study the smooth green snake (*Ophedrys vernalis*), a state-endangered snake species in Ohio. Beyond providing enhanced estimates of smooth green snake abundance across the Cuyahoga Valley, these arrays have provided novel insights into diel activity for the broader reptile and small mammal communities in surveyed areas. Continued monitoring of these arrays will be conducted by Cleveland Metroparks staff and volunteers, and opportunities for deployment of additional arrays will be leveraged to improve the spatial scope of this monitoring project. More broadly, collaborative analysis of mammal and reptile communities across project partners will be used to enhance land management and restoration decision-making in the Cuyahoga Valley.

P2.63 | Antimicrobial properties of hellbender salamander skin secretions

Kenzie Pereira, Jakobi Deslouches, Zehra Mehdi, Berthony Deslouches, Jill Dembowski, Sarah Woodley

269 Amphibian skin is a rich source of bioactive compounds. Many skin secretions have anti-predator or antimicrobial functions. Compared to anurans, very little is known about the antimicrobial properties of salamander skin secretions. We have been studying the antimicrobial (antibacterial, antiviral, and antifungal) secretions of Hellbender Salamanders (*Cryptobranchus alleganiensis*). Using *in vitro* growth inhibition assays, we found that growth of six species of ESKAPE bacteria was inhibited in the presence of a mixture of Hellbender skin peptides. Mixtures also inhibited *in vitro* growth of the chytrid

fungus, *Batrachochytrium salamandrivorans*. In contrast, the skin peptide mixture was not toxic to human cell lines and did not reduce the ability of herpes simplex virus type 1 (HSV-1) to infect fibroblasts and produce more viral particles. Individual fractions of the peptide mixture inhibited the *in vitro* growth of *Escherichia coli* and *Staphylococcus aureus*. Currently, we are trying to determine the amino acid sequences of the individual peptide fractions with antibacterial functions. Identification of bioactive peptides in Hellbender secretions could aid in both salamander conservation and in biodecovery of potentially novel antibiotics.

27.8 | Building a Curated Barcode Reference Library for Neotropical Freshwater Fishes in Tortuguero, Costa Rica

Taegan Perez, João Pedro Fontenelle, Matthew Kolmann, Alexander Van Nynatten, Arturo Angulo, Nathan Lovejoy

304 As concerns over global biodiversity continue to rise, the development of effective tools for conservation and management become increasingly important. Diversity investigations and biomonitoring rely on accurate taxonomic identification, which can be an arduous task in incredibly diverse groups, like the Neotropical freshwater fishes. Morphology-based approaches are conventionally used to assess diversity but can be inefficient when intra- and interspecific morphological variation overlaps. Previous assessments of the diversity of freshwater fishes in Costa Rica were predominantly performed using morphology, with DNA barcoding and integrative approaches only being used more recently. Previous work conducted in the Barra del Colorado Wildlife Refuge (BCWR) in Costa Rica highlighted the lingering issues of misidentifications and incompleteness in publicly available barcode databases used for molecular identification and conservation of Neotropical freshwater ichthyofauna. To remedy this, we created a barcode reference library (CBRL) for the ichthyofauna of the Tortuguero region using our previous assessment of the diversity of freshwater fishes in BCWR, literature, and expert opinion. Our library contains col barcode sequences representing 139 species (85% of regional species list) and 12S barcode sequences representing 39 species (35% of regional species list) from critically evaluated public data sequences and sequences from specimens collected in BCWR. We highlight issues with public data availability, especially regarding IUCN red listed species data availability. The library and protocols used to build the library will be made publicly available and form the basis for a broader barcode library of the Costa Rican ichthyofauna.

34.4 | Hemoparasite Diversity in Gold Tegu Lizards (Tupinambis teguixin) from Central Amazonia

Amanda Picelli, Francisco Ferreira, Maria Pacheco, Pedro Pereira, Aaron Bauer, Igor Kaefer, Felipe Pessoa, Lúcio Viana, Érika Braga, Ananias Escalante

210 The gold tegu (*Tupinambis teguixin*) is a large teiid species widespread in Amazonia. It is terrestrial and diurnal, inhabiting primary and secondary forests, savannas, and perianthropic areas. It is unique among Amazonian lizards as it hosts various hemoparasites, especially apicomplexan protozoa. We combined molecular and microscopic tools to investigate the hemoparasite diversity in gold tegus from Central Amazonia, Brazil. Blood smear screening from 26 individuals showed that 57% were positive for hemoparasites, with five animals harboring coinfections. Most infections were by haemosporidians (54%; n=14/26), followed by hemogregarines and microfilariae (7%; n=2/26), with a single individual harboring haemococcidians. We detected two haemosporidian parasites similar to described species *Saurocytozoon tupinambian* and *Plasmodium minasense*. To date, these species do not have associated molecular data. Preliminary molecular screening of haemosporidians amplifying a portion of the *cytb* gene showed a detection rate of 65% (n=17/26), similar to the detection via microscopy (χ^2 with Yates' correction, $P > 0.05$). Sequencing results revealed two new genetic sequences belonging to the Plasmodiidae group. Our following goals are to complete the morphological characterization of these parasites, conduct phylogenetic analyses, and sequence the complete mitochondrial genome of these haemosporidians. By linking the morphologies to their sequences, we expect to contribute to

understanding criteria for species delimitation and the phylogenetic relationships of these species within the order Haemosporida, as well as to provide the first DNA sequence data for the genus Saurocytozoon.

22.2 | Taxonomic Turmoil: Using Genomic Data to Resolve Taxonomic Discrepancies within Characodon (Cyprinodontiformes: Goodeidae)

Kyle Piller, Andrew Sherman, Elyse Parker

78 Characodon (Cyprinodontiformes: Goodeidae) is a highly imperiled group of fishes from Mexico. The genus consists of two extant species (Characodon lateralis and Characodon audax), as well as a third species, only known from the holotype, that is considered extinct (Characodon garmani). There are taxonomic issues associated with the location of the type localities for *C. lateralis* and *C. garmani*, making taxonomic revisions challenging. In several recent studies, others have applied a simple taxonomic classification scheme that corresponds to one species being limited to above the waterfall known as “El Salto” (*C. audax*), and the other occurring below the falls (*C. lateralis*), although circumstantial historical evidence suggests that this is not accurate. We used next-generation sequencing (ddRADSeq) to generate a genome-wide data set for populations of Characodon across the range to examine genetic variation. Our population genetic and phylogenetic analyses indicate that there is some genetic structure across the range of Characodon, including one group corresponding to populations above the falls, and another group corresponding to populations below the falls. Species delimitation analyses using BPP confirm these results and indicate that two species within Characodon should be recognized. As a result of the uncertainty in the type localities for *C. lateralis* and *C. garmani* and no available name for the populations downstream of the falls, we take a conservative approach and recognize everything as *C. audax* (above the falls) and *C. cf. audax* (below the falls) until a formal taxonomic revision of the genus is completed.

35.2 | Scales of Selection of Eulerian and Lagrangian Environmental Parameters for Three Pelagic Sharks

Jerome Pinti, Helga Huntley, Aaron Carlisle, Matthew Shatley, Barbara Block, Matthew Oliver

313 Most studies of pelagic predator distributions have focused on ocean conditions coincident in time and space with the animal (Eulerian, or state predictors), without consideration of the dynamic history of the water parcel selected by the predator (Lagrangian predictors). However, there is growing evidence that some marine organisms may select for Lagrangian and not just Eulerian features. Lagrangian predictors can capture filaments, eddies, and fronts as well as along-trajectory processes such as accumulation of biomass that cannot easily be extracted from Eulerian fields. In addition, these Lagrangian features can display a wide range of characteristic sizes, and the spatio-temporal scale at which we observe these features and the spatio-temporal scale at which marine organisms select for these features may differ – creating a potential mismatch between the scales of ecological processes and the scale at which we investigate these processes. Here, we investigate the selection of both Eulerian and Lagrangian features by salmon sharks, blue sharks, and shortfin mako in the North Pacific, at an array of spatio-temporal scales. We show that the most relevant scale of environmental selection varies for each environmental variable and species considered. In addition, we show that including Lagrangian variables in spatial analyses significantly increases our understanding of the distribution of top predators. These results have implications for pelagic species management and conservation.

P1.76 | Analyzing Anti-Predator Responses of Tadpoles after Chronic Exposure to Microplastics

Emma Pollackov, Sara McClelland

500 Production of single-use plastic goods has increased throughout the world since the mid-1950's. Today, over 360 million metric tons are created annually. These plastics never disappear from the environment. Instead, over time, breaking down of plastics leads to different sizes of debris such as microplastics, which are particles < 5 mm, or nanoplastics, which are particles

< 1µm. In nature, tadpoles aggregate as a defense mechanism when predators are around. Previous research using a concentration of microplastics on the higher end of what is found in nature, showed that tadpoles exposed to microplastics have a lower cluster rate than tadpoles that are not exposed to microplastics. The aim of this study was to test if exposure to lower concentrations of microplastics, likely more commonly found in aquatic habitats, also impact how tadpoles react to predators. We raised tadpoles in two groups: one group was exposed to a low concentration of microplastics in the water and the other was not exposed to microplastics. Tadpoles were then placed into an experimental tank. After the tadpoles habituated, a crayfish was added to the tank. Using a grid-style system, the cluster rate of the tadpoles will be measured. By comparing tadpole cluster rates, we will be able to better understand how differing concentrations of microplastics in the environment can impact predatory responses of tadpoles. This work can have implications on the conservation of tadpoles, as tadpoles may be more likely to succumb to predation if they do not display antipredator defense behaviors.

15.7 | Not So Straight Forward: Swimming, Turning, and Feeding of the Scalloped Hammerhead (Sphyrna lewini)

Marianne Porter, Ivan Heerdegen

455 Many studies on shark swimming have examined kinematic variables along straight tracks or under controlled flow speeds in flumes, but there is less known about unsteady swimming during maneuvering or feeding. Sharks may adjust their speed, undulatory kinematics, or body curvature to accommodate different actions. This study quantified variations in kinematics during straight swimming, maneuvering, and feeding in scalloped hammerhead sharks (*Sphyrna lewini*). We obtained video of three juvenile scalloped hammerheads, developed an ethogram assessing three behavioral categories, and tracked points along the body's midline. We found that velocity was lower during feeding compared to maneuvering and straight swimming, while body curvature increased during feeding turns but decreased with increasing velocity. These data will provide insight into kinematic variations in hammerhead sharks across ontogeny and among behaviors, ultimately expanding on the relationship between form and function. This also provides context for varying behaviors and trends within the movement ecology paradigm.

25.6 | Gamete-based Linkage Mapping for the Sand Tiger Shark, Carcharias taurus.

David Portnoy, Dominic Swift, Christopher Hollenbeck, Wyffels Jennifer, Kady Lyons

251 High-density linkage maps serve a variety of purposes, including linking phenotype to genotype, identifying quantitative trait loci, and aiding in the interpretation of population genomic results. For species with large and repetitive genomes, linkage maps are also a valuable tool for guiding genome assembly. Traditionally, the construction of linkage maps has required detailed pedigree information or the ability to collect many offspring from planned crosses, something that would not be possible for chondrichthyans which are long-lived and feature low fecundity. However, advances in sequencing technology have made it possible to genotype single cells at many thousands of loci, making it possible to generate linkage maps from haploid gametes. Here, we present preliminary results of a project to develop a linkage map for the sand tiger shark, *Carcharias taurus*, using sperm cells. The linkage map will be used to facilitate genome assembly and interpret population genomic data, as well as to characterize the relationship between recombination rate and physical distance across the genome, which has not yet been done for any chondrichthyan species.

13.6 | 2024 Unusual Sawfish Mortality Event in the Florida Keys: What Have We Learned?

Gregg Poulakis, Andrew Wooley, Lukas Heath, Dylan Yakich, Jose Castro, Jennifer Wyffels

334 On 30 January 2024, the U.S. Sawfish Recovery Hotline received the first report of what became an Unusual Sawfish Mortality Event in the lower Florida Keys. In late 2023, reports began of many types of fish exhibiting unusual,

"whirling" swimming behaviors. As of early March 2024, many individuals and over 30 fish species were affected. Most individuals and most species recovered; however, many endangered smalltooth sawfish, *Pristis pectinata*, did not. As of the 2024 ASIH abstract due date (5 March), few details were available, but if available in the time leading up to the ASIH meeting, details will be shared during the presentation. Since most of the sawfish carcasses were in relatively fresh condition, we tried to take as many biological samples as possible, whether they were related to determining the cause of the event or not. What we learned from those samples will be shared during the presentation also.

14.3 | The Impressive Mouth Opening Morphology of the Pelican Flounders (Pleuronectiformes: Bothidae: Chascanopsetta)

Paulo Presti, G. David Johnson, Alessio Datovo

93 Pleuronectiformes present one of the most intriguing morphological modifications of vertebrates: the migration of one eye towards the opposite side of the head. Previous morphological studies on flatfishes have focused on their cranial skeleton, poorly exploring other informational systems. Our study describes the remarkable mouth opening of representatives of *Chascanopsetta* (Bothidae) and discusses distinct characteristics of the gill arch functionality in Pleuronectiformes. *Chascanopsetta* has one of the most extreme mouth opening among flatfishes. This genus has a well-developed gular membrane and several muscular modifications that allow them to eat larger preys in comparison to a same size flatfish. The adductor mandibulae is shifted, where the insertion is posterior to the origin, a common condition of large swallows. The bones from the hyopalatine arch and the opercular series are spaced to one another, giving the suspensorium a high malleability. The upper pharyngeal tooth plate is medially positioned indicating that these fishes have a considerable degree of lateral mastication with the gill arches. The gill arches can move drastically in the dorso-ventral axis by the joint action of retractor dorsalis and pharyngoclavicularis externus, pulling the gill elements up and down, respectively. Both of these muscles are really long and retractor dorsalis assumes a vertical orientation, thus being directly opposed to pharyngoclavicularis externus. Once in the stomach, a large swallowed prey is accommodated by the greatly capacity of stretching of the stomach. This gut distension is facilitated by the stripped hypaxialis inferioris muscle, giving enough space in between fibers for this expansion.

3.1 | Navigating Changing Environmental Contexts: Flood-pulse Inundation Mediates Collective Behaviors of Schooling Fishes

Adam Quade, Guillaume Rieucou

298 Predation is often considered to be the primary driving force behind the formation of fish schools. Schooling generally improves safety through the actions of several anti-predatory mechanisms such as collective predator detection, risk dilution, or confusion effect. Observed variations in collective behaviors influenced by environmental context, predation risk, and anthropogenic disturbances suggests fish schools exhibit a high-degree of behavioral and structural plasticity. Thus, in complex and highly aquatic dynamic systems such as floodplains, it is important to assess how schooling fish assess and respond to the rapid and unpredictable variation in environmental conditions (e.g., pulse of floodwater) they are exposed to. Combining non-invasive high-resolution imaging-sonar technology and semi-automated tracking technology, we quantified how floodplain-associated schooling fish adjust their schooling tendencies and school topology (school area, polarization and inter-individual distances) across a latitudinal gradient of hydrologic connectivity in the Mississippi floodplain. 56 hours of high-resolution video data has been recorded with 6,307 schools documented. We found that fish formed denser schools when floodplain habitats were connected to the main-stem river, suggesting schooling fish may perceive these habitats as high-risk. Our preliminary results indicate that the degree of floodplain connectivity, mediated by the inundation level and distance from the river, strongly affects school topology even under limited predation pressure.

15.11 | Microbiome Analysis of Three Migratory Shark Species off the Southeastern US

Anna Quintrell, Heather Fullerton, Bryan Frazier

375 The bacteria living in and on an organism are essential for development, immunity, and nutrition; yet, this has been studied sparingly in most fishes, particularly sharks. The importance of understanding the microbiome of sharks applies not only to the health of an individual but also to the quality of the surrounding marine environment in which they exist. This interest has increased given the biological and ecological significance of these species. The primary aim of our study was to characterize the bacterial communities in the mouth, gills, epidermal tissue, and cloaca of three shark species: bonnethead (*Sphyrna tiburo*), blacknose shark (*Carcharhinus acronotus*), and finetooth shark (*Carcharhinus isodon*). Sharks exhibited species-specific microbial communities distinct from the surrounding water, predominantly composed of Gammaproteobacteria, Alphaproteobacteria, Cyanophyceae, Bacteroidia, and Verrucomicrobiae. Finetooth sharks displayed the greatest microbial diversity and had a higher abundance of Actinobacteria, Acidimicrobia, Desulfobacteria, Desulfobulbia, and Planctomycetes.

Bonnetheads exhibited the lowest diversity, suggesting variations in ecological niches and community structures. Dermal tissue supported the most diverse communities, whereas the cloaca displayed the least, indicating differences in ecological niches and community structures both between species and across various anatomical locations. Moreover, the microbial community of the cloaca was distinct from other anatomical sites. Understanding bacterial communities across the shark microbiome is crucial for predicting responses to a changing ocean and managing healthy populations in captivity. This study establishes a foundation for future research into shark health.

P1.51 | The Molecular Evolution of Vision across the Marine to Freshwater Transition in Potamotrygonidae

Anthony Rajkumar, Clare Gillis, Belinda Chang, Nathan Lovejoy

289 Vision is a crucial sense for many organisms, enabling behaviours such as predator detection, foraging and seeking a mate. However, it is heavily influenced by the spectral environment of the organism. Visual transduction, the process which allows organisms to sense environmental light, may differ based on the prevailing light conditions in an organism's environment. Organisms which have undergone ancient transitions between different spectral environments provide a key opportunity to study the influence of environment on visual evolution. Potamotrygonidae is a family containing all of the obligate freshwater South American stingrays, which transitioned from a marine to freshwater environment during the Miocene period. As freshwater environments tend to be shifted towards red wavelengths of light compared to more blue-shifted marine habitats, adaptation to this new spectral environment is expected in the visual system. However, studies of the molecular evolution of vision are lacking for this clade, likely because of a rarity of genomic resources. To address this gap, we sequenced genomes of four potamotrygonid rays and recovered vision-related gene sequences using a custom bioinformatics pipeline. Using these and other publicly available elasmobranch sequences, we estimated patterns of selection across the marine to freshwater transition. Our preliminary analyses provide no evidence for shifts in selection. This indicates that molecular evolution may not be a significant factor in visual adaptation across the marine to freshwater habitat transition for our dataset, and alternative mechanisms may be employed.

P2.48 | Sexual dimorphic effects of a keystone predator on prey communities

Maxwell Ramey, Alan Babineau, Reese Sloan, Autumn Groesbeck, Ali Montazeri, Jon Davenport

324 The importance of trait variation has long been recognized in ecological and evolutionary research. One form of intraspecific trait variation, sexual dimorphism, has potential ecological effects between trophic levels in food webs. The divergence of sexually dimorphic traits (e.g., body size, morphology, behavior) is primarily attributed to sexual selection but variability can have consequences for diets and habitat use. Recent evidence for one aquatic predator species (adult newts; *Notophthalmus viridescens*)

suggests that trait differences and habitat partitioning between the sexes may be important in structuring zooplankton communities. However, most experimental data on newts as predators focuses on adult male newts and how they increase amphibian diversity within pond communities via keystone predation. Therefore, we conducted a series of mesocosm experiments in 2021 (with spotted salamander larvae) and 2022 (with wood frog tadpoles) to determine the effects of sexual dimorphism of adult newts on larval amphibian communities. We hypothesized that male and female newts would have differing effects on prey communities. We found that female newts significantly consumed more amphibian prey than male newts and no newt treatments. Size at metamorphosis was greater in the presence of newts (either male or female) in comparison to no newt treatments. Our findings indicate that sexual dimorphism within a known keystone predator can have differential effects on prey. Indeed, our results indicate that while the effects of predators on one response (survival) can differ within sexes, the ultimate impacts on another response (prey fitness; measured as size at metamorphosis) are the same.

31.6 | Status, Habitat Threats and Conservation Challenges to Freshwater Turtles in National Chambal Sanctuary, Madhya Pradesh, India

R Rao

475 The Chambal River in India supports seven species of freshwater turtles. The National Chambal Sanctuary is an intensively used river ecosystem and landscape with high levels of human poverty. Threats to the continued functioning of the Chambal River have reached a critical level due to the exponential expansion of human populations. Ground truth data were collected in more than 500 check points which were selected on the basis of habitats like sand banks, rocky banks, hard-soil banks, mid-river rocky and sand islands, and different activities like agriculture, sand mining, and human habitation. The geographic coordinates of these points were noted from the Google Earth map and checked in the field with Garmin GPS 76. Data collected from the check points were used for assessment of habitat features and various developmental activities. Multi-temporal satellite images were used to develop land cover maps of the Chambal River and its catchment area. The species inhabited in the Chambal River are under threat due to a wide range of human disturbances like modification of river flows, modification of nutrient and sediment fluxes and degradation of habitat due to barrage and dam construction, pollution from point and non-point sources, poaching and overexploitation of fish resources. Status of fresh water turtles and potential threats to their habitat are discussed.

