Southeastern Fishes Council 46th Annual Meeting
Virtual Meeting via Zoom
November 19-20, 2020
All times are in Central Time Zone

Thursday, Nov 19th

9:00-10:30 am	Welcome and Presentation Session
10:30 am	Morning break
10:45-12:00 pm	Presentation Session
Noon	Lunch break
1:30-2:40 pm	Presentation Session
2:40-2:50 pm	Discussion
2:50 pm	Afternoon break
3:00-4:00 pm	Presentation Session

Friday, Nov 20th

9:00-10:15 am	Presentation Session
10:15 am	Morning break
10:35-10:50 am	Presentation Session
10:50-11:00 am	Discussion
11:00 am	Business Meeting
12:00 pm	Awards Ceremony
1:30-5:00 pm	Workshop: Introduction to Geometric Morphometrics in R

A zoom link will be sent out to registered individuals the week of the meeting. When you join, your video and microphone will be set to off. If you wish to ask a question, enter it into the chat, and meeting moderators will present the questions at the end of the talk. For lightning talks, questions can be asked during the designated discussion period or at scheduled breaks. Emails have been included with every abstract if you have additional questions for the presenter.

Southeastern Fishes Council 2020 Annual Meeting TECHNICAL PROGRAM (presenter in bold)

All times are in Central Time Zone

Thursday: early morning

9:00. **Brian Alford, Chair**
Introductory remarks

9:15. **Kearstin Findley**, Henry L. Bart Jr., Kyle R. Piller
Student Presentation (G)
Distributional assessment of six imperiled freshwater fish species in Louisiana

9:30. **Willow Newman**, Chance Garrett, Matthew Gifford, Ginny Adams, and Reid Adams
Student Presentation (U)
Turning Up the Heat: Thermal Tolerances of Fishes in the Kings River, Arkansas

9:45. **Daniel P. Morrill**, S. R. Adams, G. Adams, Matthew H. Connolly
Student Presentation (G)
Historical Changes in Fish Assemblage Structure within the Ozark Plateau of Missouri and Arkansas

10:00. **Nastasia Disotell**, Zachary Wolf, Mollie Cashner, and Rebecca Blanton
Student Presentation (G)
Are neighbors pillaging nests: detecting allopaternal care in the imperiled Egg-mimic Darter (Percidae: *Etheostoma pseudovulatum*)

10:15. **Jacob F. Brumley**, Rebecca E. Blanton, and Mollie F. Cashner
Student Presentation (G)
Impacts of habitat loss on the genetic diversity of *Etheostoma lemniscatum*, the Tuxedo Darter

10:30. **Morning break**

Thursday: late morning

10:45. **Joshua Hubbell**, Jake Schaefer, Brian Kreiser
Student Presentation (G)
Functional connectivity begets conflicting impacts of landscape gradients on the occupancy and genetic distance of two headwater fishes

11:00. **Aaron Coons**, Amanda Rosenberger, Jacob Westhoff

Student Presentation (G)

Multi-Scale Habitat Associations of Longnose Darters (*Percina nasuta*)

11:15. **Loren W. Stearman** and Jake F. Schaefer

Student Presentation (G)

Do Communities Respond to Processes at Different Scales During Disturbance?

11:30. **Maggie E. Coffey**, Thomas F. Laughlin, T. Andrew Joyner, and M. Kevin Hamed

Student Presentation (G)

Use of ecological niche modelling to inform management strategies for the Tennessee Dace (*Chrosomus tennesseensis*)

11:45. **Joseph Miller**, Ginny Adams, and Reid Adams

Student Presentation (G)

Status and Detectability of the Colorless Shiner (*Notropis perpallidus*), a Rare Minnow Endemic to Arkansas and Oklahoma

12:00. **Lunch**

Thursday: early afternoon

1:30. **Courtney A. Weyand** and Jonathan W. Armbruster

Student Presentation (G)

Taxonomic relationships within the genus, *Rhinichthys* using previously accessioned GenBank sequence data

1:45. **Scott Meyer**, Christian Cox, and Jamie Roberts

Student Presentation (G)

Conservation genomics of eight imperiled freshwater mussel species

Lightning talks:

2:00. **Noah Daun** and Jake Schaefer

Student Presentation (G)

Always Freckled, Rarely Spotted: Assessing Percina lenticula populations in Mississippi.