26.7 | Biofluorescent cutaneous glands are sexually dimorphic in desmognathine salamanders

Taylor Reitz, Ebony Saccento, Michael Kardos, Sarah Woodley

292 Biofluorescence occurs when organisms absorb light at one wavelength and emit it at another. Biofluorescence is widespread in animals and has recently been discovered in cutaneous glands of salamanders. For example, in Red-backed salamanders (*Plethodon cinereus*), males exhibit a higher density of biofluorescent glands on their ventral tail than females, suggesting a function in social interactions related to reproduction. To determine if male-biased sex differences in biofluorescent glands are widespread among salamanders, we evaluated sex differences in density and locations of biofluorescent glands in three species of salamanders in the *Desmognathus* genus. Salamanders were anesthetized and biofluorescence was observed under a fluorescent microscope (excitation of 480 nm; emission 535 nm). The density of biofluorescent glands on several body areas was measured using Image J. Contrary to expectation, females in all 3 species had a significantly greater density of biofluorescent glands compared to males throughout the body, including the ventral and dorsal tail, and the ventral head. Overall, we conclude that patterns of biofluorescent glands vary among plethodontid salamanders. Future research will seek to determine the function of the biofluorescent glands to better understand sex differences.

28.4 | The Early Evolution of Lateral Line Canals in Extant Ray-Finned Fishes, with a New Terminology and Nomenclature

Pedro Rizzato, Flávio Bockmann

236 The mechanosensory lateral-line system (LL) is incredibly diverse among ray-finned fishes, being commonly used as a source of characters in taxonomy. However, the lack of a standardized terminology and nomenclature, especially for the canals and their portions, hampered broader uses of the LL as a source of phylogenetic relevant characters for investigating the relationships between the major clades of Actinopterygii. We propose a new terminology and nomenclature for the LL canals of ray-finned fishes, and apply them to describe the canals of selected taxa representing the major clades of living Actinopterygii (Cladistii, Chondrostei, Holostei, Teleostei). The phylogenetically informative characters identified are mapped, using maximum parsimony optimization, on a cladogram expressing current hypotheses of relationships between basal actinopterygians. By using innervation to identify the LL canals in the head of ray-finned fishes, we were able to establish meaningful comparisons even among distantly-related taxa, and to identify phylogenetically informative characters for understanding the relationships between these taxa as well as the evolutionary history of the LL itself. The application of this terminology and nomenclature will help improve the study of the LL canals in fishes, including fossil lineages, and its use as a source of phylogenetically informative characters, in order to contribute for a better understanding of the evolutionary history of the mega-diverse ray-finned fishes.

P2.32 | The Osteology of *Stygichthys typhlops* (Teleostei: Otophysi, Characiformes), a Rare, Endemic, Enigmatic and Endangered Subterranean Characin from Brazil

Pedro Rizzato, Gabriel Gomes, Maria Bichuette, Murilo Pastana

331 *Stygichthys typhlops* is a blind and unpigmented stygobitic characin from Brazil discovered in 1962 during a well-drilling operation and described three years later by Brittan and Böhlke with basis on a single specimen. The species was rediscovered and redescribed almost a half-century later based on a larger number of specimens, and additional data on its external anatomy and natural history was provided. However, there is to date no detailed information on its internal anatomy, notably its skeleton, due in part to the limited number of specimens available for study. This information would be useful to investigate its phylogenetic placement within Characiformes, as well as to investigate additional morphological features associated with its subterranean habits. We describe for the first time in detail the osteology of *S. typhlops* with basis on cleared and double-stained specimens, and on 3D models generated from CT-data. We also provide information on its muscles, ligaments, nerves and lateral-line canals whenever relevant to understanding features of its skeleton. We identified characteristics putatively associated with its subterranean habits, such as reduction of lateral-line canals and their association to skull bones, which may result from developmental truncation. *Stygichthys typhlops* is the only exclusively subterranean characin besides *Astyanax mexicanus*, which is currently a model for investigating the evolution of life in subterranean habitats. Providing information on *S. typhlops* may contribute to its use as an additional model for investigating the evolution of subterranean organisms, as well as to the conservation of this enigmatic and endangered species.

14.2 | Edwards Plateau Anomaly: Morphology and Genetics of a Potentially Undescribed Catostomid, the Llano River Carpsucker (*Carpiodes* sp.) of Central Texas

Hayden Roberts, Preston Bean, Kevin Conway, Gary Voelker, Henry Bart, Joshua Perkin

380 In Texas, there is evidence of an undescribed species of carpsucker, the Llano River Carpsucker (*Carpiodes* sp. cf. *carpio*). Llano River Carpsucker (LRCS) are known to possess a more elongated body compared to sympatrically occurring River Carpsucker (RCS). Molecular relationships to valid species of *Carpiodes* are currently unknown. The objective of this study was to assess morphological and molecular variation among members of *Carpiodes* inhabiting central Texas river basins. Sampling resulted in whole body and tissue preservation of 260 specimens. Seventeen homologous landmarks

from photographed specimens were used to perform a morphological analysis. Specifically, a principal component analysis (PCA) was performed on the landmarks to determine body shape relationships across taxa. DNA from tissue samples were extracted and amplified using Polymerase Chain Reaction (PCR) protocols unique to the Mitochondrial Cytochrome b and Nuclear IRBP2 genes and sequenced. The aligned DNA sequences were used as input to determine genetic clusters for each gene using iterative K means clustering algorithms. A permutational multivariate analysis of variance (PERMANOVA) using morphological principal components from the PCA as response variables and genetic clusters as predictor variables was assessed. A significant relationship between genetic cluster and body shape was revealed, suggesting that morphological differences observed in *Carpododes* populations of central Texas have an underlying genetic signal. The analysis suggests populations of LRCS are genetically and morphologically different than RCS. This study has direct implications in determining the taxonomic status of LRCS and is crucial in providing information for the conservation and management of this putative species.

6.1 | Genome-Wide Insights into the Evolutionary History of *Girardinus* (Cyprinodontiformes: Poeciliidae)

Sheila Rodríguez, Diego Elías, Prosanta Chakrabarty

250 *Girardinus* is a poeciliid genus endemic to Cuba with seven species. The lineage includes species restricted to highland ecosystems and others that are widespread in lowlands distributed across the island. Although *Girardinus* has been recovered as monophyletic in past analyses, there is no agreement regarding its origins. Early morphological hypotheses suggest a Middle American origin; however, DNA-based support has been lacking. Here, we examine the phylogenetic relationships, biogeography, and diversification histories of *Girardinus* using target capture methods. We present the first phylogenomic hypothesis of *Girardinus* based on genome-scale data (990 UCE loci, 100% complete data matrix). Our coalescence-based phylogenetic hypothesis aligns with previous ones based on mitochondrial and nuclear markers, and all clades received high support. The only exception was the position of *G. creolus*, for which we inferred two equally likely placements. We also found evidence for reticulate evolution playing an important role in the evolutionary history of the genus. According to our ancestral state estimation analyses, *Girardinus* seems to have closer relationships with South American poeciliids. Overall, our phylogenomic analysis sheds new light on the evolutionary history of the genus *Girardinus*, revealing insights into its phylogenetic relationships, origin, and diversification.

23.3 | Combining Data Sources in Capture-Recapture Models for Greater Insight into Species Demography

Jonathan Rose, Brian Halstead

20 Capture-recapture models have been used for decades to study the demographics of wildlife populations. These models often focus on estimating survival and how this vital rate varies over time, and among individuals and populations. When researchers capture animals, they can collect a wealth of data on individual morphology, health, reproductive status, and genotype. Such data has been used to model the growth and fecundity of animals, usually in analyses that are not directly connected. Although each of these data sources has value in isolation, much more can be learned by analyzing them jointly in an integrated model. Integrating growth into capture-recapture models enables the use of individual size as time-varying covariate on survival, even for animals that are not recaptured and measured repeatedly. I will present examples of integrating growth and survival models for gartersnakes (*Thamnophis*) using Bayesian hierarchical models that propagate uncertainty in snake size to estimates of size-dependent capture probability and survival. Integrated growth and survival models can also identify senescence in wild populations of long-lived reptiles. These models are particularly valuable for rare or elusive species with low recapture rates. I will discuss how to leverage existing datasets to acquire more information about species' demography and how to tweak existing studies to collect data suited to integrated models. Integrating multiple data types in capture-recapture models has tremendous

potential for gaining new insights into the ecology of reptiles and amphibians, and will increasingly become the standard for demographic studies of these taxa.

P1.55 | A New Species of Flathead (Platycephalidae: *Elates*) from the Philippines, with Notes on the Biology of the Genus

Ned S. Rose, Kevin L. Labrador, Maybelle A. Fortaleza, Joey P. Cabasan, Joemarie J. Lanutan, Cleto L. Nañola, Matthew G. Girard, Katherine E. Bemis

264 We describe a new species of flathead in the genus *Elates* (Platycephalidae) based on five specimens collected from fish markets in the southern Philippines. This species differs from the Dwarf Flathead (*Elates ransonnetii*) in having smaller scales, no postocular spine, larger eyes, reduced dorsal-fin pigment patches, and two dark saddles on the posterior half of the body. We sequenced and analyzed cytochrome oxidase subunit I to highlight genetic differences among flatheads and offer insight on the phylogenetic relationships of *Elates* and close relatives. We also comment on the life history and distribution of the genus.

P2.52 | Bromeligenous Amphibians in Suboptimal Habitats: A Case Study of *Phyllodytes gyrinaethes* and its Environmental Interactions

Gustavo Ruano Fajardo, Alessandro Catenazzi, Tamí Mott

437 Amphibians have developed a close relationship with bromeliad plants due to their moisture, prey availability, shelter capacity, and for being an effective reproductive site. This interaction has been so extreme that some species are fully dependent on this microhabitat, also known as bromeligenous species. The environmental change hypothesis states that species distribution could be associated with environmental features that change in different time periods. Amphibian selection of bromeliads in suboptimal conditions can have a high environmental component, possibly increasing disease risk. Amphibian presence in plants may be avoided when environmental factors hamper their moisture maintenance in suboptimal conditions. In contrast, moisture conditions may favor amphibian presence but also be associated with higher pathogen infection. *Phyllodytes gyrinaethes* is a bromeligenous treefrog endemic to the Atlantic rainforest and it was used as a species model to evaluate (1) whether *P. gyrinaethes* presence in bromeliads is associated with close canopy cover, (2) whether *P. gyrinaethes* presence in bromeliads is associated with rainy season in their suboptimal distribution, and (3) if *P. gyrinaethes* has a higher chytrid fungus infection in suboptimal microhabitats share with other amphibian species. We sampled 131 bromeliads for *P. gyrinaethes* presence. The presence of *P. gyrinaethes* is associated with the rainy season, higher Ph, and bromeliad with more leaves. There is difference in chytrid fungus disease infection loads during season in bromeliads suboptimal conditions for *Phyllodytes* species. Moreover, disease infection loads of *P. gyrinaethes* in forest canopy differ from *Phyllodytes* species in non-overlapping habitats in the rainy season.

P1.63 | Measuring Performance to Investigate Suction-Biting Tradeoff in Cichlidae

Khalil Russell, Peter Wainwright

443 Tradeoffs between phenotypes with mutually exclusive biological demands are widespread across biological systems. One such tradeoff is thought to exist in the oral jaws of teleosts, where increased biting performance necessitates a relative loss in suction performance, and vice versa. This tradeoff hypothesis is based on a model of teleost oral jaws as a set of levers, wherein the mechanical advantage tradeoff inherent to lever systems would be reflected in the oral jaws. The heroine cichlids, a Mesoamerican lineage of freshwater teleosts, contain multiple transitions between biting- and suction-dominant feeding modes. As such, they are an ideal system to test for this widely expected tradeoff in teleosts. In this study, I will experimentally measure bite- and suction-feeding performance, as well as collect morphological data, across neotropical cichlids which are ecologically specialized in either biting- or suction-dominant feeding. I aim to investigate the relationship between

trophic ecology, oral jaw morphology, and performance across two major trophic strategies (suction and biting) in neotropical heroine cichlids, focusing on whether there is a trade-off between biting and suction performance.

P2.12 | Ecomorphology and Mitochondrial D-Loop Sequencing of Sculpin (*Cottus* sp.) at Tytoona Cave

Travis Russell, Katherine Golden, Justin Wright, Thomas Firreno Jr, Christopher Grant, Vincent Buonaccorsi, Regina Lamendella

412 Cave-adapted fish are often noted for their constructive and regressive morphological differences to surface counterparts. Tytoona Cave in northeastern North America represents a relatively recent (~12 ka) cave environment in which subtle changes in sculpin (*Cottus* sp.) genetic structure and morphology may be present. We collected sculpin from the interior and exterior of Tytoona Cave (Blair Co., Pennsylvania). We sequenced the mitochondrial d-loop and collected morphological data from all specimens to assess potential genetic divergence and adaptive differences between collection locations and broader populations of *Cottus* in PA. Sculpin captured on the exterior of the cave were significantly larger when compared to interior sculpin. Our genetic analyses revealed little to no divergence between interior and exterior sculpin, but that the Tytoona Cave populations are closely related to those of other *Cottus* species from other PA cave systems.

P2.3 | Description of a spadefish (*Acanthomorpha*: Ehippidae) from Pakistan and its implications for marine fish biogeography in the Paleogene

Hadeel Saad, Matt Friedman

397 Ehippidae (spadefishes) is a clade of marine fishes containing 15 extant species divided among 8 genera. Found on coral reefs and in open waters worldwide, ehippids are laterally compressed fishes with small, non-protrusive mouths and often bear striking, dark vertical bars of pigmentation on their flanks. Articulated remains of putative ehippids derive almost exclusively from the early Eocene (Ypresian, ca. 49 Ma) deposits of Bolca, Italy, and include two extinct genera: *Eoplatax* and *Archaehippus*. Today the greatest diversity of extant spadefish species is in the Indo-West Pacific, yet there are no known fossil ehippid remains from this region. Here we report the first fossil spadefish from the Indo-Pacific, from the middle Eocene (Lutetian, ca. 47 Ma) Habib Rahi Formation of western Pakistan. Preserved as an impression on a limestone slab, this single articulated individual does not preserve definitive synapomorphies of ehippids, such as the branchial skeleton, dentition, and pelvic girdle. However, intact portions of the skeleton correspond closely to the anatomy of *Eoplatax* from Bolca. Major similarities include a nearly circular body, greatly elongated dorsal- and anal-fin rays, and a very deep caudal peduncle. The discovery of an *Eoplatax*-like fossil in the middle Eocene of Pakistan could have important implications for marine fish biogeography in the Paleogene. At this time, Indo-Pakistan is thought to have been outside the margins of an ancient biodiversity hotspot centered in the West Tethys. The presence of similar faunal elements in the ancient Indo-Pacific can help to constrain models of shifting biodiversity hotspots during the Cenozoic. Such hotspot migration is supported by fossil evidence as well as patterns of relationships among some extant groups. Integration of putative fossil ehippids, including the new form from Pakistan, into a phylogenetic framework with living examples will be critical for determining what—if any—bearing spadefishes might have on these broad biogeographic questions.

P2.66 | Anuran Calling in the Extreme Conditions of the High-Andes of Peru

Daniel Saenz, Kelsey Reider, Cory Adams, Lee Fitzgerald

182 As global temperatures continue to rise, some anuran species have expanded their ranges into habitats created by glacial recession. High-elevation wetlands in the Cordillera Vilcanota Mountain range of southern Peru, are among the highest known sites to be occupied by amphibians on Earth. In early December 2018 we initiated an autonomous audio sampling program to record two species of calling anurans at breeding sites, ranging in elevation from 4,882m to 5,362m. Our survey results indicate that marbled

four-eyed frogs (*Pleurodema marmoratum*) are present at all our survey sites, including possibly the highest recorded calling site of any anuran. Calling activity occurred almost exclusively after sunset and most of the calling occurred at air temperatures below freezing at the higher elevation sites, with the lowest recorded temperature of -6.2°C. Marbled water frogs (*Telmatobius marmoratus*) were recorded calling at only one intermediate-elevation site in our study and they showed a similar pattern as *P. marmoratum* by calling exclusively after sunset and mostly when air temperatures were below 0°C. Though results are preliminary, clear patterns of seasonal calling activity are emerging. It is also evident that these two high-elevation species are actively calling at extremely low air temperatures. As more data become available, we will explore interactions among temperature and hydrology with breeding activity of the advancing anuran species.

10.5 | Determining Genetic Composition of Atlantic Striped Bass within Four Rivers of Chesapeake Bay

Amanda Salmoiraghi, Robert Latour, Jan McDowell

315 Striped Bass, *Morone saxatilis*, is a coastal anadromous fish that is important for both commercial and recreational fisheries throughout eastern North America. Striped bass within Chesapeake Bay are managed as a single genetic stock; however, recent studies have suggested that there may be genetic differentiation among river systems. As an important fisheries stock with a long history of exploitation, policies that properly address potentially distinct populations within the Chesapeake Bay could lead to more effective management practices. This project will use genetic markers to determine if adult striped bass collected from the Rappahannock, James, Potomac, and Susquehanna rivers comprise multiple genetic stocks within Chesapeake Bay. In 2023, a total of 1,470 samples were collected and a subsample of 60 adult fish per river were selected for analysis. DNA will be sequenced, and data will be added to a larger database of fish collected from a wide geographic range to select a panel of single nucleotide polymorphisms (SNPs) that can be used to estimate the number of genetically distinct populations within Chesapeake Bay. If adequate genetic differentiation is found, it may warrant splitting of the single Chesapeake Bay stock into smaller groups to be better managed based on individual needs.

12.5 | Lost specimens and old documents: how a forgotten herpetological collection can contribute to modern herpetology

Bruna Santos, Mariana Marques, Luis Ceriaco

148 Francisco Newton (1864–1909) was an important Portuguese naturalist of the late nineteenth and early twentieth century, renowned for his zoological expeditions that contributed to the study of former Portuguese overseas territories. For more than 25 years, Newton surveyed Angola, São Tomé and Príncipe, Guinea-Bissau, Cape Verde, Benin, Equatorial Guinea and East Timor. Newton's herpetological collections were of special relevance to the study of African herpetology and his specimens were used in the description of over 20 species, more than half of which are still valid today. Specimens collected by Newton continue being used as type material for new species, as the case of the recently described Angolan endemic, *Phrynomantis newtoni*, in 2021. Newton is also celebrated in more than a handful of herpetological eponyms. Most of Newton's specimens were lost in the tragic fire that destroyed the Museu Bocage (Lisbon) in 1978, but some of his specimens, including type material, are still extant today and can be an important resource in the resolution of longstanding taxonomic questions. Using an interdisciplinary approach, we retrieved, compiled, and updated data from different sources, ranging from historic archival material such as field letters and shipment lists to extant specimens and bibliography. Using Newton's herpetological specimens, both extant and those that were lost, we explore how these different types of data play a critical role in present day herpetological research, and how historical data can be retrieved even after the physical specimens are lost.

36.2 | Use of Coelomic Fluid as a Noninvasive Indicator of Reproductive Status in Elasmobranchs

Emily Sapp, Jim Gelsleichter

19 Information on reproduction in elasmobranchs is important for the management and conservation of populations. There has been progress in the field of elasmobranch reproduction; however, our ability to obtain reliable data without animal euthanasia is still extremely limited. Therefore, there has been a call for nonlethal approaches for identifying reproductive status, such as ultrasonography and blood analyses. Although useful, these techniques can be limited with respect to access to equipment and reliability of blood analyses. This study will investigate whether a new noninvasive approach, examination of coelomic fluid (CF), can provide a reliable indicator of reproductive status. CF is fluid that bathes the internal organs of the abdominal cavity, including ovaries, and can be sampled noninvasively through catheter. Recent studies on CF have demonstrated the presence of yolk platelets in the fluid, a specific indicator of follicular development. This suggests that CF may provide a more detailed representation of reproductive state, than other nonlethal approaches, such as plasma hormone levels. Therefore, we examined CF collected from Atlantic stingrays (*Hypanus sabinus*) and bonnethead sharks (*Sphyrna tiburo*) which serve as model elasmobranchs for this work due to their well-described pattern of reproduction, abundance, and easily accessible coelomic pores. In this presentation, we report on the differences in gonadal steroid hormone concentrations and protein content in CF in relation to reproductive stage, as well as variations in gonadal steroid concentrations in CF and those in plasma.

P2.62 | Determining dietary niche overlap of two woodland salamanders using stable isotopes in Great Smoky Mountains National Park

Bailey Sauls, Jon Davenport, Benjamin Fitzpatrick

242 Plethodon salamanders have been identified as ideal model organisms for ecological and evolutionary research. These amphibians are typically abundant where found and play vital roles in their ecosystems. Southern Zigzag salamanders, *Plethodon ventralis*, and Southern Redback salamanders, *Plethodon serratus*, are two small-bodied woodland salamanders that potentially overlap in the Great Smoky Mountains National Park and the surrounding area. These two species are ecologically similar but research is lacking to explain how they coexist. Resource partitioning is often thought to contribute to species coexistence. Sympatric and allopatric populations of the two salamander species will be studied to determine if niche overlap exists in isotopic diet. Tail tissues approximately 5mm in length were collected and processed for stable isotope analysis since previous work showed ample information can be gathered from these tissues rather than sacrificing the animal. Sympatric and allopatric populations were sampled to determine isotopic diet of individuals from eighteen sites. Based on preliminary results, it appears there is overlap in the dietary niche space of *P. ventralis* and *P. serratus*. Environmental parameters may play a bigger role in the coexistence of the two woodland salamanders in question. This research will expand our understanding on what factors may enable coexistence of ecologically similar species.

11.12 | Snake Captures Decline as a Function of Trap Age

Christopher Schalk, Reuber Antoniazzi, Josh Pierce, D. Craig Rudolph

27 Demographic and diversity studies rely on sampling techniques that produce representative samples from populations and communities. Snakes, with their cryptic behaviors and prolonged periods of inactivity, make population and community assessments particularly challenging. In terrestrial ecosystems, box traps paired with drift fences have been used widely to survey for large-bodied snakes. However, there has been anecdotal evidence that suggests snakes become trap shy over time, reducing capture rates. Utilizing a long-term trapping dataset of snake captures throughout forests in east Texas and western Louisiana, we sought to determine if snake capture rate declined as a function of trap age (i.e., time it was installed on the landscape). Total snake captures declined across time when comparing the first year of trapping to subsequent years ($n = 43$ traps). These results suggest that

to maximize capture success, long-term monitoring programs should attempt to move box traps to from year-to-year as they will provide better assessment on the structure of populations and communities of this taxon group in their habitats.

P2.45 | Survival Patterns of Repatriated and Wild Alligator Snapping Turtles

Christopher Schalk, Connor Adams, Jessica Glasscock

31 The alligator snapping turtle (*Macrochelys temminckii*) is the largest freshwater turtle in North America. As such, *M. temminckii* are sought after for human consumption and are vulnerable to overharvest or bycatch. Despite having protection from harvest in Texas since the 1980s, *M. temminckii* are still harvested illegally for food and novelty products. Given their life history, such threats may exacerbate declines in local populations. Therefore, efforts that can bolster wild populations are of importance to *M. temminckii* conservation. In June 2021, 8M. *temminckii* confiscated by federal agents were released at the Angelina/Neches Dam B WMA. Using survival as a metric to evaluate repatriation efforts, we monitored these previously released repatriated turtles alongside 10 wild turtles. We estimated survival probabilities using Hidden Markov Models (HMM) to account for inconsistencies in radiotelemetry data, and to assess how certain covariates (e.g., home range, movement, habitat use) may impact survival. Overall, repatriated *M. temminckii* had significantly lower survival than wild *M. temminckii*. Movement distance between relocations and time of year had a significant influence on repatriated turtle survival. Some reductions in survival probability were likely linked to sex-specific differences in behavior; however, wild *M. temminckii* had high survival regardless of sex. These results highlight how long-term studies are often difficult, but necessary to assess survival in long-lived species. Understanding factors that influence *M. temminckii* survival can inform future conservation efforts, and are especially valuable to translocation efforts attempting to bolster wild populations.

33.5 | Revelations and Revisions: 10+ Years of The ETYFish Project

Christopher Scharpf

129 Since 2013, The ETYFish Project (etyfish.org) has researched and recorded the meanings behind the genus- and species-level names of Recent fishes. Right now, over 43,000 etymologies are available, plus over 550 short explanatory essays. Since its inception, The ETYFish Project has revealed the true and sometimes surprising meanings behind dozens of enigmatic or poorly known epithets. For example, the specific name of the Yellow Bullhead *Ameiurus natalis* does not mean “nates or buttocks” as reported in many references. It means “Christmas.” (We’ll explain why.) In addition, The ETYFish Project has uncovered several nomenclatural errors that have necessitated revisions to either the name of a fish, or to the authority to which the name dates. In short, The ETYFish Project explores and celebrates the diversity of fishes through the diversity of their names.

19.4 | Accounting for heterogeneous effort and misclassification when modeling iNaturalist data

C. Scher, Riley Mummah, Evan Grant, David Miller

87 Information from participatory datasets like iNaturalist can inform integrated Species Distribution Models, but patterns are obscured by a complex and heterogeneous observation process. The iNaturalist database contains presences that were recorded inconsistently across time and space with no standardized protocol. The resulting heterogeneity in sampling effort makes interpreting iNaturalist data difficult. iNaturalist data is further complicated by misclassification of records due to observation error, spatial uncertainty, and other factors. We examine three methods intended to account for heterogeneous effort and misclassification and compare their effects on model performance with iNaturalist records for a variety of amphibian species. These methods include (1) filtering criteria that reduce spatial imbalance and spatial uncertainty, (2) using effort covariates that capture heterogeneous sampling effort, and (3) including model features that account for misclassification.

Preliminary results indicate that the best-fit model uses the number of iNaturalist records of similar, co-occurring species as a covariate in the observation model and restricts effort to a probability rather than a scalar. Filtering to reduce spatial imbalance and spatial uncertainty produces the best model for prediction. However, the covariates and model structure that are best for prediction vary across species. After identifying the optimal observation model for iNaturalist data, we demonstrate its use in an integrated model of Spring Salamander (*Gyrinophilus porphyriticus*) distribution.

4.1 | Beyond Thermoregulation: UV & Temperature Regulation by Tree Lizards along an Ecological Gradient

Andreanna Schultz, Matthew Lattanzio

202 Historically the maintenance of physiological homeostasis in ectotherms via basking and shuttling behavior has been understood through the lens of body temperature regulation alone. However, lizards also behaviorally regulate their exposure to ultraviolet (UV) light crucial for organ function and bone development, among others. While lizards may be able to sustain preferred body temperatures in the shade, exposure to direct sunlight is necessary to manage their UV needs. This disparity, coupled with evidence that lizards may even prioritize UV over temperature needs, supports the hypothesis that trade-offs in terms of their effectiveness at regulating both conditions should occur across distinct microhabitats as well as ecological gradients. We combine field surveys and laboratory behavioral data to address this hypothesis using adult tree lizards (*Urosaurus ornatus*) captured along an elevation gradient in south-eastern Arizona. Based on prior work, we predict that the ability of *U. ornatus* to regulate its body temperature effectively will increase with elevation, but their UV regulation effectiveness will be more strongly impacted by microhabitat use. Our findings largely aligned to these predictions, but microhabitat use also partly influenced temperature regulation. Perch type occupied by lizards had the largest influence on which condition was better regulated at a given locality, regardless of elevation. Additionally, temperature was better regulated across localities, but the degree of trade-offs with their UV regulation ability varied. Thus, ecological factors long assumed to influence homeostasis mainly via thermoregulatory constraints may actually have stronger fitness implications for a species' ability to regulate its UV effectively.

P1.17 | Examining the nurse shark's (*Ginglymostoma cirratum*) mating system, dispersal, and response to climate change using next generation sequencing and immunogenetics.

Naomi Scott, Harold Pratt, Edward Hesit, Nick Whitney, Toby Daly-Engel

410 Elasmobranchs (sharks and rays) are large-bodied fishes whose slow growth and low fecundity make them vulnerable to extinction. Because so many elasmobranch species are depleted and in decline, it is increasingly important to understand reproductive behavior and movement patterns in order to create effective management. The nurse shark (*Ginglymostoma cirratum*) has long been a model organism for the study of shark reproductive behavior, as both males and females are known to show strong site fidelity to sites in the northwest Atlantic. Though some behaviors like mating are well-documented, little is known about most other aspects of reproductive behavior and dispersal. This study will compare patterns of diversity between two types of DNA: neutral genome-wide single nucleotide polymorphisms (SNPs), and functional Major Histocompatibility Complex (MHC) immune system genes that are subject to selection from the environment. Because MHC genes are hypervariable (with >1,000 alleles in humans) and often used as a basis for female mate choice, these loci will help shed light on the genetic mating system, patterns of dispersal, habitat use, and potential response to climate change in nurse sharks. For this project, we will use tissue samples taken from animals in the Dry Tortugas over several decades, as well as from contemporary sites in the Gulf of Mexico, US Atlantic Coast, and elsewhere in the Caribbean. Taken together, the results of this study will better elucidate patterns of dispersal in nurse sharks and help managers to devise accurate conservation units to protect populations at risk from climate change.

P1.98 | The Long-Term Effects of Thermal Developmental Plasticity on the Endangered Streamside Salamander (*Ambystoma barbouri*)

Cindy Scruggs, Aileen Granados, Julia Thulander, Joshua Hall

314 Embryos of vertebrate ectotherms are particularly vulnerable to changes in temperature because they have little ability to thermoregulate. Although much research demonstrates embryonic temperature can alter fitness-relevant phenotypes via developmental plasticity, little research has considered the long-term effects of developmental temperature on ectotherms. The streamside salamander (*Ambystoma barbouri*) is an endangered species that oviposits in shallow, ephemeral streams which are subject to thermal variation over time. The purpose of this study was to determine the long-term effects of developmental temperature during embryogenesis on adult fitness-relevant traits. Eggs were collected from streams of natural populations, incubated at naturally occurring temperatures (5°C, 10°C, and 20°C), and resultant metamorphs are currently being raised into adulthood to assess temperature effects on morphology (body size, head size, body mass), performance (speed and endurance), and physiological (growth rate) traits. We present preliminary results for morphology at 6- and 12-months post-metamorphosis and discuss our future endeavors to assess how interactions between incubation temperature and environmental temperature shape salamander performance traits. With these results, we aim to assess the potential for incubation temperature to influence fitness of the streamside salamander via lasting impacts on phenotypes.

P1.40 | Quantifying the Vulnerability of Winter Skate and Smooth Dogfish to Offshore Wind Electromagnetic Fields

Rachel Sechrist, Tobey Curtis, Kevin Friedland, Paul Bologna

115 Offshore wind development in the northeastern U.S. shelf will contribute to renewable energy goals but will also overlap with numerous marine species and economically important fisheries. High voltage transmission cables from offshore wind farms emit electromagnetic fields (EMFs) that all elasmobranchs can detect using sensory organs known as ampullae of Lorenzini. However, sensitivity to EMFs varies by species due to differences in the number and arrangement of pores and subdermal canals within the ampullae of Lorenzini sensory network. This study aims to quantify the vulnerability of two economically important elasmobranch species, winter skate (*Leucoraja ocellata*) and smooth dogfish (*Mustelus canis*), as a function of spatial exposure to the cables and physiological sensitivity to electromagnetic fields. Using GIS, cable routes from offshore wind farms were overlaid with winter skate and smooth dogfish distributions to quantify overlap area with each offshore wind project in the region. Offshore wind cable placement off the coasts of New York, Rhode Island, and Massachusetts are within regions of high biomass. Additionally, the first ampullary pore maps for both species were constructed in order to better understand their potential sensitivity to EMFs. Understanding variation in the biology of electroreception across elasmobranchs is important when considering that anthropogenic changes to the marine environment could impact their foraging, mating, and migration abilities.

P2.59 | Evolution of Vitellogenin Proteins in Sauropsids

Kyle Selcer

239 The egg-yolk precursor protein vitellogenin (VTG) can be a useful model for studying evolutionary processes due to its crucial role in provisioning embryos of oviparous animals with energy and nutrients. This presentation provides an analysis of VTG proteins of sauropsids, using data from existing genome sequences of various species of turtles, squamates, crocodylians and birds. Three distinct VTGs were identified in all major groups. For each group, VTG2 and VTG3 were more closely related to each other, consistent with the assertion that they are recent paralogs. All three VTGs showed considerable variation in amino acid number within and between groups. Five VTG regions were recognized: a signal peptide, lipovitellin heavy chain (LVH), phosvitin (PV), lipovitellin light chain (LVL), a B' region and a C-T region. These regions varied in amino acid number within and among groups, particularly the PV region, which was responsible for most of the size differences between VTGs. PV has a high percentage of serine residues and this region was determined

to be highly disorganized. The PV region may be involved in binding calcium ions; therefore, the number of serine residues might be more important than the exact amino acid sequence. Other differences among VTGs of sauropsids included shorter LVL, PV and CT regions in squamates, possibly related to the evolution of viviparity in this group. These results show that VTG is highly variable between and within taxonomic groups, presumably due to differences in the energetic and nutritional needs of the various sauropsid species.

P1.91 | Urban Forests: Unsafe Refuge for Puerto Rican Herpetofauna

Eva Serrano, Amanda Maldonado, Starling Brown, Julia Martinez, Adolfo Rodríguez-Velázquez

408 Urban forests provide diverse ecosystem services. One of the most important is serves as a refuge for native, endemic, and migratory wildlife. These spaces may be vulnerable to the presence of invasive species. The risk could increase in tropical places with high anthropogenic activity, such as Puerto Rico. Our study focused on identifying invasive vertebrates in the Julio Enrique Monagas National Park. Despite being an urban forest, it has a great diversity of amphibians and reptiles. It is one of the few places in the metropolitan area with a stable population of Puerto Rican boa (*Chilabothrus inornatus*). These species are the ones that could be most affected by an increase in the presence of invasive predators. In a gradient of anthropogenic activity, within the forest, we established a transect with ten camera traps. Each camera had a lure to attract the animals. We identified thirteen vertebrate species, eight of which were invasive. Rodents (*Rattus* spp. and *Mus musculus*) had a greater presence in the forest with 95 individuals detected, followed by cats (*Felis catus*) with 59 individuals and 41 mongoose (*Herpes auropunctatus*) individuals. We detected juveniles and adults of these species across the gradient of anthropogenic activity, indicating established populations in the forest. All three species have been implicated in the extinction and extirpation of amphibians and reptiles. In Puerto Rico, none of these have management plans for control or eradication.

27.1 | How Genomics has Enabled Conservation Actions in California Amphibians and Reptiles

H. Bradley Shaffer, Robert Cooper, Erin Toffelmier

291 Landscape and population genetics have always contributed to conservation action, from the recognition of cryptic species to the delimitation of potential management units. At both federal and state levels, California has been a leader in using these data to identify, manage, and recover reptile and amphibian species of concern. We discuss several case studies of recent listing actions that have relied on landscape genomics derived from our lab—the recent listing of the foothill yellow-legged frog (*Rana boylei*) by the California Department of Fish and Wildlife, and the nearly completed federal listing decisions for the western pond turtles (*Actinemys marmorata/pallida*) and western spadefoots (*Spea hammondi* northern and southern clades). In all cases, detailed, range-wide sampling in combination with high-quality reference genomes, RADseq, and whole-genome resequencing were crucial pieces of information leading to listing and recovery actions. Additional, ongoing work on California tiger salamander (*Ambystoma californiense*) and desert tortoise (*Gopherus agassizii*) have identified genomic signatures of inbreeding and heterozygosity that directly impact individual and population health in these federally listed species. Currently, as part of the California Conservation Genomics Project, we are completing statewide whole-genome resequencing for 18 species/genera of amphibians and reptiles, including chromosome-level reference genomes, to enable conservation efforts of many of the state's most threatened taxa.

9.5 | What Happened to the World's First Ecolabel Certified Sustainable Shark Fishery?

David Shiffman

18 There is intense public interest surrounding the conservation and management of sharks, including a debate over whether sustainable shark fisheries are possible or fishing bans on sharks are needed to conserve these animals.

An important but rarely discussed data point in discussions of global shark fisheries is the case of British Columbia's fishery for Pacific spiny dogfish, *Squalus suckleyi*, which in 2011 became the first Marine Stewardship Council-certified shark fishery anywhere in the world. A few years later, despite reportedly healthy local stocks and thriving global markets for this shark, the fishery voluntarily withdrew its MSC certification, and in recent years more than 95% of the quota for Pacific spiny dogfish has been left in the water. This study provides insight into what happened to this fishery through a review of grey literature and a series of stakeholder interviews with British Columbian fishers, fish processors, managers and environmentalists. It is a rare case study of a fishery that largely ceased operations without a clear mechanistic explanation like a stock collapse, a government mandate to limit fishing or a clear shift in market demand. This fishery appears to have been affected by the combination of several factors, including a temporary reduction in biomass due to oceanographic effects, potential blowback from overly broad environmental messaging that did not distinguish between sustainable and unsustainable shark fisheries, management changes resulting in altered fishing incentives and changes to processing capacity associated with consolidating the fishing industry into ownership by relatively few large companies.

4.6 | Comparative Analysis of Ophidiomycosis Prevalence and Severity in Urban & Natural Habitats in the Southeast, USA, with Implications for Imperiled Species

Shivam Shukla, Jeremiah Doody, Zachary Gray, Michael Shablott

25 Snake fungal disease (SFD), caused by the invasive pathogenic fungus *Ophidiomyces ophiodiicola*, is an emerging threat to snake populations worldwide. This study aims to investigate the prevalence and severity of SFD in urban and non-urban sites across Florida, Louisiana, and Mississippi, with a particular focus on species of conservation concern. Through comprehensive surveillance efforts involving over 300 snake samples, we collected data on SFD prevalence, severity, and species distribution across multiple sites within the study region. We employed standardized methodologies for visual examination, swab sampling, molecular diagnostics, and necropsies of dead-on-road (DOR) individuals to detect the presence of the causative fungus and assess the severity of clinical signs. Our study presents data and analysis comparing the severity and prevalence of SFD between natural and urban areas. We also document the first reported case of ophidiomycosis in the federally listed black pine snake (*Pituophis melanoleucus lodingi*), a species of grave conservation concern. This discovery highlights the need for focused monitoring and management strategies to safeguard vulnerable snake populations from the impacts of this emerging disease. Our study provides valuable insights into the dynamics of SFD across diverse habitats and emphasizes the importance of monitoring imperiled species. These findings contribute to a better understanding of the epidemiology of snake fungal disease and inform targeted conservation efforts to mitigate its impact on snake populations.

28.6 | Reducing taxonomic lag via convolutional neural nets

Tiffany Sih, Peter Unmack, Michael Hammer, Matthew McGee

137 The ability to discriminate and describe a species' characteristics is a fundamental step in taxonomy. Meristics, the quantification of features such as fins and scales, and morphology, the relative comparison of shape and structure, are important aspects of classifying a species compared to congeners. These steps can be time-consuming and require attention to detail, and due to the limited number of experts in this field can create a 'taxonomic lag'. Computer vision combined with machine learning techniques can help to alleviate this problem by efficiently identifying features in images. Radiographs (x-rays) offer unique insight to several internal characteristics commonly used in ichthyology, for instance, shape and placement of skeletal elements. If we could harness computer vision methods, we could reduce the time spent on meristic counts by allowing experts to rapidly quantify these traits. Here we present a machine learning procedure for identifying features of interest and providing vertebral counts from radiographs of Retropinna (Retropinnidae, smelts) using object detection. We produced models using several popular computer vision frameworks to identify individual specimens and provide counts of individual vertebral elements using bounding boxes, which are then reviewed by a human observer. This supervised classification algorithm can

reduce mental fatigue, inhibit observer bias, and has broad applications in taxonomy, functional ecology and beyond. Similar models can be used to aid in the identification of species, which can be applied for taxonomic or biosecurity needs.