2:05. **Jeff Stevens** and Xingli Giam

Student Presentation (U)

Winners and Losers: Life History, Ecological, and Behavioral Trait Impact on Native Invasions in the Tennessee River System

2:10. **Grace Davenport**, Jennifer Main, George Gavrielides, Calvin Rezac, Ginny Adams, Reid Adams

Student Presentation (U)

Do Farm Ponds and Small Impoundments Influence Fish Assemblages in the Black River Watershed in Arkansas?

2:15. **Chance Garrett**, Ginny Adams, Reid Adams
Student Presentation (G)
Fish Community Dynamics in Two Intermittent Ozark Headwater Streams having Different Levels of Connectivity

2:20. **Jessica Rath**, Reagan Spinelli, Ginny Adams, and Reid Adams
Student Presentation (U)
Does Gut Length of Luxilus pilsbryi Vary in Response to Stream Drying?

2:25. **Calvin Rezac**, Daniel Morrill, Ginny Adams, Reid Adams, and Robert Hrabik
Student Presentation (G)
Rediscovery of the Pallid Shiner, *Hybopsis amnis*, in the Black River System of Arkansas and Missouri

2:30. **Jessica K. Wilks**, Gregory J. Glotzbecker, Gary D. Grossman, Michael J. Blum
Student Presentation (G)
Fitness of interspecific hybrids in the genus *Cyprinella*: An evaluation of swimming performance in stream fishes

2:35. **Reagan Spinelli**, Jessica Rath, Ginny Adams, Reid Adams
Student Presentation (U)
Morphological and Dietary Responses of Fishes to Stream Drying

2:40. **Discussion**
2:50. **Afternoon break**

Thursday: late afternoon

3:00. **Jason O'Connor**, Christopher Anderson, Travis Tuten, Rick Stout, Nia Morales, and Ramesh Paudyal
Who really cares about rare fish conservation? Awareness and attitudes about rare fish and their management in Florida

3:15. **Bernie R. Kuhajda** and Shawna M. Fix
Imperiled Mobile Basin shiners and darters: doing better than you might think!

3:30. **Thomas J. Near**, Liam U. Taylor, and Jeffrey W. Simmons
Genomics and museomics inform translocation strategies in the endangered Bluemask Darter, *Etheostoma akatulo*

3:45. **Shawna M. Fix**
Life History of the Federally Endangered Laurel Dace (*Chrosomus saylori*)

4:00. **Jessica Grady**, Chris M. Gienger, Luke M. Bower, Rebecca E. Blanton
Environment and phylogeny influence scale shape variation in Etheostomatinae darters

Friday: early morning

9:00. **Bryn H. Tracy**, Fred C. Rohde, Gabriela M. Hogue
An Annotated Atlas of the Freshwater Fishes of North Carolina

9:15. **Ian Hurst**, Matthew Wagner, Robbie Ellwanger
The Distribution and Status of Ironcolor Shiner (*Notropis chalybaeus*) within the Coastal Plain of Mississippi

9:30. **Robert J. Ellwanger** and Matthew D. Wagner
The Distribution and Status of Freshwater Mussels in the Bear Creek Watershed in Mississippi

9:45. Dustin R. Thomas, Hilary K. Canada, Brett Timmons, Leah Berkman, Chelsea Titus, Allison Asher, and **Brook L. Fluker**
Genetic assessment of Walleye in the Eleven Point River, Arkansas, following a six-year stocking gap

10:00. **Steven L. Powers** and Dakota R. Spruill
Habitat Partitioning and Associated Morphological Differences Among Three Species of Catostomidae (Teleostei: Actinopterygii) in the South Fork Roanoke River, VA.