P2.14 | Australia's tropical deepwater fish assemblages

Tiffany Sih

138 Up to a third of the fishes found in Australia's marine environments are estimated to be unique to this region. Greater exploration of deeper environments, such as mesophotic coral ecosystems (MCEs), consistently result in new species discoveries. We are underestimating the value of Australia's deep and offshore waters as important marine bioregions and conservation hotspots. Mesophotic and deeper marine habitats in tropical Australia include Queensland's outer continental slope, the Coral Sea and extend to the remote Christmas and Cocos (Keeling) Islands. For many of these locations we only have a basic understanding of resident fish assemblages and underlying benthic habitat. During the Schmidt Ocean Institute research cruises in 2020, the Remotely Operated Vehicle (ROV) SuBastian collected imagery of never-before-seen underwater landscapes and documented many organisms believed to be new to science. In 2021 and 2022, Museums Victoria and CSIRO cruises aboard the RV Investigator collected towed camera imagery and specimens from the Christmas and Cocos (Keeling) Islands region. These deeper reefs, submarine canyons, submerged shoals and seamounts greatly extend the area of complex reefal habitat available and support rich fish assemblages. Information on deepwater habitats and associated fish communities is essential and will directly inform the conservation and management of the newly formed marine parks.

7.6 | Effects of Trans-Generational Glucocorticoid Exposure on Latency to Emerge in the Western Fence Lizard (*S. occidentalis*)

Amber Singh, Tanushri Rana, Rochelle Sanidad, Emma Wen, David Ensminger

80 The physiological effects of stress have been a topic of interest for decades, specifically, the stress response and the release of glucocorticoids such as corticosterone (CORT). More recently, we have begun to understand the importance of how the physiological effects of repeated CORT elevations have evolutionarily relevant behavioral consequences. Repeated CORT treatments have been shown to cause lasting behavioral changes such as altered latency to respond in *S. occidentalis* offspring from treated mothers (Ensminger et al. 2018). However, the extent of these changes is not well understood. Here we present our findings on how maternal stress and individual stress contributes to behavioral responses to a simulated predator attack in *S. occidentalis* juveniles. To test this, we simulated a predator attack in the lab with lizards who had been exposed to maternal CORT only, maternal and individual CORT, individual CORT only, or a control vehicle until they took refuge and measured the time until they re-emerged. Preliminary results indicate that offspring who only received the control vehicle had the longest time to re-emerge, offspring who received either individual stress or maternal stress only had similar, slightly shorter times to re-emerge, and offspring who were exposed to both maternal and individual stress had the shortest time to re-emerge. These results indicate that stressed juveniles may have a greater ability to recover more quickly after an adverse experience alternatively, or additionally, stressed juveniles may also be more likely to experience adverse outcomes than their more cautious control counterparts if they re-emerge prematurely.

P1.92 | Heat vs. Humidity: Novel Methods for Studying Microhabitat Use of Small Lizards in the Lab

Amber Singh, David Ensminger

81 Under standard conditions, thermoregulation is currently understood to be the main driver for microhabitat selection in lizards. The exact preferred temperature range is relatively easy to study in a laboratory setting as thermal gradients are easy to control over a prolonged period. Humidity is assumed to be an important secondary driver of microhabitat selection. However,

humidity is difficult to study in a prolonged, controlled setting due to the quick evaporation and dissipation of water molecules in a small area, as well as the direct relationship between temperature and humidity. Here we present our novel approach to studying the intersectional effects of temperature and humidity on the microhabitat selection of a small species of lizard, *Sceloporus occidentalis*. Sectioned gradient enclosures were constructed to allow for a continuous temperature gradient to exist along one axis (short side) and a segmented substrate humidity gradient to exist along the perpendicular axis (long side). This construction allowed for the free movement of individuals between the gradients while limiting the movement of humidity, so conditions remained relatively constant over a 36-hour period. In this way, we can tease apart the importance and range of both humidity and temperature on Western Fence Lizard microhabitat selection.

33.1 | A Preliminary Phylogeny of the Anguilliformes

Leo Smith, Edgar Nikols, Alex Maile, Michael Ghedotti, Matthew Davis

383 With more than 1,000 described species, the eels (Anguilliformes) are one of the most successful orders of fishes. In addition to their diversity, they have been the only major radiation of fishes into coral reef environments outside of the acanthopterygians. In this study, we use the results of an analysis of ultraconserved elements and other gene fragment sequence data to produce an updated phylogeny of the eels. Our resulting phylogeny is at odds with the traditional and recent taxonomy of eels. As such, we will present a revised monophyletic taxonomy at the order and family level and highlight the scale of the taxonomic problems at the genus level.

P2.18 | Genetic Trails: Restoring Brook Trout in the Southern Appalachian Mountains Through Multi-Source Reintroductions

Rebecca Smith, David Kazyak, Matthew Kulp, Barbara Lubinski, Benjamin Fitzpatrick

179 Wildlife reintroductions are a conservation tool to re-establish native species to their historical ranges. However, identifying appropriate source populations for reintroductions can be a challenge because introduced genotypes may not be well suited for the target environment. In practice, reintroductions are rarely preceded by detailed genetic evaluation. Brook Trout (*Salvelinus fontinalis*) is a threatened species in the Southern Appalachian Mountains and has been extirpated from its historical range due to anthropogenic impacts and competition with non-native species. In the Great Smoky Mountain National Park (GRSM), Brook Trout is the only native salmonid but has been isolated in remote headwater systems since the early 1900s, exchanging little to no genetic information between populations. State and federal agencies have been strategizing to restore the genetically unique Southern Appalachian Brook Trout to their native range and reintroduction efforts are ongoing in GRSM. To prevent depleting source populations, managers mix multiple native Brook Trout populations in a single reintroduction site. However, recent studies suggest multiple source populations do not readily admix as a consequence of being too genetically differentiated. This suggested nonrandom admixture raises concerns about assortative mating or outbreeding depression. Our research addresses these admixture concerns by assessing the genetic composition of reintroduced populations and we aim to contribute and guide management's selection of source populations in a single reintroduction site.

P1.37 | Anterior Myology of the Smalltooth Sawfish, *Pristis pectinata*: Implications for Assessing Effects of Marine Debris

Qingsong (Seisho) Song, Matthew Kolmann, Andrew Wooley, Lukas Heath, Dylan Yakich, Gregg Poulakis

151 The smalltooth sawfish (*Pristis pectinata*) was listed as endangered under the Endangered Species Act in April 2003 due to massive population decline from fishery bycatch and habitat loss. Details of the anatomy and internal morphology of the family Pristidae are poorly documented and are important for conservation and management actions. This is an important topic to comprehend because marine debris entanglement is increasingly reported

to be damaging the anterior body musculature, impeding gill ventilation and feeding. In this study, we dissected, identified, and mapped the anterior musculature based on preserved and fresh specimens. The musculature was elongated and had a primitive structure for superclass Batoidea. It shares some similarities with non-pristid members of Rhinopristiformes, but also has some unique and distinctive features. The musculature appears to be designed for maneuverability and agility for hunting prey, such as schooling teleosts, and defense against predators with its long, toothed rostrum. Muscles involved with respiration and feeding have been damaged by marine debris and may affect survivorship.

P1.99 | Diversity and Distribution of the Herpetofauna of São Tomé e Príncipe, West Africa

Ana Carolina Sousa, Bruna Santos, Mariana Marques, Paulo Passos, Luis Ceriáco

135 São Tomé and Príncipe are two oceanic islands of the Gulf of Guinea, West Africa, which were formed as a result of volcanic activity along the Cameroon Volcanic Line and have never been connected to the African mainland. Both islands are surrounded by deep waters and respectively 280 and 250 km away from the African mainland. The herpetofauna of these small islands has been the topic of renewed interest in the last two decades, especially regarding its taxonomy and systematics, which led to the description of eight new species, as well as the validation of several others. Nowadays the country's herpetofauna is one of the best known in Africa in terms of taxonomic diversity, with nine and 21 recorded species of amphibians and reptiles, respectively. The isolation of the islands resulted in speciation processes which drove to a high rate of endemism. All the occurring amphibians are endemic to their respective island, while 17 out of 21 reptiles are endemic to the country. This poster presents a compilation of the most recent taxonomic novelties and maps the currently known distributions of the 30 species. Based on data from museum collections, historical bibliography, recent field work and citizen science platforms such as iNaturalist, we present the species distribution patterns, richness and knowledge gaps on the two islands, as well as highlight future research directions.

P1.42 | Crossing Borders: Comparative Phylogeography of South American Livebearers

Igor Souto-Santos, Dahiana Arcila, Emma Lehmborg, Eugenia Zandonà, Paulo Buckup

40 The La Plata basin, spanning an extensive area of South American highlands from the Amazon basin in the North to the La Plata River estuary in the South, is characterized by its eastern boundaries delineated by the escarpments of Serra do Mar and Serra Geral. These features give rise to numerous hydrographic basins isolated by mountainous terrains, flowing directly into the ocean. Our study aims to investigate the biogeographic role of the watershed divide that separates the coastal basins and the inland La Plata basin, focusing on the livebearers of the genus *Phalloceros* (Poeciliidae) as a model group. Through the integration of morphological and whole-genome sequencing data, we delineated over 20 species within the genus. Notably, four species—*Phalloceros reisi*, *P. spiloura*, *P. titthos*, and an undescribed species—are found on both sides of the divide. For our phylogeographic analysis, we sampled 192 individuals across 46 populations, with 19 originating from headwaters of the La Plata basin and 27 from headwaters of coastal basins, utilizing a variety of markers ranging from mitochondrial data (COI) to ddRADseq. Preliminary results reveal that *Phalloceros* populations from the La Plata are not monophyletic, and the distribution of highland species suggests a minimum of four independent dispersal events across the Serra do Mar biogeographic barrier.

12.4 | Projected Contemporary Habitat Distribution and Quality for Wood Turtles (*Glyptemys insculpta*) across the Midwest

Sara Spaid, Donald Brown, Joel Mota, Andrew Badje, Petra Wood

366 Habitat suitability models (HSMs) play an important role in conservation planning by identifying priority areas for habitat management and guiding field

surveys for population discovery and monitoring. The wood turtle (*Glyptemys insculpta*) is a species of semi-terrestrial turtle that is also tied to riparian corridors. Habitat loss and degradation have caused range-wide declines, causing this species to be listed as threatened or endangered throughout the Midwest. Previous HSMs have been developed for this species, however, no published HSM exists for the Midwestern portion of their range, and no published HSM has incorporated terrestrial, aquatic, and climatic variables. We developed a HSM for this species across their distribution in Iowa, Michigan, Minnesota, and Wisconsin. Model cells consisted of 1-km stream segments derived from the National Hydrography Dataset (NHD) and a 300-m buffer surrounding each cell. Verified occurrence records were obtained from 2000-2022 from state agencies, concurrent research projects, and the community science platform iNaturalist. Assessment metrics indicate good model performance (AUC = 0.92, TSS = 0.68). Preliminary results indicate that stream order and width were the most influential aquatic variables, with lower stream order and stream widths being associated with more suitable habitat. Heat Load Index (HLI) and proportion of still water in the riparian zone were the most important terrestrial variables with higher HLI and lower proportion of still water being associated with more suitable habitat. Additional results will be presented regarding estimated relationships between distribution and environmental variables and an overarching analysis of wood turtle distribution in the Midwest.

21.2 | Insights into the Movements of Previously Captive Ragged-tooth Sharks, *Carcharias taurus*, along the Coast of Southern Africa

Kevin Spiby, Koebraa Peters, Taryn Murray

221 Ragged-tooth shark, *Carcharias taurus*, populations are found globally in coastal waters. These large slow-growing predators historically have been targeted by commercial fisheries and are now listed as Critically Endangered on the IUCN Red List of Threatened Species; they are also a popular angling species for recreational fishers. Due to their slow swimming nature, and desired 'dangerous' look, they have become a popular species to house in public aquaria. The Two Oceans Aquarium in Cape Town, South Africa, has had ragged-tooth sharks on display since 1995 as ambassador species for various education & conservation programmes. Since 2004, sharks that have become too large for the exhibit have been released back into the wild. Between 2012 and 2021, 37 sharks (10 male, 27 female) were acoustically tagged and released providing the opportunity to learn more about coastal movements after spending time in captivity. The South African coastal receiver network (Acoustic Tracking Array Platform) has recorded over 177 000 detections. Average minimum straight-line distances covered by females (366.82 ± 477.35 km) were more than double that of males (134.61 ± 62.61 km), and were also faster (females: 3.80 ± 7.20 km/day; males: 2.39 ± 2.35 km/day). This rate of movement is lower than previously aquaria-released ragged-tooth sharks, but is similar to those of wild conspecifics. The results of this study can provide useful insights into determining the feasibility of releasing ragged-tooth sharks after spending extended periods of time in public aquaria and could be extended to other species.

P2.55 | Using stable isotopes to examine dietary niche space of three coexisting *Plethodon* salamanders in North Carolina

Zachary Spicer, Jon Davenport, Alan Babineau, Rosemary Ronca, Elyssa Winterton

243 The southern Appalachians harbor a high diversity lungless salamander of the family Plethodontidae. Six closely related Plethodontid species can coexist in certain terrestrial and aquatic communities. Despite the coexistence of multiple species, 1-2 species tend to be more abundant. Prior research with terrestrial salamanders suggests that competition may limit the distribution and abundance of *Plethodon* salamanders. Three species of large-bodied *Plethodon* salamanders (*Plethodon montanus*, *P. cylindraceus*, *P. yonahlossee*) can be found coexisting in forested ecosystems of northwestern North Carolina. Little is known about the factors that permit this coexistence, but diet may be one contributing factor. Therefore, we sought to understand overlap in dietary niche space of these 3 species in 4 separate communities. We predicted a generalist diet for each species with significant overlap in dietary niche space. Previous work has shown that tail tips can

provide coarse information on salamander diets without the need to sacrifice individuals. Therefore, we calculated isotopic niche space and diets of each species using tail tips from field collected individuals in summers of 2021-2022. We found significant overlap in niche space among the 3 species across all 4 communities. We also found that *P. yonahlossee*, appears to be consuming different forest floor invertebrate guilds in comparison to the other 2 species. These findings suggest that the 3 focal species may be eating prey with similar Nitrogen values, but 1 species may be partitioning prey to reduce competitive interactions. This dietary niche partitioning may provide explanation for current patterns of coexistence at our sites.

P2.4 | Rediscovery of a Relict Population of Brindled Madtom in Crooked Creek

Nelson Squires, Luke Beall, Abigail Powell, Beth Dakin, Anthony Honick, Brady Porter

406 Crooked Creek is a mine-impacted tributary to the Allegheny River located in western Pennsylvania. Most of the stream lies upstream of a dam maintained by the U.S. Army Corps of Engineers (USACE), as well as its reservoir, Crooked Creek Lake, a popular fishing and recreation area. Backpack electrofishing surveys conducted by Duquesne University and USACE from 2020-2021 revealed not only a healthy fish community but also a previously unknown population of Brindled Madtom *Noturus miurus*, a state-threatened catfish species that had not been recorded in the area since 1905. All of the Brindled Madtoms were found in the mainstem, upstream of the reservoir. The purpose of this study was to collect additional information on the fish community upstream of Crooked Creek Lake as well as to gain further understanding of the newly-rediscovered Brindled Madtom population. Three backpack electrofishing surveys were conducted at different points along the stream using a seine and dip nets. Results from 2023 indicate a relatively healthy fish community, and a persistent population of Brindled Madtom with multiple size classes indicating successful reproduction. Although the dam may genetically isolate this relict population, it can also protect it from invasive species. Future surveys will determine the upstream extent of this state-threatened species and its habitat requirements.

12.2 | Foot morphology comparison between two species of Plethodontid salamanders, *Plethodon ventralis* and *Plethodon websteri*.

Sydney Stahl, Jennifer Deitloff

358 Through evolution, adaptations to environmental conditions contribute to the morphological features expressed by organisms. Two species of salamanders, *Plethodon ventralis* and *Plethodon websteri*, are genetically distinct but share similar behaviors and morphology. Geographic range overlap occurs between these two species within Jefferson County, Alabama, where both allopatric locations of each species and a sympatric location were studied. Both species exhibit polymorphism in color (red-backed and lead-backed morphs) at allopatric locations. However, within sympatric locations, these two species diverse in this characteristic: *P. ventralis* exhibit the lead-backed morph, and *P. websteri* exhibit the red-backed morph. In addition to color morph, *P. ventralis* and *P. websteri* differ in the microhabitat in which they were found. *P. ventralis* was frequently observed within a ravine with steep sides, whereas *P. websteri* was found on either side of the ravine in the adjacent forest. Divergence of other morphological features may be influenced by microhabitat differences. We hypothesized that foot morphology between *P. ventralis* and *P. websteri* would diverge within the sympatric location studied. Using images of the feet of *P. ventralis* and *P. websteri*, we assessed shape differences using geometric morphometrics. Our results demonstrate that these two species differ in foot morphology. Future studies should explore whether these differences provide function benefits associated with microhabitat characteristics.

30.6 | Sex Ratio and Size of the Saddleback Darter, *Percina vigil*, Over 5 Consecutive Years in the Pearl River, Louisiana

Bruce Stallsmith

122 The Saddleback Darter, *Percina vigil*, subgenus *Imostoma*, is found in flowing channels over sand and gravel in the lower Mississippi River embayment and the Gulf Coast. Earlier research on the species has determined its spawning season to be February–April. Access to large preserved collections of the species held by the Royal D. Suttkus Fish Collection of Tulane University allowed study of *P. vigil*'s sex ratio and growth patterns. In particular, annual collections were made of the species during spawning season for five consecutive years, 1965–1969, from the Pearl River at a site in Washington Parish, Louisiana. Collections were of 208–397 adult individuals. Sex of all individuals was determined by external examination, along with SL (mm) and weight (g). All five collections showed significant male skew, with females comprising 25.7–42.4% of a given collection. Male SL was significantly larger than female SL in each collection. Creating Length/Weight regressions for each sex annually in the form of $W=aL^b$ showed males gaining more weight at a given length than females. Testing each year's male and female regressions with ANCOVA showed that the slope of female regression lines was significantly lower in four of the five years. What influences a male skew sex ratio is unknown, although such skew has also been observed in another *Imostoma* species, *P. tanasi*, the Snail Darter. Spawning microhabitat is likely to be over sand and gravel in swifter and more shallow shoals as has been observed with *P. tanasi*.

P1.14 | Chemical Tags in Calcified Vertebral Cartilage Reveal Movement Dynamics of a Migratory Shark

Nicholas Starosta, Nathan Miller, R.J. Wells, Sharon Herzka, Oscar Sosa-Nishizaki, Juan Carlos Perez-Jimenez, John Mohan

490 Rebuilding populations of ecologically important elasmobranchs under exploitation is particularly challenging when species move across international borders. It is therefore important to understand species- and region-specific connectivity to implement effective management strategies. Natural chemical tracers (i.e., stable isotopes and trace elements) can provide insight into spatial habitat use by reconstructing patterns of animal movement between chemically distinct water masses. Accretionary structures, such as the mineralized vertebral cartilage of chondrichthyan fishes, are metabolically inert after calcification and thus retain an unaltered chemical profile throughout ontogeny. Regional variations in water chemistry and dietary preference can lead to differences in the elemental composition of vertebrae during growth. Habitat-associated differences in food web structure and associated isotopic baselines are simultaneously recorded in the bulk isotopic composition of the organic fraction of the vertebrae. In the Gulf of Mexico, the north-south population connectivity of the bull shark (*Carcharhinus leucas*) was investigated using trace elements and stable isotopes within mineralized vertebral cartilage. For vertebral edges (recent life), elemental concentrations (Sr, Ba, and Mn) differed between the northern and southern Gulf of Mexico, and corresponding $\delta^{13}C$ and $\delta^{15}N$ values showed low overlap. These results suggest separate isotopic niches and limited connectivity between regions, demonstrating the potential of vertebral cartilage for tracking broad scale movement patterns of highly migratory elasmobranchs. Further investigation across species and regions is needed to understand the broader applications of this methodology.

34.2 | Effect of Noise Pollution on the Development and Behavior of Dryophytes arenicolor

Montserrat Suárez-Rodríguez, José García-Dimas, Hibrain Pérez-Mendoza

249 Noise pollution, a persistent consequence of human activity, disrupts sensory perception and has traditionally been studied because of its impact on animal communication. Recent research has expanded its focus to investigate its effects on other traits, including stress and short-term behaviors. There is increasing recognition of the long-term consequences of chronic noise exposure, which may be a common stimulus in urban and suburban environments. Amphibians, undergoing crucial metamorphosis from aquatic to terrestrial life, present a unique opportunity to study the developmental impacts of noise pollution. In this study, we exposed *Dryophytes arenicolor* tadpoles to urban

noise six hours per day during metamorphosis. We observed their growth and behavior throughout the tadpole and frog stages. Our findings reveal that tadpoles subjected to noise exhibited accelerated growth rates without noticeable changes in tadpole-stage activity levels. However, frogs that experienced noise during development displayed decreased foraging success and shorter jump distances. This study highlights the significant developmental effects of sensory pollution, such as noise, on animals, potentially compromising their survival and fitness in later stages.

15.5 | Orientation of Blacktip Sharks (*Carcharhinus limbatus*) to Underwater Sound

Caroline Sullivan, Edmund Gerstein, Stephen Kajjura

233 Sharks respond to low frequency pulsed sounds but are thought to lack the capacity to detect these sounds beyond the acoustic near field. This study quantified the distance that blacktip sharks (*Carcharhinus limbatus*) oriented to sound stimuli and determined that responses could be consistently initiated from the acoustic far field. Populations of *C. limbatus* in the wild were exposed to sound stimuli (100 – 200 Hz; 200 – 400 Hz; and 400 – 800 Hz; 10 kHz) presented by an underwater speaker. The sound pressure levels for all stimuli were measured in situ and used to model the propagation away from the source. This permitted direct calculation of the stimulus intensity for the point at which each shark initiated its response. Stimulus intensity was a minimum of 50 dB above ambient to ensure that the sharks would respond. An aerial drone was used to film the response of the sharks and quantify the distance at which sharks reacted. When a sound was presented, *C. limbatus* elicited a sudden 20 – 160° turn away from the speaker, and rapidly swam away. Sharks responded to all frequencies from at least 62 m, and 71.6% of all responses (n = 209) occurred in the far field. Sharks never responded to a high frequency (10 kHz) control stimulus of comparable volume. The ability of blacktip sharks to detect and orient away from a sound stimulus at distances that extend beyond the acoustic near field, suggests that they are detecting these sounds using a non-otolithic pathway.

P1.56 | Evolution of Feeding Strategies Across Marine Habitats in Lizardfishes (*Aulopiformes*)

Natalie Swearingen, W. Smith, Matthew Davis

161 Lizardfishes and their allies (*Aulopiformes*) are distributed across a breadth of marine habitats and include lineages composed of captivating deep-sea fishes and key coral-reef predators. In this study, we utilize a new hypothesis of evolutionary relationships among *Aulopiformes* as inferred from a combination of ultraconserved elements (UCEs), protein-coding gene fragments, and morphological data to provide new insights into their evolutionary history. We use this evolutionary framework in combination with a study on feeding strategies across *aulopiforms* to infer the evolution of different feeding strategies as lizardfishes transitioned across a variety of marine habitats.

P2.67 | Short and Long-Term Effects of Urban Development on Native and Invasive Treefrogs at Florida Gulf Coast University

Bryce Sweely, Matthew Metcalf, Andrew Durso

147 Climate, which is shifting due to global warming, and urbanization are essential factors that determine the distribution and range of native and invasive species. In southwest Florida, behavioral patterns of hylids are not only affected by temperature and rainfall but are dependent on variation in such factors throughout the dry and rainy seasons. Combined with global climate change, human influence, and rapid urban development, short and long-term behavioral effects may be observed in native and invasive hylid species over time. The Cuban tree frog (*Osteopilus septentrionalis*) is an invasive species that actively competes with the native American green tree frog (*Hyla cinerea*) and the squirrel tree frog (*Hyla squirella*). This study compared the likelihood of treefrog presence due to temperature and rainfall throughout the dry and rainy seasons across different habitat types (urbanized areas and natural areas) on the Florida Gulf Coast University campus in 2013 – 2014 and 2022 – 2023. We utilized polyvinyl chloride tubes as artificial refugia to sample frog

occupancy throughout the years at five sites around student housing buildings and five sites within conservation areas. Preliminary results from regressions and occupancy modeling show how local temperatures during the rainy and dry seasons have increased within the past decade, and rainfall variation may affect treefrog presence. In natural habitats, Cuban treefrogs may be less likely to be observed as daily precipitation increases, whereas native treefrogs may be more likely to be observed. Probabilities of treefrogs being found has decreased between the 2013 – 2014 and 2022 – 2023 sampling periods.

P2.16 | Developing an eDNA Metabarcoding Assay for Lake Ontario Coregonines Using Mitochondrial Genome Sequences

Joseph Sweeney, Nicholas Sard, J Siegel

310 Across the Great Lakes, the population of many native fish species has declined due to various anthropogenic factors such as pollution, overfishing, the introduction of invasive species, and habitat destruction. Coregonines have been some of the most negatively impacted native species in the Great Lakes. In Lake Ontario, three species that have been the focus of restoration efforts are cisco (*Coregonus artedii*), lake whitefish (*C. clupeaformis*), and bloater (*C. hoyi*). Bloaters have been stocked into Lake Ontario as part of a collaboration among the Canadian and United States federal agencies since 2012. To date, over one million fish have been reintroduced into the lake. To determine the success of these reintroduction efforts, bottom trawls have been used to catch reintroduced fish or their offspring. However, this method is not viable for the north shore of Lake Ontario because of the rocky substrate composition of the benthos. As a result, environmental DNA (eDNA) metabarcoding methods are being investigated to survey the lake for coregonine species. A problem with using this method is that many of the species of the genus *Coregonus* are very closely related and can be difficult to distinguish from one another using currently published assays. Using tissue samples of known bloater, cisco, and lake whitefish, we analyze mitochondrial genome sequence variation among these species to develop a comprehensive eDNA metabarcoding assay to survey for coregonines in Lake Ontario.

32.5 | Are All Nurseries Created Equal? Understanding Differences Among Scalloped Hammerhead (*Sphyrna lewini*) Nurseries in the Western North Atlantic Ocean

Dominic Swift, Amanda Barker, William Driggers, Bryan Frazier, Douglas Adams, James Gelsleichter, Dana Bethea, Bethany Deacy, David Portnoy

245 Nurseries are essential habitats for many elasmobranchs and their identification and preservation is vital for conservation and management. In a paradigm-shifting paper, Heupel et al. (2007) developed a framework that has been used extensively to identify nurseries for a variety of species. However, given resource constraints faced by managers, it is imperative to understand differences among nurseries so that habitat preservation can be prioritized effectively. Here, we present a case study in which population genomic data was used to understand differences among nurseries by genotyping 484 young-of-the-year and juvenile scalloped hammerheads (*Sphyrna lewini*) sampled in five discrete nurseries in the western North Atlantic Ocean. Fifty-three pairs of siblings were sampled, with the vast majority (49) in the same nurseries, indicating female fidelity to these habitats with low levels of straying. Variation in estimates of effective population size among the nurseries indicate that some nurseries are used by larger numbers of breeders than others. Furthermore, distinct environmental conditions among the nurseries and repeated use by female lineages appear to have resulted in the localized sorting of adaptive genetic variation, which is important for long-term species persistence. Taken together, the results demonstrate that these five nurseries are not equivalent and highlight the significance of considering differences among essential habitats in management planning.

18.4 | An Update on Comparative Genomic Approaches Applied to Cartilaginous Fish Genome Evolution

Milton Tan

328 Cartilaginous fishes occupy a critical branch in vertebrate evolutionary history. They represent some of our most distant relatives that share some of our core traits, including jaws and adaptive immunity. Until recently, few cartilaginous fish genomes were sequenced relative to bony vertebrates, complicating the study of their genome evolution. However, much more active genome sequencing efforts have now focused on cartilaginous fishes. I update my prior analyses on the whale shark genome with the addition of several new shark genomes. I critique some of the basic assumptions and shortcuts in modern comparative genomics and how I attempted to address them in the present work. I again test for differences in rates of overall genome evolution, patterns of gene family size evolution, and augment these with analyses of rates of positive selection, to further explore the potential functional roles of genes in phenotypes through a comparative genomics framework. Finally, I discuss some remaining challenges that hamper a comprehensive analysis and understanding of vertebrate genome evolution.

14.9 | Exploring the Species Diversity of Selenanthis (Perciformes: Anthiidae) Using an Integrated Taxonomic Approach, With the Discovery of a New Species

Chi-Ngai Tang, Wei-Jen Chen

495 Selenanthis is a small genus of the Anthiidae with three valid species (*S. analis*, *S. barroi*, *S. myersi*). These benthic fishes inhabit deep reefs or seafloors at depths ranging from 110 to 360 m in the tropical to subtropical Indo-West Pacific (IWP). While recent efforts have been dedicated to reviewing the species-level taxonomy of Selenanthis, these advances relied solely on traditional morphological approaches and limited examined materials due to the difficulty of collection. Therefore, further investigations are needed to explore their taxonomy, species diversity, and phylogeny. Here, based on 23 newly collected specimens of three morphospecies obtained mostly during several oceanographic expeditions in the IWP over the last decade under the "Tropical Deep-Sea Benthos" program, we aimed to explore the diversity of Selenanthis through an integrated approach in taxonomy (e.g., DNA-based species delimitation methods, morphology, and geographical data). Our results reveal four putative species of Selenanthis, one of which corresponds to *S. analis*. Hidden diversity is detected within *S. barroi*, which comprises a pair of sister lineages with sympatric distributions occurring at different depths that we interpret as two putative species. Additionally, we discovered a potential undescribed species from seamounts in the Coral Sea and around New Caledonia. It is readily distinguished from its congeners by having a relatively slender body and large eye, and the absence of dark spots on dorsal and anal fin for both sexes. Moreover, we ascertain that Selenanthis exhibits sexual dimorphism, with each inferred species exhibiting two color morphs corresponding to body size and sex.

P1.67 | The Infraorbital Morphology of Plectranthis and Selenanthis Species (Perciformes: Anthiidae)

Chi-Ngai Tang

496 The infraorbital series (IO) forms part of the circumorbitals in fishes. The number, morphology of IOs, and the presence or absence of the subocular shelf—a bony wall extending inwardly from the IO—are often used to infer phylogenetic relationships among taxonomic groups. The Anthiidae comprises a group of small, reef-associated fishes found from tropical to temperate regions worldwide, encompassing about 250 known species. Despite its broad distribution and species richness, our knowledge about their phylogenetic relationships remains limited, primarily due to challenges of sampling new specimens for the research. As a result, the classification, especially at generic level, remains a subject of debate. Previous research by the author using a multigene phylogenetic approach revealed that the genus Plectranthis is polyphyletic, necessitating a taxonomic revision. To identify informative characters for diagnosing and distinguishing clades within Plectranthis, the IOs of five selected species (*P. azumanus*, *P. japonicus*, *P. maekawa*, *P. randalli*, *P. sagamiensis*), along with a closely related species

from the genus Selenanthis (*S. analis*), were examined using cleared and stained specimens. The IO series were removed from the specimens and observed under a stereomicroscope. Observation revealed that all examined Plectranthis and Selenanthis species possess six IOs, with the anteriormost (IO1) being the largest. Subocular shelves were observed lining the inferior wall of IO2 and IO5, with a broadly expanded shelf on IO3. Overall, the shape and size of IO1 and the development of the subocular shelf on IO3 varied among clades and genera, providing informative morphological characters for taxonomic differentiation.

P2.33 | Phylogeny of Ophidiiformes

Kevin Tang, Matthew Girard

127 igmatic group of marine fishes with a worldwide distribution. The order is divided into four families (Bythitidae, Carapidae, Dinematchthyidae, Ophidiidae), with over 120 genera and more than 500 species. Representatives from all four families were included in this study, encompassing over 70 genera and 170 species. More than forty acanthomorph species were included as outgroups. Ten genes were used for analysis: six mitochondrial (12S, 16S, ATPase 8/6, cytochrome b, cytochrome c oxidase I) and four nuclear (ectodermal-neural cortex 1, histone H3, recombination activating gene 1, and zic family member 1). The resulting phylogeny shows that the order is monophyletic. The family Ophidiidae is rendered polyphyletic by the presence of a monophyletic Carapidae nested within ophidiid taxa. Both Bythitidae and Dinematchthyidae are monophyletic. Members of Aphyonidae, a previously recognized family, formed a clade but is entirely within Bythitidae.

6.7 | Assessing the Gut Content of Connecticut's Endangered Sturgeons

Loren Tardif, Michelle Kraczkowski, Jacqueline Benway

372 Shortnose Sturgeon (*Acipenser brevirostrum*), a Federally Endangered Species since 1967 due to overfishing, has only been monitored in Connecticut since 1988. Populations remain low and risk extinction due to habitat degradation and alteration within the Connecticut River. The Atlantic Sturgeon, *Acipenser oxyrinchus*, federally listed as endangered in 2012, has five distinct population segments (DPSs). Connecticut's seasonal population of Atlantic Sturgeon is primarily comprised of the New York Bight DPS. For both species, there is minimal knowledge of their feeding habits and preferred diet, and how their diet affects them. One safe technique used to determine the diet of SNS of gastric lavage. We have begun to assess their gut content with collections from both species in partnership with the Connecticut Department of Energy and Environmental Protection (NMFS Permit #19641). Our findings so far are consistent with the sparse literature that suggests that they may consume very little during breeding seasons, however inconsistent in that initial samples were not during the breeding season. Sampling is on-going and prey items are predominately freshwater invertebrates (polychaetes). Our goal is to investigate the complexity of the seasonal variation in these Sturgeon diets, and subsequently determining which habitats are important to protect the lower Connecticut River.

P1.57 | Big Fish, Tiny Appetite: Assessing the Gut Content of Sturgeon

Loren Tardif, Michelle Kraczkowski, Jacqueline Benway

373 The Connecticut River provides for two Sturgeon species: the Shortnose Sturgeon (*Acipenser brevirostrum*) and the Atlantic Sturgeon (*Acipenser oxyrinchus*). The Shortnose Sturgeon, endangered since 1967 due to overfishing and industrial use of rivers, has been monitored by CTDEEP since 1988. However, populations remain low due to life history traits and habitat changes. The Atlantic Sturgeon, federally listed as endangered in 2012, has five distinct population segments (DPSs). Connecticut's seasonal population of Atlantic Sturgeon is primarily comprised of the New York Bight DPS. For both species, there is minimal knowledge of their feeding habits and preferred diet, and how their diet affects them. Our ultimate goal is to determine the current Sturgeon diets, and thus, determine which prey items and their respective habitats are important for protecting in the lower Connecticut River. We proposed a study to collect and lavage approximately 50 Sturgeon, using gastric lavage as a

safe technique to determine the diet of Sturgeon. CT DEEP is conducting the Sturgeon collections through Federally permitted research activities. For each species sampled so far, both the quantity and volume of prey is very low. Identified prey items include mainly aquatic insect parts, amphipods, and more.

P2.38 | Where Do You Want to be When You Grow Up? Amphibian Communities in Different Wetland Types

Taylor Thomisee, Stephen Mullin

70 Wetlands successfully support amphibian species because a diversity of resources are present, including food and breeding habitat. The species in these communities can be impacted by habitat loss, contaminants, and fluctuations in water level. Understanding how these species persist with respect to their habitat is imperative for conservation efforts. We are employing a variety of survey techniques uniformly across 40 wetlands that are categorized as follows: (1) Reference, sites over 25 years of age within wildlife refuges that present ideal habitat conditions for amphibians; (2) Control, agricultural ditches that are capable of sustaining at least one amphibian population; and (3) Restored, parcels under 20 years of age enrolled in the Wetland Reserve Easement Program. Each restored parcel was selected to represent a broad range of characteristics such as wetland size and age of the easement. We are quantifying the diversity of amphibian species at each site, as well as assessing the relative abundances of their different life-history stages. We are also measuring environmental factors such as vegetative composition, canopy cover, and soil and water quality, in order to correlate these variables with the composition of the amphibian community inhabiting each site. We discuss our results in the context of understanding the relationships between habitat characteristics and amphibian diversity, with a primary focus on modeling ecosystem characteristics for optimizing conservation efforts in these differing wetland types.

7.5 | Vulnerable Populations of the Endangered Streamside Salamander (*Ambystoma barbouri*) are Sensitive to Rising Temperatures at the Embryonic Stage

Julia Thulander, Jason Bracken, Joshua Hall

152 Climate change will substantially impact embryo survival of ectotherms due to their relative lack of parental care, thermal sensitivity of development, and reduced capacity for thermoregulation. Although the effects of climate change have been studied extensively using eggs of non-avian reptiles, much less is known about impacts on amphibian development and resultant phenotypes of larvae and metamorphs. Thus, we conducted an egg incubation study with the Streamside Salamander (*Ambystoma barbouri*), to consider how developmental temperature impacts salamander development in population-specific ways. We collected eggs from across the species' range, which spans from southern Tennessee to Ohio, incubated them at various temperatures in the laboratory (5-25 °C) and measured resultant larval and metamorph phenotypes. We also monitored nest temperatures in disturbed and undisturbed habitats to assess the effects of urban development on stream temperature because urbanization is a threat for this species. Nest temperatures were warmer in disturbed than undisturbed sites and decreased with latitude. Higher incubation temperature resulted in increased developmental rate and decreased egg survival, body size at hatching, and size at metamorphosis. Moreover, temperature had population specific effects for developmental rate, size at metamorphosis, and egg survival. In particular, eggs from Ohio and Kentucky had greater survival at higher temperatures than populations from Tennessee, where the species is endangered due to habitat destruction caused by urbanization. Collectively, our results show that two aspects of global change, urban development and climate change, may have synergistically negative impacts on the development of sensitive species.

27.4 | The Advantage of Size in Desert Tortoise Head-starting and the Impact of Extreme Drought

Brian Todd, Kurt Buhmann, Tracey Tuberville

449 The appeal of desert tortoise head-starting rests in the increase in survival that accrues as tortoises grow in size in captivity before release. To test the impact of head-starting on survival after release, we released head-started Mojave Desert Tortoises spanning 70–145 mm midline carapace length in the Mojave National Preserve in lower Ivanpah Valley in San Bernardino County, California in Fall 2018 (n=78), Fall 2019 (n=72), and Fall 2020 (n=60) and monitored their fates to date using radiotelemetry. We found modest support for a relationship between survival and tortoise size at release in some years. Annual survival from 2018–2023 ranged from 60–98%, but was at least 83% or higher in all years except for 2021, when the study site was in 'extreme drought' condition. Prior studies have attributed elevated predation rates of even adult tortoises in droughts to coyotes when preferred coyote prey like jackrabbits become scarce; indeed, the number of jackrabbit sightings relative to coyote sightings plummeted during the extreme drought in this region. We likewise suspect that drought-induced prey switching by coyotes and possibly other mammal predators explains the increased mortality of head-started tortoises from predation that we documented in 2021, irrespective of tortoise size. Considering the challenge of droughts like that in 2021, releasing larger head-started tortoises may still likely benefit populations by improving survival in non-drought years, ensuring that, with more tortoises alive on the landscape before droughts, more may remain alive in the aftermath of such bottlenecks.

21.3 | Reproduction and pup growth of the Sand tiger shark, *Carcharias taurus*, at Ibaraki Prefectural Oarai Aquarium, Japan

Kotaro Tokunaga, Shinsuke Saito, Kazuhiro Shibagaki, Takashi Sakai, Junichi Fujimori

26 The Sand tiger shark *C. taurus* is considered to be at high risk of extinction in the wild and is listed as endangered by the IUCN (Pollard et al., 2019). Although they are exhibited in many aquariums around the world, there are few examples of natural reproduction in aquariums, and there are almost no detailed records before and after the birth of pups. We report the first successful natural reproduction of this species in Japan at Ibaraki Prefectural Oarai Aquarium in June 2021, and a record of pup growth was obtained. We kept 6 individuals (M:2, F:4) for breeding purposes, and by adjusting the water temperature and lighting time of the tank, they succeeded in shifting the estrus of males to spring, and mating was observed on March 18, 2020. Fetal movements were observed in the female abdominal wall on February 12, 2021, and our observations were intensified for behavioral recording and protection of offspring after birth. On June 17, 2021, one individual gave birth normally, and the next day, one individual in a slightly lower developmental stage was released stillborn, and we successfully recorded them on movie. The pup was 92.2 cm in TL and 4.3 kg in BW at birth; after approximately 2 years, their TL was 193.0 cm. We believe that the data obtained from the offspring of Japan's first naturally reproduced *C. taurus* is important for advancing the conservation of this species.