10:15. **Morning break**

Friday: late morning

Lightning talks:

10:35. **Scott A. Smith**, Fred C. Rohde, and Bryn H. Tracy
NCfishes.com: a website devoted to North Carolina's freshwater and saltwater fishes

10:40. **Nathaniel P. Hitt** and Michael Floyd
Modeling occupancy of rare stream fishes in the Upper Cumberland and Kentucky River Basins: effects of environmental quality and the detection process

10:45. **Bruce Stallsmith**
Luxilus chrysocephalus, Striped Shiner, Spawns March - May in North Alabama

10:50. **Discussion**
11:00. **Business Meeting/Awards Ceremony**
1:30. **Workshop: Introduction to Geometric Morphometrics in R**

Southeastern Fishes Council 46th Annual Meeting Virtual Meeting via Zoom

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PRESENTATION ABSTRACTS
(presenter underlined)

Kearstin Findley[1,3], Henry L. Bart Jr.[2], and Kyle R. Piller[1]

Distributional assessment of six imperiled freshwater fish species in Louisiana

Determining the status of imperiled fishes is crucial for the implementation of effective management practices. The status of fish species in the southeastern U.S. is particularly important to assess, due to the high rates of imperilment in such a species-rich region. This study applies a modern approach to assess the distribution of six imperiled freshwater fish species in Louisiana using MaxEnt modeling combined with targeted field sampling. We used field sampling to ground-truth the models for each species (*Cyprinella camura*, *Hybopsis winchelli*, *Pteronotropis signipinnis*, *Noturus munitus*, *Etheostoma caeruluem, and Percina lenticula*) by sampling both known and unknown localities. Target species were collected at 15 of 28 known localities and 9 of 21 unknown localities. Our results suggest that ecological niche models (ENM's) predict species distributions more accurately for certain species than for others. Although ENM's can positively predict distribution for some aquatic species, more relevant aquatic data should be incorporated to increase accuracy.

[1] Southeastern Louisiana University, Department of Biological Sciences; [2] Tulane University, Biodiversity Research Institute; [3] University of Arkansas, Arkansas Cooperative Fish and Wildlife Research Unit

Keywords: ecological niche modeling; MaxEnt; freshwater fish conservation
Email: kmfindle@uark.edu

Willow Newman[1], Chance Garrett[1], Matthew Gifford[1], Ginny Adams[1], and Reid Adams[1]

Turning Up the Heat: Thermal Tolerances of Fishes in the Kings River, Arkansas

The Kings River in northwest Arkansas is host to a diversity of fishes and other aquatic organisms vulnerable to disturbances, including increased temperatures due to climate change. However, many of these fishes are understudied, and little is known about their life history, including physiology. This study aimed to quantify the upper thermal tolerance of 23 species of fishes in the Kings River, spanning six families (Cyprinidae, Catostomatidae, Fundulidae, Cottidae, Centrarchidae, Percidae). Critical thermal maximum (CTM) protocol was employed for this experiment using Loss of Equilibrium as the endpoint. We collected fish, held them in flow-through nets in the river overnight, and tested them within 24 hours on-site in a temperature-controlled circulating water bath. We acclimated fishes and tested them in river water starting at temperatures naturally experienced in the river (25-28℃). A total of 229 individuals were tested ranging from 4 to 16 individuals per species. Mean CTM for species ranged from 34.3℃ for *Notropis percobromus* to 41.1℃ for *Fundulus catenatus*. Species with restricted ranges (endemic to the Ozarks) had an overall lower (36.3℃ + 0.23SE) CTM compared to species with more widespread distributions (37.6℃ + 0.13SE; t-test P<0.001). Species inhabiting run habitat (36.5℃ + 0.21SE)

had a significantly lower CTM compared to those inhabiting pools (37.6℃ + 0.14SE) and riffles (37.7 + 0.21SE; ANOVA, P<0.001). On average Cottidae (34.9℃) and Cyprinidae (36.8℃) had the lowest CTM, with Centrarchidae (39.0℃) and Fundulidae (40.8℃) tending to have the highest mean value. By understanding the thermal tolerance of fishes, we can better predict how community assemblages may change in the future as climate change continues.