25.5 | Development of artificial uterus: A new conservation breeding technique for sharks

Takeeru Tomita, Minoru Toda, Atsushi Kaneko, Kiyomi Murakumo, Masaru Nakamura, Keiichi Sato

214 Artificial uterus is a next-generation technique to support the survival of premature embryos/fetuses of viviparous animals outside the maternal body. This technique is important for the conservation breeding of endangered species in public zoos and aquariums. However, most studies on this technique have been restricted to mammals. Since 2017, the Okinawa Churashima Foundation Research Institute and the Okinawa Churaumi Aquarium have developed novel artificial uterine systems for elasmobranchs. These systems are distinguished from the previous studies in using "artificial uterine fluid" that is a urea-containing liquid with osmotic pressure and salinity nearly equivalent to those of shark blood plasma to facilitate embryonic osmoregulation. Application of this system for the embryonic slender lantern shark

(*Etmopterus molleri*) four times led to the successful maintenance of embryos for a maximum of one year and juveniles for over 11 months after artificial parturition. Notably, this study demonstrated the longest record of extrauterine life support for viviparous vertebrate embryos to date. This technique can also be used to explore the ecology of viviparous elasmobranch embryos. Lantern sharks emit blue–green light throughout their body surface via luciferin–luciferase reactions. We have observed that embryonic lantern sharks emitted light in the artificial uteri before the onset of oral feeding. This seems to contradict a previous hypothesis that lantern sharks acquire luciferin from food sources.

CANCELLED - 6.2 | Diversification of a Putative Evolutionary Radiation of fishes from Hispaniola

Patricia Torres-Pineda, Hernán López-Fernández

326 The family Poeciliidae constitutes an important component of Neotropical freshwater fish fauna, especially in Middle America (Central America and insular Caribbean). In the West Indies, the genus *Limia* is the largest freshwater clade of the region and is thought to have experienced explosive speciation, with Hispaniola (Haití and Dominican Republic) as the center of said radiation, where 19 out of the known 22 species occur. *Limia* has been proposed as a case of adaptive radiation, but this hypothesis has never been formally tested. We are integrating genome-wide, morphological, and ecological data to study the diversification patterns and evolutionary processes behind this radiation of Caribbean livebearing fishes. To unravel the mechanisms and patterns of diversification of the clade of interest, we are building a species-level phylogeny based on Next Generation Sequencing (i.e., Double Digestion Restriction-site Associated DNA Sequencing; ddRADSeq) as well as exploring population level relationships. We use the phylogeny as a framework to study associations between morphological divergence and ecological variables in a comparative context using a functionally informed ecomorphological framework to assess the relative role of adaptation in the diversification of this group. Phylogenetic analyses suggest both complex biogeographic relationships within Hispaniola and ecology-linked diversification in discrete clades. Moreover, morphological, and stable isotope trophic divergence indicate that ecological specialization and niche partitioning may play a role in assemblage of communities of coexisting *Limia* species.

P2.70 | Effects of elevation on morphological traits in a vulnerable salamander: *Plethodon welleri* (Weller's salamander)

Abby Turner, Rosemary Ronca, Jon Davenport

276 Southern Appalachia is highly diverse in wildlife taxa. One prolific group in this region is lungless salamanders of the Plethodontidae family. Despite the prevalence of these amphibians, fundamental data on many species is missing from current literature, which can create voids in information crucial to conservation planning. *Plethodon welleri* is a data-deficient species endemic to Southern Appalachia and considered vulnerable in its conservation status. Our study aimed to determine if morphological traits of *P. welleri* vary along an elevational gradient. We hypothesize that body size (snout-vent-length, SVL) will increase with elevation. Additionally, we hypothesize that head size (head length and width) and limb length (humerus/femur length) will increase with elevation. To investigate morphological variation at different elevations, we measured and compared *P. welleri* individuals from 11 populations in North Carolina and Tennessee. Individuals were photographed and measured using ImageJ. We found no significant effect of elevation on SVL or head morphology. We did find a significant effect of elevation on leg length with front and rear limbs being shorter at higher elevations. These findings suggest that *P. welleri* body size may not be influenced by elevation, a trend that has been documented in other Plethodontid salamanders. Our results indicate that leg length in *P. welleri* may be impacted by elevation, but more research is needed to understand the biological implications of this finding. Overall, our study provides new information on how an important life history trait may interact with this species' environment which could be valuable in developing informed, targeted conservation efforts.

18.2 | New genetic tools give a detailed picture of hybridization and population structure of Flannelmouth Sucker

Thomas Turner, Thomas Dowling, Abby Wicks, Alexander Cameron, Guiherme Caeiro-Dias, Megan Osborne

427 We adapted next-generation genetic screening tools to study hybridization and fine-scale population structure in Flannelmouth Sucker (*Catostomus latipinnis*) in two important Colorado River systems. We genotyped 1472 larvae distributed in two, 200-mile reaches in the Grand Canyon (GC) and San Juan River (SJR). We also genotyped 1085 adult fish sampled throughout the SJR mainstem and 300 adults that entered McElmo Creek, an intermittent tributary and an important spawning site for suckers. All sampled fish were identified as Flannelmouth Sucker based on morphology. Genetic analysis focused on hybridization status of individuals, and whether frequencies of hybrids were the same within and among river systems. Overall, 12% and 14% of larvae in the GC and SJR, respectively, had some evidence of introgression with Razorback Sucker (*Xyrauchen texanus*), with marginal differences in frequencies across river systems. Introgressed larvae were randomly distributed in the GC, but not in the SJR. Larvae sampled downstream of McElmo Creek were more likely to be introgressed than larvae upstream. Adults in the SJR showed the same pattern, where adults sampled downstream of McElmo were more likely to be introgressed than upstream. We did not observe F1 or recently backcrossed hybrids in McElmo Creek, suggesting that hybridization with Razorback Sucker is probably occurring downstream. When all introgressed individuals were removed, reanalysis yielded two patterns of population structure. There was no obvious structure in the GC, but the SJR showed evidence of longitudinal differentiation up- and downstream, with hints of an unsampled spawning aggregation upstream.

5.4 | Dynamics of Shark-Infested Waters: How Environmental Factors Shape Blacktip Shark Migrations

Isaac Tuszynski, Stephen Kajiura, Mary Bowers, Ryan Stolee

108 Each winter, thousands of blacktip sharks (*Carcharhinus limbatus*) in the Western Atlantic gather off the coast of southeast Florida. Data from aerial surveys and acoustic telemetry show that these sharks migrate north in the spring, eventually ranging as far north as Long Island. However, these methods cannot quantify the sharks' offshore movements. Further study is also needed to determine how seasonal changes in the environment affect this migration. To address these knowledge gaps, we deployed fin-mounted satellite transmitters on blacktip sharks during their wintering period in southeast Florida (January–March) starting in 2017. We compared the location data from these detections with the surrounding coastline and bathymetry in ArcGIS Pro to quantify distance from shore. We found that these sharks range from the beach to >70 km offshore and were largely constrained to the continental shelf. We also compared the spatiotemporal extent of tag detections with ERDDAP environmental data to identify possible migration drivers. Summaries from the tags' onboard temperature sensors showed that these sharks spent most of their time (~70%) in waters between 22°C and 26°C. Comparison of tag detections with ERDDAP SST data indicate temperature as a probable driver of latitudinal migration. It is likely that these sharks leave their wintering grounds in the spring due to rising water temperatures exceeding their thermal preference range.

3.4 | The Influence of Researcher Disturbance on Frequency of Raccoon (*Procyon lotor*) Predation of American Alligator (*Alligator mississippiensis*) Nests

Clarissa Tuten, Scott Parker, Randeep Singh, Philip Wilkinson, Joachim Treptow, Mark McAlister, Morgan Hart, Andrew Grosse, Ashleigh Nelson, Lindsey Bell, Thomas Rainwater

296 Raccoons (*Procyon lotor*) are dominant predators of reptile nests in the southeastern US, including those of the American alligator (*Alligator mississippiensis*). Studies on alligator nesting ecology often require researchers to create paths through marsh habitat to access nests, potentially introducing sensory cues that raccoons may use to help locate nests. We evaluated the effect of human visitation to alligator nests on the frequency of raccoon nest

predation at two sites in South Carolina. One location, Tom Yawkey Wildlife Center (TYWC), has experienced active alligator research for about 50 years, whereas the second location, Santee Coastal Reserve (SCR), has experienced little historical alligator research. We predicted that human foot traffic associated with nest monitoring increases the frequency of nest predation by raccoons compared to nest sites that do not experience foot traffic. Nests were allocated to three treatment groups: foot-visited nests, drone-visited nests, and non-visited nests. Overall, nests that experienced foot traffic had higher predation frequency (16.7%) compared to nests that experienced no foot traffic (11.1%) however, these differences were not statistically significant ($p = 0.462$). There was a non-significant trend ($p = 0.106$) of increased predation of foot-visited (17.6%) compared to aerially-visited (0.0% predation) and non-visited (5.9%) nests at TYWC compared to SCR where predation frequency was similar among treatment groups ($p=1.000$; foot-visited 15.0%, aerially-visited 10.0%, never-visited 10.0%). These results suggest raccoons may use human cues to locate alligator nests; however, replication of the study over multiple years to increase sample size would help strengthen this analysis.

P1.60 | Fins and Fragments: Navigating Fish Assemblages through Environmental DNA

Emily Vanaselja, Kyle Piller

71 Lake Maurepas is a body of water located on the far western edge of the Lake Pontchartrain Basin in southeastern Louisiana that receives freshwater input from three rivers: Tickfaw River, Amite River, and Blind River. From a biological and especially an ichthyological perspective, Lake Maurepas has received far less study than Lake Pontchartrain, its sister lake. Our knowledge of Lake Maurepas' fish assemblage is based on only a handful of published scientific papers and known geographical distributions of fishes. Therefore, we undertook a comprehensive environmental DNA (eDNA) study to broadly investigate the spatial and temporal variation of the fish assemblage of Lake Maurepas. Water samples from both near shore (N=12/quarter) and offshore (N=12/quarter) sites were taken every three months for a year. Samples were extracted and PCR amplified (12S mtDNA) following a previously developed protocol. This non-invasive approach will provide the most comprehensive summary of the Lake Maurepas fish assemblage to date. The results and implications of our results will be presented.

26.5 | Don't Wanna Be Your Bony Wrench: phylogenetic inferences from skeletal morphology of dwarfgobies, genus *Eviota* (Gobiidae), and other coral-reef gobies

Diego Vaz, Christopher Goatley, Luke Tornabene

411 Dwarfgobies (genus *Eviota*) are a speciose group of cryptobenthic fishes distributed across Indo-Pacific coral reefs. Species of this genus are characterized by their diminutive size (< 30 mm) and for having a very short life span of less than 100 days. Integrative taxonomy in conjunction with underwater photography employed in the last thirty years led to an explosion in descriptions of new species, currently with 128 species. Despite the recent advances on the taxonomy, skeletal anatomy of *Eviota* is poorly known. This study presents accounts of the skeleton of more than 30 species of *Eviota* in addition to comparisons with *Gobiodon*, *Paragobiodon*, *Pleurosicya*, and *Brianinops*. The interopercle of all examined species of *Eviota* extends anteriorly, contacting the lower jaw and lacking the retroarticular-interopercle ligament. In other gobies the interopercle does not contact and is connected to the lower jaw through the retroarticular-interopercle ligament. Species in a clade of *Eviota* united by branched pectoral-fin rays have the posterior tip of the interopercle shaped like a wrench, which articulates directly with the posterior ceratohyal. This condition is different than the observed in any other Gobiidae (and Telestei) to date. *E. prasites*, *E. bifasciata*, *E. atriventris*, *E. lachdeberae*, *E. nigri-ventris*, *E. infulata*, and *E. seebrei* lack the posterior portion of the mesethmoid. Other species of *Eviota* and other gobiid genera have a trapezoidal posterior portion of the mesethmoid that extend posteriorly to the posterior region of the ethmoid cartilage. The phylogenetic significance and implications resulting from these skeletal variations are discussed.

P2.56 | Occupancy Modeling and Population Density of *Chamaeleo calyptrotus* and *Anolis equestris* in Southwest Florida

Anna Velten, Andrew Durso

143 Southwest Florida (SWFL) has become home to a large number of invasive species, which have been known to cause damage to their non-native ecosystems. Species such as the veiled chameleon, *Chamaeleo calyptrotus*, and the knight anole, *Anolis equestris*, have become abundant in SWFL, but their populations have not been studied in depth. This study sought to assess the abundance and distribution of *C. calyptrotus* and *A. equestris* on the campus of Florida Gulf Coast University in SWFL through the use of visual surveys. Fifteen 350 m transects were surveyed six times each after dark. Environmental conditions such as wind speed, humidity, and temperature as well as anthropogenic factors like noise and light were measured for each transect. The tree species composition of each transect was also measured and compared with tree characteristics used by individual lizards. Occupancy models suggested that both chameleons and knight anoles were more likely to be found in areas of lower light and when the duration of surveys are longer. Temperature and humidity appeared to have little effect on the likelihood of finding either species. Finally, we used distance sampling to estimate population density, the first such estimates for these two species in Florida. Larger sample sizes are likely needed in order to make more specific determinations.

23.5 | Using Expert Elicitation to Fill in Gaps in Species Knowledge for Conservation

Hardin Waddle, Jennifer Moore

440 Managers frequently make important conservation decisions about species for which they have incomplete data. Important life-history data are often poorly known or only known from a portion of a species range. However, the knowledge of species experts can fill in important knowledge gaps when properly elicited. We used expert elicitation techniques to compile the survival and reproduction data needed to make a matrix population model of the Wood Turtle (*Glyptemys insculpta*). With the same expert group, we also elicited the most important threats to species and the proportional effect of those threats on survival for the various life stages. By aggregating the expert elicitation values and accounting for uncertainty in the estimates, we were able to build a reliable population growth model that can be used to help understand the contributions of different life stages to population growth. Then by incorporating the threats to those life stages, we can begin to determine which threats that managers could address will have the biggest effect on population growth. This information can be used to allocate resources when cost of actions is included to provide the largest expected effect to a population growth for the budget available. At a time when increasing numbers of species are facing conservation need, these expert elicitation and aggregation methods can provide data and help guide conservation decisions that must be made before sufficient data are available.

26.4 | Bizarre Feeding Behavior in the Moorish Idol (*Zanclus cornutus*)

Peter Wainwright, Michalis Mihalitsis

422 The Moorish Idol is a widespread Indo-Pacific coral reef fish with a striking appearance. Small jaws are mounted on the end of a strongly tapering skull and are endowed with anteriorly pointed, tightly packed elongate teeth. This species feeds on benthic prey including sponges, bryozoans and algae. We studied their feeding behavior when offered tufts of filamentous algae fixed to a firm substrate. Feeding trials were filmed in the lab using 2000 Hz video. Fish showed an unusual ability to flex their jaws laterally as they descended to the benthic prey, allowing them to orient the jaws directly toward the prey. Algae was then gripped in the jaws and pulled away from the holdfast by turning the head away from the substrate as the closed jaws were flexed away from the substrate. We infer that unilateral contraction of adductor mandibulae muscles attaching to the maxilla provide the muscular basis of this behavior. Lateral flexion of the jaws has only been described previously in fishes with asymmetrical skull or jaw structures, such as flatfishes and scale-eating cichlids. Observations of the skeleton and connective tissues indicated that the left

and right mandibles are loosely connected at the midline, allowing one to slide posteriorly on the other as the jaws are laterally flexed. Field GoPro videos from Hawaii demonstrate that this species apparently uses this behavior to achieve a favorable orientation to prey residing in complex reef surfaces and to aid in extracting prey they have bitten.

P1.28 | Spatial Distribution of Whitespotted Eagle Rays from Aerial Surveys in the Florida Keys

Jordan Waldron, Stephen Kajiura

59 The endangered whitespotted eagle ray, *Aetobatus narinari*, is distributed throughout the Atlantic and is commonly found in nearshore waters off the coasts of Florida, where it is listed as a protected species. Previous studies show potential subpopulation structuring in Florida, where populations in the Gulf of Mexico exhibit migratory behavior whereas those in the western Atlantic appear to be resident. Information on the spatiotemporal distribution of *A. narinari* is limited to the east and west coasts of the state and is lacking within the Florida Keys. Therefore, the goal of this study is to determine the abundance and distribution of *A. narinari* in the upper and middle Florida Keys. Aerial surveys were conducted from Government Cut, Miami to Old Bahia Honda Bridge (185km) biweekly in March-June 2023 and January 2024-present. Preliminary results show rays are present in the Florida Keys during all months, but a peak in abundance occurs during March-April. Distribution varied along the transect, with high concentrations of rays found near Key Biscayne and Tavernier Key. These preliminary results suggest a potential seasonal increase in abundance of *A. narinari* in the Keys with some areas of higher concentrations. The continuation of aerial surveys through the end of 2024 and beyond will provide further data on the spatiotemporal distribution of rays in the Florida Keys, which will contribute important information for the effective management of this species.

P1.25 | Tracing the Inheritance of Immune Genes to Estimate Multiple Paternity in Sandbar Sharks (*Carcharhinus plumbeus*)

Riley Wallace, Eloise Cave, Dylan Gore, Erin Brasher, John Philip Ostapovich, Manav Agarwal, Dean Grubbs, Toby Daly-Engel

468 Understanding reproductive strategies is crucial for effective conservation planning. Multiple paternity (MP), when one female's litter is sired by more than one male, is a common strategy in elasmobranchs that may enhance population genetic diversity. Traditionally, MP is detected using microsatellite DNA, but such tools may lack the resolution needed to estimate rates of MP fully. We explored the advantages of the Major Histocompatibility Complex (MHC) genes, which are highly variable elements of the vertebrate adaptive immune system, in detecting multiple paternity in sandbar sharks (*Carcharhinus plumbeus*). We amplified MHC Class IIβ genes in 11 sandbar shark litters and compared results to microsatellite data. Seven litters confirmed the MHC's efficiency in detecting multiple paternity, two litters exhibited a better resolution of multiple paternity with MHC, and one litter showed fewer sires than the previous research. Gene duplication in this species did not appear to interfere with measuring MP. In the future, we plan to examine additional species and conduct comprehensive assessments to fully examine gene duplication. This study demonstrates that the shark MHC is a promising tool for understanding reproductive strategies in elasmobranchs, with the potential to aid in conservation efforts.

11.8 | Bias in hydroacoustic data processing can lead to different fish population estimates

Liam Ward, Garrett Johnson, Wesley Bouska, Benjamin Marcek

92 Side-looking, split-beam echosounder (SSE) surveys are an efficient sampling method for monitoring fish populations without harming sampled individuals. However, density estimates from SSE sampling may be affected by decisions made by individual data processors. For example, manually editing algorithm-derived fish tracks and bottom lines (which set the bounds of useable data), is sometimes necessary, but may impact the number of fish and sample volumes included in subsequent analyses. The goal of this

study was, therefore, to quantify among-processor differences in fish density estimates and compare those to algorithm-derived fish densities. Three individuals processed hydroacoustic data from ten 0.5-mile sites surveyed in Pool 18 of the Mississippi River during October 2022. We compared abundance, density, and volume estimates among processors and between processors and algorithm-derived estimates using generalized or general linear models, depending on the residual distribution of each data set. Preliminary analyses demonstrate that one data processor reported significantly lower density estimates than those generated by the algorithm. Further, fish abundances estimated by all data processors significantly differed from the algorithm-generated abundances. No significant differences were noted for volume estimates between human processors and algorithm-derived volumes. There were also no significant differences among data processors for any of the three metrics presented here. These results demonstrate that individual variation in processing hydroacoustic data can significantly alter fish density estimates, which could consequently influence management decisions. Future directions include increasing processor and transect sample sizes, and identifying areas where standardized training may improve consistency among data processors.

P2.5 | Bias in hydroacoustic data processing can lead to different fish population estimates

Liam Ward, Garrett Johnson, Wesley Bouska, Benjamin Marcek

91 Side-looking, split-beam echosounder (SSE) surveys are an efficient sampling method for monitoring fish populations without harming sampled individuals. However, density estimates from SSE sampling may be affected by decisions made by individual data processors. For example, manually editing algorithm-derived fish tracks and bottom lines (which set the bounds of useable data), is sometimes necessary, but may impact the number of fish and sample volumes included in subsequent analyses. The goal of this study was, therefore, to quantify among-processor differences in fish density estimates and compare those to algorithm-derived fish densities. Three individuals processed hydroacoustic data from ten 0.5-mile sites surveyed in Pool 18 of the Mississippi River during October 2022. We compared abundance, density, and volume estimates among processors and between processors and algorithm-derived estimates using generalized or general linear models, depending on the residual distribution of each data set. Preliminary analyses demonstrate that one data processor reported significantly lower density estimates than those generated by the algorithm. Further, fish abundances estimated by all data processors significantly differed from the algorithm-generated abundances. No significant differences were noted for volume estimates between human processors and algorithm-derived volumes. There were also no significant differences among data processors for any of the three metrics presented here. These results demonstrate that individual variation in processing hydroacoustic data can significantly alter fish density estimates, which could consequently influence management decisions. Future directions include increasing processor and transect sample sizes, and identifying areas where standardized training may improve consistency among data processors.

15.9 | Picking the Nose: investigating dermal denticle orientation at the nares of sharks

Amani Webber-Schultz, Kayla Hall, Brooke Flammang, Lauren Simonitis

195 Dermal denticles cover the entire body of sharks and play a critical role in directing flow around the body. While most fluid-denticle interaction research has been either nonspecific or constrained to the body, dermal denticle imaging and flow research has not examined the nares. Based on previous research, the initial assumption was that dermal denticles will be oriented in such a way that smoothly directs flow into the incurrent naris. Originally discovered on *Squalus suckleyi* (pacific spiny dogfish), we investigate a novel denticle patterning on additional species to determine if it is a recurring phenomenon through micro-computed tomography and scanning electron microscopy. These species include *Squalus suckleyi*, *Sphyrna tiburo*, *Carcharhinus plumbeus*, *Rhizoprionodon terraenovae*, and more. Furthermore, we used particle image velocimetry to analyze the impact of the dermal denticle patterning on fluid flow. We herein show a recurring dermal

denticle patterning at the anterior region of the incurrent naris across species, implying that denticles may be playing a more complex role in narial flow than previously thought.

32.3 | An Integrative Model to Predict Climate Change-Driven Range Shifts in Marine Predators Using Genomics

Anna Weber, Eloise Cave, Charles Bangley, Marcus Drymon, Bryan Frazier, Matt Smukall, Dean Grubbs, Neil Hammerschlag, Toby Daly-Engel

171 As oceans warm under climate change, migratory marine fishes are expected to shift ranges poleward to more favorable habitat. Some large Atlantic sharks are already migrating earlier and establishing coastal nursery habitats further north than has ever been observed. Researchers and managers often estimate habitat use with species distribution models, which draw correlations between organismal occurrence and environmental variables. Yet in widespread species, subpopulations may be locally adapted to specific habitats, causing conventional distribution models to produce generalized predictions that fail to account for regional differences. We aim to develop a spatial modeling platform that integrates genomics and environmental data to forecast the distributions of highly migratory fishes under climate change, while accounting for intraspecific adaptive differences. Our platform is developed using mapped spatial occurrences and genomic data from tiger sharks (*Galeocerdo cuvier*), overlaid with publicly available environmental data such as temperature, dissolved oxygen, salinity, nitrate, and primary productivity. We found that these environmental parameters exert selective pressure unevenly across the species range, as evidenced by strong correlations between these variables and 25 polymorphic loci identified across the tiger shark genome. By incorporating these loci as variables to take local adaptation into account, we can improve model accuracy in predicting the future distribution of shark habitat. Since sharks are keystone predators, this information is crucial to maintaining healthy marine ecosystems under climate change. Further, as availability of genomic data increases, this model can be extended to other migratory fishes, making it an especially useful tool for conservation planning.

21.6 | Epigenetic Age Estimation in the Cownose Ray, *Rhinoptera bonasus*: Implications for Noninvasive Elasmobranch Ageing

Nick Weber, Jennifer Wyffels, Kady Lyons, Andrew Fields, David Portnoy

247 Age data are essential for estimating life history parameters and are thus critical for fisheries assessment and management. Age estimation in elasmobranchs has traditionally relied on the analysis of growth zones in vertebrae, which can be costly and time intensive, of low precision for some species, and is necessarily lethal. Recent studies, however, have demonstrated that DNA methylation levels at certain CpG sites (cytosines followed by guanines) exhibit strong correlations with chronological age, allowing for the development of DNA methylation-based, age-predictive models referred to as epigenetic clocks. While the utility of this noninvasive ageing technique has been demonstrated for a handful of teleost fishes, the ability to develop epigenetic clocks for elasmobranch species of management or conservation concern, without a draft genome, is poorly understood. Therefore, we developed epigenetic clocks for the cownose ray, *Rhinoptera bonasus* ($n = 45$; age 7 to 7,878 days) using aquarium-bred individuals with known dates of birth and two different tissue types (fin clips and whole blood). Reduced-representation DNA sequencing (i.e., RAD-seq) was used to assemble a reference, and enzymatic methyl-seq (EM-seq) was used to identify CpG sites that exhibit age-correlated DNA methylation. Epigenetic clocks were then developed from 100s of CpG sites found within and across tissue types. Overall, results have important implications for future epigenetic clock development and noninvasive age estimation in elasmobranchs.

31.1 | A biodiversity update of West Virginia fishes

Stuart Welsh, Daniel Cincotta, Nathaniel Owens

434 Updates to species diversity lists and distribution data are critical for the management and conservation of faunas at local and regional scales. West Virginia waters contain a rich ichthyofauna in the Central Appalachian region

of North America with the most recent checklist of the fish fauna published in 1995 (164 species). We have recently updated the faunal checklist to include 195 species. A total of 27 fish families are represented in West Virginia waters with the highest diversity in Leuciscidae (58), Percidae (33), Catostomidae (20), Centrarchidae (14), and Ictaluridae (14). The state has two federally endangered species: *Etheostoma osburni* and *Crystallaria cincotta*. A high proportion of non-native species occurs in the New River drainage (65.6%; 32 native, 61 non-native) and Potomac River drainage (60%; 34 native, 51 non-native). Recent additions to the fauna and recent range expansions of non-native species will be discussed, along with the status of the two federally listed species.

P1.90 | Tadpole Gut Microbiota Acquired from Natural Environmental Sources Are Responsive to Dietary Tannins

Rosemary Westcott, Elizabeth Rudzki, Kyle Emerson, Sarah Woodley, Kevin Kohl

50 Tannins are plant-secondary compounds that, when consumed, can have toxic effects on animals, including herbivorous amphibian larvae. Tannins can also interact with the gut microbiota, as these compounds are antimicrobial and can induce changes to the gut microbial community structure. Previous studies on the effects of tannins on tadpoles have been performed in laboratory water, which is largely devoid of natural microbes. Given that tadpoles acquire much of their gut microbial diversity from the aquatic environment, we sought to understand the effects of tannins on tadpole development and gut microbiota when animals were exposed to natural pond water, supplying a repertoire of microbes that are not present in laboratory water. Specifically, we raised green frog (*Lithobates clamitans*) tadpoles under two water treatments for 4 weeks: either natural (microbially-rich) or autoclaved (microbially-depleted) pond water. Animals in these treatments were fed either control diets or diets containing 2% tannic acid. Gut microbial diversity was profiled using 16S rRNA sequencing. The gut microbial community from tadpoles raised in natural pond water was considerably more diverse than that of tadpoles raised in autoclaved pond water. Tannin treatment had a greater effect on gut microbial diversity in the natural compared to the autoclaved pond water group. However, there was no effect of tannins on tadpole body size in either pond water condition. These results indicate that the gut microbiota acquired from natural environmental sources are relatively responsive to dietary tannins, perhaps due to greater opportunities for biotic interactions between tannins and the gut microbiota.

13.8 | Interdisciplinary and human-dimensions research in shark science: Experiences, challenges, and priorities

Julia Wester, Catherine Macdonald, David Shiffman, Divya Karnad, Paula Dominguez

273 Interdisciplinary approaches that incorporate social science disciplines are critical to addressing the wicked complexity of marine wildlife conservation and management. Social research approaches in particular have increased in recent years in shark sciences. In this talk, I will present the preliminary findings of a comprehensive effort to understand the growing field of social science on chondrichthyans, including key challenges and emerging priorities. Focus groups and surveys were used to solicit the experiences, background, and perceptions of those publishing on shark science using social research methods. Data collection and analysis for this research was conducted with the collaboration of the IUCN Shark Specialist Group Human-Dimensions Working Group and includes insights from a global sample of hundreds of published scientific experts. Results highlight the need for cross-disciplinary training and specific support for social research in our field. Findings also summarize emerging research priority areas for interdisciplinary teams.

20.3 | Biomechanics and Morphometrics: Linkage Modeling of Labrid Fishes in Three Dimensions Using μ CT Coordinate Data

Mark Westneat, Samantha Gartner, Kory Evans

497 Computational modeling of musculoskeletal function can yield important insights into force transmission, kinematics, and evolution in functional

systems. Many lever and linkage systems have limited mobility and may be modeled in 2D, yet 3D modeling is required to capture the full functional repertoire of most systems. The explosive increase in μ CT data sets for the skulls of fishes, through the #ScanAllFishes and #oVert projects, is a promising avenue for development of new computational biomechanical models. Here we developed a new three-dimensional computational model of lever and linkage biomechanics in the feeding mechanics of labrid fishes to yield novel mechanical traits, address questions of functional variability, and explore evolutionary patterns across recent phylogenetic trees. We used scans of 206 species of the Labridae (wrasses and parrotfishes), to collect over 200 3D coordinates quantifying the geometric morphometrics of the skull, including the jaw lever systems and the linkages of the anterior jaws, the opercular system, and the hyoid mechanism. Computational modeling shows that the planarity of the anterior jaws system is high, with standard mechanical advantage and kinematic transmission similar to 2D analysis, yet the dynamics of linkage motion, expansion advantage, and path analysis reveal the importance of 3D modeling. Phylogenetic comparative analysis of novel linkage traits in labrid fishes reveals hidden pockets of functional diversity in the transmission of force and motion during feeding.

17.2 | A tribute to Alan Henningsen and his contributions towards shark and ray research, conservation and husbandry

Bradley Wetherbee, Emily Kelly

345 Alan D. Henningsen's accomplishments in husbandry and care of elasmobranchs have left a lasting legacy. Alan received his BS degree at the University of Miami and completed his MS degree at Miami on age and growth of lemon sharks under the supervision of AES founder Samuel Gruber. Alan traveled the world and spent considerable time in Bimini working with "Doc" Gruber. He moved to Maryland where he spent over 30 years at the National Aquarium, establishing many collaborations on husbandry and care of elasmobranchs. Alan mentored numerous interns, volunteers, and coworkers, with a large influence on the aquarium industry and colleagues from other institutions. While at the National Aquarium, he conducted research on the elasmobranchs under his care, published numerous scientific articles and book chapters, and presented his findings at conferences. Alan had a profound appreciation of sawfish, which led to work crafting plans and policies to conserve these critically endangered species. The list of scientific research-based organizations that Alan worked with is impressive and includes the American Elasmobranch Society (AES), Elasmobranch Husbandry Manual, International Union for Conservation of Nature (IUCN) Shark Specialist Group, Association of Zoos & Aquariums (AZA) Sawfish Species Survival Plan (SSP), AZA Saving Animals From Extinction (SAFE) Sharks and Rays International Census of Chondrichthyans. Alan attended the very first AES meeting in 1985 and was heavily involved in AES for the majority of his career. With his gentle manner and thoughtful character, his impact in the field is unparalleled.

P2.17 | Temporal Genomics of Fishes in the Center of Marine Biodiversity

John Whalen

257 The Philippines is the global epicenter of marine fish biodiversity. The Philippines also ranks highest globally for threats to marine biodiversity and coral reefs. Therefore, identifying the impacts of human activity, such as over-exploitation and habitat degradation, on the adaptive potential of fishes in the Philippines is of growing concern. The goal of this study is to identify what genetic level changes have occurred over the past century in the Philippines. The USS Albatross research vessel conducted sampling expeditions across the Philippines between 1907 and 1910 and contemporary duplicate collections were made to sample the same populations. Low coverage whole genome sequencing was used to investigate centennial genetic changes. We hypothesize that we will observe a loss of genetic diversity and recent population bottleneck events, comparable to preliminary data observed in multiple species in a similar system. This study is unique because it successfully sequenced 100-year-old specimens. Differences in declines between species might be due to connectivity differences or localized fisheries and habitat

impacts. This study will help to inform conservation management efforts and highlight the urgent need to protect the adaptive potential of marine fishes in the Philippines.

17.3 | In It for the Long Term: The Role of Aquariums in Supporting Shark Research in a Changing Climate

Nick Whitney, Jeff Kneebone, Ryan Knotek, Caroline Collatos, John Mandelman

278 Although shark research predominantly relies on grants from government agencies and private foundations, most of these grants are awarded over 12-month terms, or rarely for periods of 2-3 years. This short-term funding can be used to address some narrow questions but is inadequate for long-term monitoring of shark populations that is needed to understand the impacts of climate change. This funding gap can be filled by institutions with a mission-driven commitment to conservation, including aquariums. In recent years, the New England Aquarium has supported long-term monitoring of three shark populations using passive acoustic telemetry techniques that can track tagged animals for up to ten years: sand tiger sharks (*Carcharias taurus*) in Boston Harbor, MA, sandbar sharks (*Carcharhinus plumbeus*) in Nantucket Sound, MA, and nurse sharks (*Ginglymostoma cirratum*) in the Dry Tortugas, FL. Here we present how, in addition to their conservation research value, these projects are uniquely suited for aquarium support in that they are: 1) hands-on, involving scientists directly engaging with animals for sampling and tagging, producing compelling images for outreach and education, 2) cross-departmental, providing platforms for staff from multiple departments to collaborate and obtain professional development experience, 3) multi-organizational collaborations, aligning the Aquarium with other institutions and government agencies, and 4) multi-taxa, allowing the Aquarium to monitor multiple shark, fish, and sea turtle species using the same telemetry technology and listening array. We propose that aquariums are uniquely suited to support long-term shark research, and suggest our approach as one model to accomplish this.

P1.26 | Testing and first deployment of a new CTD-tag on pelagic sharks in the Mid-Atlantic Bight

Caroline Wiernicki, Matthew Oliver, Michael Fedak, Aaron Carlisle

489 In the western Atlantic Ocean, the Mid-Atlantic Bight (MAB) is a heavily populated region with a unique physical oceanography that renders it vulnerable to hurricanes. The MAB contains some of the strongest seasonal thermal stratification in the world. This stratification reduces the ability of current hurricane models to predict storm intensity in an accurate and timely matter. Better intensity predictions require greater volumes of water column temperature and conductivity data than currently provided by ships, buoys, and autonomous gliders. The development of new animal-borne conductivity, temperature, and depth (CTD) tags, designed to collect and deliver real-time, in situ oceanographic data, creates a valuable opportunity for scientists and federal agencies to enhance collection of oceanographic data using marine animals as ocean observing platforms (OOPs). Pelagic sharks are good candidates for OOP deployment in the MAB based on their vertical and geographic movement patterns. We deployed these tags for the first time on pelagic sharks and describe their performance. Tag testing includes evaluation of tag CTD and transmission quality via deployment on autonomous vehicles, as well as evaluations of predicted buoyancy and stability through flume tests. Deployment consisted of tagging pelagic blue sharks with CTD tags in the MAB, monitoring transmission success, quality, and frequency, and integrating data collection into the Global Telecommunication System for immediate use. Tag performance will be analyzed for consistency, duration, and data quality, with the goal of developing a new tool for ocean observing that can be used to supplement oceanographic sampling, particularly in data-deficient regions, globally.

P1.87 | Factors Influencing Geographic Variation in Color and Relative Size of Scute Color Patches of Eastern Box Turtles (*Terrapene carolina carolina*)

Marcus Williams, Matthew Lattanzio

112 The size and coloration of light-colored patches within scutes on the carapace of eastern box turtles (*Terrapene carolina carolina*) varies throughout the species' geographic range in North America, yet we know little in regard to the potential drivers of that variability. Given that these traits are generally stable at adulthood and exposed to both climatic conditions and potential predators, scute coloration *T. c. carolina* may be non-random. For instance, darker and/or smaller patches may favor faster heating rates and warmer body temperatures, as well as greater camouflage in forested environments. In contrast, larger and/or lighter patches may be more beneficial in more open-canopied, warmer environments. Here we rely on public photographs (iNaturalist) to provide preliminary insight into the potential functional relevance of the light-colored patch with respect to their physiology (e.g., heat exchange or water balance) and ecology (e.g., habitat-specific background matching). Specifically, we evaluate how relative patch size and patch color (relying on red-green-blue loadings from images) vary with respect to several key bioclimatic variables, land cover and canopy cover estimates. We also consider whether these relationships differ between males and females for a subset of photos. Data analysis is ongoing, however preliminary results support a positive relationship between relative patch size and the average temperature of the driest annual quarter. Overall, we expect our findings to show that turtles observed in more open-habitats, as well as turtles observed towards the southern edge of their distribution, exhibit larger and more lighter-colored patches overall.

P1.32 | Assessing the effect of abiotic variation on bonnethead (*Sphyrna tiburo*) estuarine habitat use

Sabrina Wilner, James Kilfoil, Bryan Frazier, Bryan Keller

235 The bonnethead is a small, coastal shark, whose range in the western North Atlantic Ocean extends from North Carolina to Brazil along coastal and insular habitats. This species is migratory and demonstrates high site fidelity to estuarine waters from spring to fall; some individuals having been observed returning to the same estuary for eight years in a row. While high site fidelity has been observed, they do not appear to display the same fidelity to winter habitats. The fine-scale spatiotemporal dynamics within estuarine systems is not well understood. In this study, we aim to: delineate the fine-scale movement patterns of bonnetheads in the North Edisto River, South Carolina; assess the effect of abiotic variation on space use across tidal and diel cycles; and determine if habitat partitioning or site fidelity to particular areas within the river occurs. Using active acoustic telemetry, 10 individuals will be tagged in the North Edisto River and manually tracked for periods up to 48 hours to assess space use patterns and environmental parameters.

P2.78 | The Effects of Ambient Light at Night on Anole Energetics

Kerrigan Wilson, Christopher Howey

175 Prolonged exposure to ambient light at night (ALAN) can be linked to increased glucocorticoid concentrations in the body, causing disruption to circadian rhythms, hormone regulation, immune function, and reproductive processes, all of which can influence an organism's body condition. Organisms living in habitats exposed to ALAN may need to cope with physiological effects or may be able to use behavior to avoid ALAN. The objective of this project was to measure the metabolic rates, food consumption, behavior, and body condition of Green Anoles (*Anolis carolinensis*) exposed to ALAN and to determine if anoles could use behaviors and/or energy reallocation to cope with the ALAN stressor. For nine weeks following a one-week acclimation period (10 weeks total), anoles ($n = 18$) were kept in either a room with constant ambient light or ($n = 18$) were kept in a room with a 12:12 Light:Dark cycle. Half of the anoles were provided a hide box where they could escape ambient light. Metabolic rates were measured at the beginning and end of the project. Anoles were fed crickets every 3-4 days and monitored daily to determine food (i.e., energy) consumption. Preliminary results have shown disruption in

circadian rhythms regarding metabolic rates, no change in body condition, increased food consumption, and possible reallocation of energy from other physiological processes (i.e., reproduction). This project aims to expand on these preliminary results and improve knowledge of how environmental stressors physiologically affect an organism's homeostatic state.

12.6 | Artificial Light Preference in a Wide-spread Invasive Species (*Hemidactylus turcicus*)

Samuel Wilson, Desi Joseph, Samuel Miess, Guinevere Wogan

393 Invasive species are becoming increasingly more common in urban and suburban areas. These areas harbor a range of differences in habitat, such as artificial lighting and increased disturbance. The Mediterranean House Gecko, *Hemidactylus turcicus*, is a widespread invasive species that is found in many large cities across the United States. Our goal is to understand whether artificial light influences abundance in this species and what factors make these artificial lights more attractive. We hypothesize that geckos will be found in higher abundance by artificial lights but that this trend is higher in colder climates (higher latitudes). We predict this is because of two reasons: these lights attract prey (insects) and they emit heat that allows these geckos to live in more northern areas. We travelled across the United States to 20 cities, where 2-3 sites were sampled. In these sites, we collected intensity of light (lux), for all geckos seen. We also measured temperature (C) and bug abundance at different distances from light in these areas. Using collected samples, we sampled gut content to understand if there is correlation between arthropods attracted to light and those found in the gut content. We found that *H. turcicus* is attracted to artificial light with significant differences in juvenile and adult populations. Our diet analysis found a variety of arthropods in both juveniles and adults. These results may provide some explanation for the success of *H. turcicus* as an invasive species.