[1] The University of Central Arkansas, Environmental Science Program, Department of Biology

Keywords: Physiology; Ozarks; Climate Change
Email: wpoynter1@cub.uca.edu

Daniel P. Morrill[1], S. R. Adams[1], G. Adams[1], and Matthew H. Connolly[2]
Historical Changes in Fish Assemblage Structure within the Ozark Plateau of Missouri and Arkansas

Historical survey data are important to identify long-term trends in fish assemblages. The Current River drainage is unique in having two comprehensive samples collected in the 1940s and 1990s. These data were made available by Missouri Department of Conservation. The objective of our research is to assess temporal trends in fish assemblages across twelve sites representing tributaries and the mainstem of the Current River from the 1940s, 1990s, and contemporary time period. NMDS analysis of species relative abundance data indicated a community shift in species composition between all three time periods. *Fundulus olivaceus*, *Lepomis megalotis*, *Micropterus dolomieu*, and *Luxilus chrysocephalus* were significantly associated with the 1940s time period. *Notropis telescopus*, *Notropis nubilus*, and *Lepomis macrochirus* were significantly associated with the 1990s time period. *Luxilus zonatus* was significantly associated with the contemporary time period. Analysis of presence absence data between time periods showed no evidence of biotic homogenization occurring or differences in beta diversity. However, we did detect notable differences in some species expanding and contracting across sites. For this presentation, we will relate observed changes in fish assemblage structure to land use variables to test for any association between the two.

[1] The University of Central Arkansas Department of Biology; [2] The University of Central Arkansas Department of Geography

Keywords: Land use, Fish assemblage
Email: dmorrill03@gmail.com

Nastasia Disotell[1], Zachary Wolf[1], Mollie Cashner[1], and Rebecca Blanton[1]
Are neighbors pillaging nests: detecting allopaternal care in the imperiled Egg-mimic Darter (Percidae: *Etheostoma pseudovulatum*)

Alloparental care has been documented in several clades of animals, including fishes. Despite the increased energy cost of caring for more offspring, raising non-descendent young has potential benefits, including attraction of mates or reduced egg predation by dilution effects. Male Egg-mimic Darters, *Etheostoma pseudovulatum*, like other members of clade *Goneaperca*, construct nests under rocks and guard eggs until hatched. Two species from this clade, *E. virgatum* and *E. olmstedi*, exhibit

allopaternal care; whether this is a common strategy for the clade is not known. Furthermore, the potential benefits of kin-selection and how nest density or male size influence such behaviors have not been tested. We used microsatellite loci to genotype eggs and guarding males from nests, collected in 2015 and 2019, totaling samples from 37 nests. Other non-guarding males and females from both collection events were also genotyped to identify the following: (1) if allopaternal care occurs in this species, (2) if kin-selection is one benefit of allopaternal care, and (3) if male size correlates to the proportion of non-descendant eggs in a nest. We optimized 18 microsatellite loci for *E. pseudovulatum*. Eight of these loci have been genotyped for all adult male individuals and all nests collected from the study site in 2019 (n = 21). Egg parentage was estimated using SOLOMON (v. 1.1). Preliminary results showed that the actively guarding male of a nest with two clutches likely sired one but not both, suggesting allopaternal care is occurring. Collection of genotypic data for the remaining nests and males is ongoing to address the remaining objectives and further explore the role of allopaternal care behavior in our focal taxon and clade *Goneoperca* overall.

[1] Austin Peay State University

Keywords: Parentage; alloparental care; microsatellites; egg-mimic darter
Email: ndisotell@my.apsu.edu

Jacob F. Brumley[1], Rebecca E. Blanton[1], and Mollie F. Cashner[1]
Impacts of habitat loss on the genetic diversity of *Etheostoma lemniscatum*, the Tuxedo Darter

Impoundments alter the flow regimes of rivers, creating low-flow reservoirs from once free-flowing systems, leading to unsuitable habitat for many riverine-adapted fishes and causing population loss and decline in genetic diversity. The lower 50 rkm of the Big South Fork of the Cumberland River has been inundated regularly by Lake Cumberland, until 2007, when the lake was lowered for repairs to Wolf Creek Dam. During repairs, the lower reaches of the Big South Fork returned to riverine conditions and many sensitive species reinvaded the area, including the Tuxedo Darter, *Etheostoma lemniscatum*, an endangered, endemic species that occupies the mainstem. Upon completion of dam repairs, lake levels were restored in 2013, and the Tuxedo Darter lost nearly 8 rkm of suitable habitat from the re-inundation, which led to population declines at impacted sites. Washburn et al. 2020 established a genetic diversity baseline for the species, prior to the recent inundation, from specimens collected during the period of range expansion and low lake levels. Our objectives were to estimate current genetic diversity, establish a genetic monitoring program, and to analyze impacts of habitat loss by comparing to the baseline provided. Tissues were collected from 95 individuals at a subset of 11 sites across the species' range. Genotype data was collected at the same 20 microsatellite loci used to establish the diversity baseline. Despite observed drastic declines in abundance and occurrence of Tuxedo Darters in the re-inundated reaches, preliminary results show persistent gene flow across the species' range as previously described and no significant changes in basic genetic diversity metrics. The absence of change may reflect a lag effect in which population declines and loss are not yet detectable with our methods. Additional data collection and analyses are ongoing to further analyze temporal changes in genetic diversity and to outline future conservation actions for the species.

[1] Austin Peay State University, Department of Biology and Center of Excellence for Field Biology

Keywords: genetic diversity, microsatellites, endangered, impoundment, darter
Email: jbrumley@my.apsu.edu

Joshua Hubbell[1], Jake Schaefer[1], and Brian Kreiser[1]
Functional connectivity begets conflicting impacts of landscape gradients on the occupancy and genetic distance of two headwater fishes

Patch structure and connectivity in dendritic river systems is a consequence of their bifurcating structure; however the influence of this branching pattern on functional connectivity is not present in patch occupancy models. Thus, the weight of influence of environmental and anthropogenic gradients on the patch occupancy of many aquatic obligates in dendritic river systems may be under or overestimated when using this modeling framework. In our study, we modeled occupancy and genetic distance using an information theoretic approach to examine whether functional connectivity in a dendritic river system affects how two co-occurring, headwater darters relate to landscape gradients in a dendritic river system. We also tested whether the influence of these gradients on genetic distance may vary dependent on subbasin size and species. We conducted our study in two subbasins that are hierarchically nested within a larger Gulf Coastal Plain drainage. For one subbasin, we examined patterns of site-occupancy using detection data collected at the reach-scale. We used Genotype by Sequencing to identify single nucleotide polymorphisms to approximate genetic distance between pairs of sites. Rankings of site-occupancy and models of genetic distance suggested that functional connectivity strongly affected how either species related to environmental and anthropogenic gradients. Subbasin size altered the influence of anthropogenic gradients on Yazoo and Goldstripe Darter genetic distance. Relative to site occupancy models, differences in habitat specialization were emphasized when relating Yazoo Darter and Goldstripe Darter genetic distances to environmental gradients. The comparative, modeling approach used in this study suggests that patch occupancy models may over or underestimate the influence of environmental and anthropogenic gradients on stream fishes. Thus, the development of new models that feature dendritic structure should provide better insight into how landscape heterogeneity influences stream fish metapopulations.

[1]University of Southern Mississippi

Keywords: metapopulation, genetic distance, landscape gradient, occupancy
Email: jhubbell072786@gmail.com

Aaron Coons[1], Amanda Rosenberger[1,2], and Jacob Westhoff[3]
Multi-Scale Habitat Associations of Longnose Darters (*Percina nasuta*)

Longnose Darters (*Percina nasuta*) are rare across their range and represent just one of the many imperiled species of freshwater fishes in North America (Jelks et al. 2008). Within Missouri, all known populations of the species have been extirpated, except from a small section of the St. Francis River. To date, quantitative information on habitat associations of the species has been sparse (Wagner et al. 1985, Gagen et al. 2002, Holley 2018). In an effort to aid managers in conservation, this work provides the most complete habitat use data available for Longnose Darter in Missouri.