2.1 | Temporal diversification of Percidae

Julia Wood, Thomas Near

352 Biogeographers have long studied lineages of organisms that span disconnected regions to investigate the role of large scale processes like continental drift and the formation and decimation of land bridges in generating biodiversity. A compelling system for the study of historical biogeography is Percidae, a clade of freshwater teleost fishes with a Holarctic distribution. Percidae comprises 12 major lineages classified as genera, with four genera endemic to Eurasia, two that span North America and Eurasia, and six that are endemic to North America. Seventeen species of Percidae are endemic to Eurasia and approximately 290 species are endemic to North America. Despite several molecular phylogenetic studies, relationships of the major lineages of Percidae remain unresolved. Discordance among studies is likely due to the use of different types of molecular data and inherent limitations of early datasets generated with Sanger-sequencing. Here, we use DNA sequences from ~1,000 ultraconserved elements to infer a phylogeny of Percidae, estimate divergence times using tip-dating analyses with the fossil record of Percidae, and reconstruct the historical biogeography of the clade.

P1.45 | Pleistocene speciation in a temperate biodiversity hotspot

Julia Wood, Adam Taylor, Daemin Kim, Maya Stokes, Thomas Near

364 Southeastern North America is a temperate biodiversity hotspot for freshwater fishes. Despite nearly two centuries of research, species of freshwater fishes in southeastern North America are still being discovered and described. Much of this diversity is concentrated in the Eastern and Interior Highlands, termed the Central Highlands prior to glacial fluctuation that altered the landscape and influenced river drainage patterns. The Eastern and Interior Highlands are characterized by high gradient, rocky streams, whereas the lowland regions separating disjunct highlands are characterized by low gradient streams. Biogeography of the Central Highlands has long been studied to gain insight into the evolutionary mechanisms responsible for the rich aquatic fauna that comprises the southeastern North American biodiversity hotspot. Here, we use next-generation DNA sequencing and traditional meristic data to infer phylogenetic relationships, assess phenotypic

divergence, and delimit species among the geographically disjunct populations of *Percina evides* (Gilt Darter). Phylogenetic delimitation results in four genetically distinct and phenotypically disparate species. The new delimitation of species in the *Percina evides* complex is discussed in the context of previous biogeographic hypotheses and the role of refugia in shaping the post-Pleistocene landscape of freshwater fishes in eastern North America.

P2.84 | Community engagement in a summer undergraduate research program: Two approaches

Sarah Woodley

267 As the pace of technology and globalization increases, there is increasing concern about the scientific literacy of Americans. A scientifically literate public is necessary for developing a workforce that can understand and solve numerous problems facing the world and for improving the welfare of self and others. Poor science literacy is exacerbated by the general failure of scientists to effectively engage with the public. However, scientists rarely have an opportunity to develop and practice the skills and disposition for meaningful public engagement. To address this training gap, we incorporated community engagement into our 10-week summer undergraduate research program using two approaches. In the first approach, undergraduates devoted 1-2 hrs per week to translate their research programs into science activities that they shared with youth attending a day camp in a Pittsburgh neighborhood (4 years). In the second approach, undergraduates participated in a 1-week STEM camp for Pittsburgh High-school students that was held on the Duquesne campus (2 years). Attitudes of the undergraduate towards community-engagement were assessed using a retrospective post-test. Here, I compare the learning gains as well as limitations of each approach. Regardless of the approach, results indicate that community-engaged learning via sharing science with children is a meaningful addition to a summer undergraduate research program. By giving scientists-in-training opportunities to share science with the non-expert public, we hope they will become better communicators and more receptive to civic engagement in the future. This work was partially funded with grants from the NIH (R25) and the NSF (REU).

5.8 | Ontogenetic shifts in habitat use and home range of juvenile Smalltooth Sawfish in a southwest Florida nursery

Andrew Wooley, Gregg Poulakis, Dylan Yakich, Lukas Heath, Zach Siders, Andrew Carlson

327 Juvenile Smalltooth Sawfish (*Pristis pectinata*) in southwest Florida use nursery habitats for at least their first 2 or 3 years. Past studies have analyzed fine-scale movement and habitat use of small juvenile sawfish in the rivers of Charlotte Harbor, as well as large-scale migrations of large juvenile and adult sawfish. This study aims to identify how juvenile sawfish change the way they use and occupy space within the nursery as they grow. From 2017 through 2021, Florida Fish and Wildlife Conservation Commission biologists used a combination of gear types to catch and tag juvenile Smalltooth Sawfish in the Charlotte Harbor estuary. In this time, 180 juvenile sawfish were implanted with 5- or 10-year internal acoustic transmitters. This study combines catch data and acoustic telemetry data with various statistical analyses to visualize movement, characterize residency, and compare home range across size classes. Acoustic data from 65 tagged sawfish suggest that juveniles may be spending up to their first 5 years in Charlotte Harbor. We hypothesize that habitats used by juveniles increase in depth as sawfish increase in size. Likewise, we hypothesize that juvenile home range expands within the nursery as they grow larger, before eventually leaving the estuary and joining a migratory population of large juveniles and adults. There are management implications for understanding region-specific patterns in habitat use and home range, and further knowledge could help define large juvenile and adult critical habitat.

P1.12 | Using Baited Remote Underwater Video to Characterize Shark Nursery Habitat Use in a Low-Visibility Estuarine System

Sarah Worthington, Jim Gelsleichter

170 Recently, there has been increasing use of baited remote underwater video (BRUV) surveys for assessing the species composition and relative abundance of shark populations in marine ecosystems. This approach can be useful because it may provide a non-destructive, non-extractive, and cost-effective alternative to traditional fishing-based methods. However, to date, most studies using BRUVs have focused on their use in high-visibility ecosystems, such as tropical reefs. Furthermore, few studies have compared results from BRUV surveys with those obtained using traditional methods to evaluate the efficacy of this approach. Therefore, the goal of this study is to evaluate the effectiveness of using BRUV surveys to assess shark populations in low-visibility ecosystems. We are addressing this goal by comparing shark presence and abundance surveys conducted using BRUVs and bottom longline fishing in the Tolomato River, a northeast Florida estuary that has been shown to serve as a communal nursery habitat for juveniles from multiple coastal shark species including the sandbar (*Carcharhinus plumbeus*) and the scalloped hammerhead (*Sphyrna lewini*). Based on analysis of the first year of BRUV deployments, data suggest that BRUVs can work; however, visibility is limited and there is a possibility of underreporting animals at a moderate distance. Some species have been detected by both survey methods, but BRUV surveys have demonstrated a different relative species composition than bottom longline surveys. This presentation will showcase results from the first year of deployments of BRUVs in this estuary.

25.2 | Unprecedented Rates of Parthenogenesis in Zebra Sharks *Stegostoma tigrinum*

Jennifer Wyffels, Kady Lyons, David Portnoy, Christine Dudgeon, Kevin Feldheim

67 Parthenogenesis is known to occur across elasmobranchs in both viviparous and oviparous species. Cases of parthenogenesis have been primarily documented by happenstance when husbandry staff discover neonates in exhibits where adult females are housed in single-sex populations; therefore, the true rate of parthenogenetic development is unknown. This study focused on the zebra shark (*Stegostoma tigrinum*), an oviparous species commonly housed in aquariums where this mode of reproduction has been documented to occur, to quantify baseline rates of parthenogenesis. Over the course of one year, all yolked egg from 13 females across 7 institutions were incubated for several weeks to allow for visual identification of embryos in early development at the time of dissection. Tissue samples were taken for microscopy and genetic confirmation of parthenogenesis through microsatellite genotyping. Parthenogenesis was detected in all females and across all institutions, regardless of male presence or absence. There was one exception, a maturing female who laid only five eggs during her first year of laying where no embryos were identified either visually or through genetic testing of egg fluid. For institutions where all eggs were monitored for an entire year, the baseline rate of parthenogenesis was unexpectedly high, suggesting that this phenomenon occurs more often than previously recognized. The prevalence of this phenomenon may complicate conservation efforts aiming to release genetically-diverse offspring back into the wild.

25.9 | Reconciling conservation objectives with captive display of sand tiger shark

Jennifer Wyffels, Brittney R Goodwin, Rachel Munson, Kevin Feldheim, Kady Lyons

505 Ultrasound has been used to estimate fecundity in both viviparous and oviparous species, negating the need for lethal sampling which is problematic for those of conservation concern. Currently, a multi-institutional effort is underway to re-wild the endangered Zebra Shark (*Stegostoma tigrinum*) to locations where this species has been previously extirpated by leveraging aquarium collections as a source of brood stock. However, while Zebra Sharks are fecund, a large percentage of yolked eggs degrade or spoil within the first few weeks post-oviposition. Therefore, ultrasonography represents a

potential tool that could be used to both accurately distinguish fertile from non-fertile eggs and to diagnose changes in early embryonic development predictive of poor outcomes. Freshly laid eggs from four female Zebra Sharks were collected by aquarists daily from two enclosures at Aquarium of the Pacific. Eggs were incubated undisturbed for two or three weeks at 23.8 – 25°C and then underwent weekly exams via ultrasound to monitor embryo development. Eggs were evaluated for: yolk integrity, egg case fluid homogeneity and embryo morphology. Abnormalities were observed in the majority of samples (n = 69, 67%) as early as 16 days to 93 days post-oviposition. Common abnormalities included: bent or curled tails, anechoic fluid pockets forming at the attachment of the yolk stalk to the yolk, and sluggish movement. Ultrasonography was found to be an effective and non-invasive method to determine egg fertility, identify embryos with developmental abnormalities and track growth rates.

11.18 | Assessing Kinship and Recruitment in the Freshwater Sawfish (*Pristis pristis*) in Northern Australia

Lila Xenakis, Karissa Lear, David Morgan, Toby Daly-Engel

252 The freshwater (or largemouth) sawfish (*Pristis pristis*) is a benthic, diadromous ray whose geographic range was the largest of all sawfishes, spanning across the Indian, Pacific, and Atlantic Oceans. However, their abundance has declined >60% due to overfishing and habitat loss. Now this species is rare across most of its former range except in Australia, and is currently listed as Critically Endangered on the IUCN's Red List of Threatened and Endangered Species. The Fitzroy River in the Kimberly region of north-western Australia is an important nursery habitat for *P. pristis*, and is relatively pristine due to its remoteness, lack of coastal development, low human population density, and low commercial fishing pressure. The Fitzroy River is a large (~100,000 km²), highly dynamic system with distinct wet and dry seasons and occasional flooding that is known to influence *P. pristis* recruitment into the river. The river is now being considered for water resource development, but previous genetic studies have given contradictory results on dispersal and population structuring, making it difficult to formulate a conservation plan. This study will analyze ~300 DNA samples collected from *P. pristis* in the Fitzroy River over the past two decades to determine kinship, relatedness, and recruitment patterns using thousands of single nucleotide polymorphisms (SNPs) generated with next-generation sequencing technology. With these findings, we can provide a better understanding of *P. pristis* reproductive ecology to assess and manage threats affecting mortality rates within critical reproductive habitats, paving the way for more effective conservation of this at-risk predator.

11.3 | Sawfish Rescue Mission: a Case Study Highlighting the Importance of the U.S. Sawfish Recovery Hotline

Dylan Yakich, Andrew Wooley, Lukas Heath, Gregg Poulakis

330 Marine pollution is an ongoing problem that affects many fish and wildlife species, including the endangered smalltooth sawfish, *Pristis pectinata*. On 8 February 2023, a badly entangled 15-foot-long adult female was found by anglers in the Ten Thousand Islands, Florida, which was reported to the U.S. Sawfish Recovery Hotline. At that time, the fish was still strong and eluded the anglers. However, when it was reported again on 15 March 2023, the entanglement had become worse, and the fish had become lethargic. A charter captain and state law enforcement staff monitored the fish while permitted research staff mobilized. We discovered that a stone crab trap float line was deeply embedded around the rostrum and wrapped around the emaciated body, with the 40-pound trap still attached, dragging behind. After removing all debris, the fish was tagged with an acoustic transmitter and safely released. Consensus with the team was that this fish was close to death. Two months later, we detected this fish near the mouth of the Caloosahatchee River, Florida, about 80 km north, indicating it survived the ordeal and was recovering. The U.S. Sawfish Recovery Hotline is a key tool that promotes recovery of this species, including successful responses to injured individuals.

35.6 | Stability and Spatial Variance of Manta-Associated Fish Aggregates and Symbioses in south Florida

Emily Yeager, Jessica Pate, Catherine Macdonald

131 Despite their importance to organismal and ecosystem success, symbiotic associations in marine environments are often poorly understood. This is particularly true for interactions involving highly mobile or migratory species where it is difficult to observe symbioses over time. In the case of manta rays, casual and temporary associations with fish and other hitchhiker species is documented, but the extent of these interactions and the stability of symbiotic relationships over time remains relatively unknown. Here we assessed eight years of manta (*M.c.f.birostris*) visual survey data to categorize the stability of individual manta-associated fish aggregates over time and identify the relative spatial variance of those associations on the manta ray. Surveys were conducted by free divers from small vessels in south Florida and included extensive video collection. Videos were analyzed for individual manta identification and symbiont species identification, count, and spatial position relative to the host. Preliminary results indicate variation in individual manta community structure over time but relative spatial consistency across symbiotic species. Studying manta-associated fish aggregates and symbiont community structure may help us understand the ecological importance of these associations and their potential to serve as markers of stability in ecological communities. In order to adequately conserve and protect these charismatic rays, it is critically important to understand how they interact with and support the ecosystems they exist in.

30.5 | Diet of Deep-reef Lionfish in the Caribbean using DNA Metabarcoding

Sarah Yerrace, Aly Liu, Carole Baldwin, Ross Robertson, Katherine Maslenikov, Luke Tornabene

223 Indo-Pacific Lionfish (*Pterois volitans*) are a well-established invasive species in the western Atlantic that have been observed on deep reefs down to ~300m. Lionfish presence on deep reefs is concerning given their negative impacts on biodiversity and recruitment seen on shallow reefs. Deep reef fish communities are poorly known, but preliminary studies indicate that deep reefs are home to many rare, undescribed, or highly endemic species, making them highly vulnerable to lionfish predation. Understanding what lionfish are eating and how they are moving on the reef is a necessary first step to understand what impact these foreign predators will have on rariphobic communities in the Atlantic. Using spearfishing and a manned submersible, 137 lionfish were collected off the southern coast of Curacao down to 200m. Gut contents were identified using a combination of visual identification and DNA metabarcoding of the mitochondrial cytochrome c oxidase I gene. DNA sequences were matched to a custom database of 16,000+ sequences from fishes collected in the Western Atlantic. Lionfish collected across the reef slope are feeding on deep- and shallow-reef prey species. N=51 different species were detected, far more than using visual techniques alone. Commonly detected genera include *Chromis*, *Corphopterus*, *Apogon*, and *Stegastes*. Our results provide key insight as to the threats lionfish may pose to vulnerable deep-reef ecosystems.

36.10 | Budding acoustic tracking research for the movement of elasmobranchs in Taiwan

Chiju Yu, Huahsun Hsu, Lisa Hoopes, Alistair Dove, Chris Coco, Kwangming Liu, Shoujeng Joung

488 Fisheries biology of elasmobranchs has undergone scrutiny over the course of several decades, yet our knowledge of the time-spatial movement of these animals remains limited. Particularly noteworthy is the proclivity of endangered elasmobranchs to engage in expansive migratory patterns spanning diverse aquatic domains. Consequently, the imperative for international collaboration is underscored, as such cooperative endeavors are integral to the effective implementation of sustainable management strategies for elasmobranch populations. In recent years, acoustic telemetry has become a convenient tool for tracking research and is gradually being widely utilized. Properly setting up receiver arrays, choosing suitable tags, and adopting effective tagging methods are conducive to advancing research. This project

progressively deployed receivers in the surrounding waters of Taiwan and collaborated with other acoustical telemetry teams since 2023. Currently, we have set up 14 receivers in both the eastern and western waters of Taiwan, including Yilan, Hualien, Taitung, Dongsha, and Penghu. Simultaneously, this research placed transmitters on/in 26 cartilaginous fish and released them, including external transmitters on 12 whale sharks (*Rhincodon typus*), 4 Taiwanese wedgefish (*Rhynchobatus immaculatus*), 3 brown guitarfish (*Rhinobatos schlegelii*), and 1 white-spotted bambooshark (*Chiloscyllium plagiosum*), as well as internal transmitters through surgery in 5 sicklefin lemon sharks (*Negaprion acutidens*) and 1 tiger shark (*Galeocerdo cuvier*). In forthcoming work, we plan to set up more receivers, tag and release various endangered elasmobranchs, and actively seek collaborations in acoustic telemetry. This project aims to provide more favorable references for the sustainable management of elasmobranch resources in the future.

14.6 | Ontogeny of Larval Schooling and Effects of Ocean Acidification in Atlantic Silversides (*Menidia menidia*)

Max Zavell, Jenna O'del, Matthew Moulard, Jacqueline Webb, Hannes Baumann

44 Schooling in fishes increases foraging success and decreases predation risk, and sensory input from the lateral line system (LL) plays an important role. Previous studies have examined the effects of ocean acidification (OA, elevated CO₂) on other larval fish behaviors, here we present the first results on the effects of OA on schooling and development of the LL in silversides from fertilization to 25 days post hatch (dph) under control (400 μ atm, ~8.15 pH) and elevated (4200 μ atm, ~7.20 pH) pCO₂ conditions. Onset of schooling was inferred from changes in the distance distribution between larvae (from 2 to 25 dph) obtained from thousands of calibrated digital images. We found evidence that CO₂ delays the onset of schooling by 10 dph (control at 8 vs. elevated at 18 dph), as marked by a change in distance distributions (from random to a 'clumped', 'schooling' pattern). This might be due to differences in timing of neuromast differentiation and LL canal development, which we subsequently assessed with fluorescent staining (4-di-2-ASP) and SEM, respectively. Preliminary analyses show no differences in the timing of increase in neuromast numbers or in the timing of LL canal development between CO₂ treatments. Further work is needed to explain this result, as a delay in the onset of schooling is predicted to be detrimental to larval foraging and ultimately to survival.

P1.48 | Resiliency of Early Life History Stages of Black Sea Bass, *Centropristis striata*, to Future Ocean Acidification

Max Zavell, Hannes Baumann

43 Ocean acidification is known to affect numerous traits in early life history stages of fishes, but the experimental results do not allow generalizations to be made. It has been suggested that species resilient to elevated CO₂ levels inhabit more CO₂-variable inshore environments, but what about species that move between inshore and offshore bottom habitats? We determined the CO₂-sensitivity of the larvae of northern stock Black Sea Bass (*Centropristis striata*, BSB), an ecologically and economically important fish that migrates from offshore overwintering grounds to coastal spawning and nursery areas. We reared larvae from wild-caught fish at three pCO₂ levels (~400, ~2200, ~3000 μ atm), from 0 to 10 days post hatch (dph, onset of flexion and end of the initial exogenous feeding stage). No statistical effects of pCO₂ were found on hatching success or survival to 10 dph. Larval growth increased with increasing pCO₂ (0.11→0.17 mm d⁻¹), with 'extreme' individuals growing 55% faster (were 1.2× larger) than control conditions (~400 μ atm). BSB larvae may thus acquire their surprisingly high CO₂ tolerance either via high CO₂ exposure in inshore spawning grounds or via parental exposure to high CO₂ in productive inshore environments or at offshore depths during overwintering.

24.2 | Pre- and Post-Copulatory Sexual Selection Contribute to the Evolution of Eye Size in Poeciliid Fishes

José Jaime Zúñiga-Vega, Vianey Palomera-Hernández, Karla García-Cabello, Eugenia Zandonà

155 Across animal taxa, visual acuity is positively correlated with eye size. Several factors have certainly influenced the evolution of larger eyes and, hence, of superior visual capacity. In aquatic organisms, water turbidity and light intensity are well known selective factors of eye size. However, the social environment can also exert strong selective pressures on visual capacity and, in particular, the type of female sexual selection might represent an additional factor that shapes the evolution of eye size. In this study, we focused on viviparous fishes of the family Poeciliidae to compare optimal eye size between species in which females rely on the visual evaluation of males (pre-copulatory sexual selection) and species in which females do not visually examine their potential mates but instead apparently rely on cryptic female choice (post-copulatory sexual selection). Using modern phylogenetic comparative methods, we found that species that exhibit pre-copulatory female choice have slightly larger eyes compared to species that exhibit post-copulatory female choice. In addition, we analyzed the influence of different proxies for water turbidity and predation pressure, which are environmental factors that could have also contributed to the evolution of eye size. However, we found no effects of these proxies on the variation among species in eye size. Our findings suggest that the visual evaluation of males by females that occurs in some species has contributed to the evolution of larger eyes and presumably enhanced visual acuity compared to species in which females rely to a greater extent on cryptic female choice.

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