Maximum Entropy modeling suggests that geologic unit, stream order and catchment elevation were the most influential landscape variables describing Longnose Darter occurrence in Missouri. Within the St. Francis River, occupancy models show dominant substrate size had the greatest effect on site occupancy. To examine microhabitat features that were associated with Longnose Darter presence, random forest techniques support minimal bottom water velocity and dominant substrate size as the most strongly related to Longnose Darter presence.
When paired with field observations, this work provides evidence that Longnose Darters are differentially associated with habitats comprised of large, unembedded substrates in areas of minimal water velocities. These associations will hopefully be useful to managers across the species' range as.

[1] Department of Biology, TN Cooperative Fisheries Research Unit, TN Tech University, [2] U.S. Geological Survey, TN Cooperative Fisheries Research Unit, TN Tech University, [3] Resource Science Division, Missouri Department of Conservation

Keywords: fish habitat; conservation; maximum entropy; occupancy; random forest
Email: acoons42@tntech.edu

Loren W. Stearman[1] and Jake F. Schaefer[1]
Do Communities Respond to Processes at Different Scales During Disturbance?

Human alterations to fluvial systems frequently have immediate consequences for aquatic ecosystems but the longer-term trajectories and how the scales of processes which govern them might change over time are less well documented. One geomorphic process, base level lowering, is a particularly pertinent response for ecological study as it often results from human activities and drastically changes stream morphology and thus habitats. The Bayou Pierre in southwest Mississippi is currently experiencing advanced base level lowering due to mining and channel straightening. Recent work in the system has suggested substantial community change from historical records and supported hypotheses that both riffle and pool dwelling fishes are declining in the system. In this paper we revisit these analyses including more historical and current data to provide a more robust perspective on community change. We similarly compare contemporary community structure from samples in three basins at different stages of base level lowering (Buffalo River, Homochitto River, and Bayou Pierre) to provide spatial perspective on the processes. Additionally, we test the hypothesis that factors driving community structure in the Bayou Pierre have shifted from predominately local to predominately nonlocal by a two-front approach. First, we compare changes in trait syndromes focused on dispersal capacity in historical and contemporary community data. Second, we compare contemporary demographic trends in historically and currently common species in relation to geomorphic process regions to determine if population trends are locally related to habitat-forming processes.

[1] The University of Southern Mississippi, Department of Biological Sciences

Keywords: Geomorphic change; community structure; community change; metacommunity dynamics
Email: loren.stearman@usm.edu

Maggie E. Coffey[1], Thomas F. Laughlin[1], T. Andrew Joyner[2], and M. Kevin Hamed[3]
Use of ecological niche modelling to inform management strategies for the Tennessee Dace (*Chrosomus tennesseensis*)

The Tennessee dace (*Chrosomus tennesseensis*) is an endemic freshwater minnow that inhabits headwater streams of the upper Tennessee River drainage. This species is listed as State Endangered in Georgia and Virginia and as a Greatest Conservation Need species in Tennessee. Threats to the Tennessee dace include localized extirpations resulting from anthropogenic disturbances and hydrologic regime fluctuations within its specialized habitat. Conservation efforts for this species are limited by knowledge gaps regarding its current distribution. The aim of this study was to use ecological niche modelling (ENM) to characterize the fundamental niche of the Tennessee dace. Previous occurrence records and relevant bioclimatic and freshwater-specific environmental variables were used to train models. Preliminary results suggest that the distribution of the Tennessee dace may extend beyond its observed range. Field surveys targeting high suitability streams will be conducted for model validation. These results in conjunction with known life history information can be used to inform future management strategies for the Tennessee dace.

[1] East Tennessee State University, Department of Biological Sciences; [2] East Tennessee State University, Department of Geosciences; [3] Virginia Polytechnic Institute and State University, Department of Fish and Wildlife Conservation

Keywords: ecological niche model; fisheries management; freshwater conservation; endemic species
Email: mag.coffey1@gmail.com

Joseph Miller[1], Ginny Adams[1], and Reid Adams[1]
Status and Detectability of the Colorless Shiner (*Notropis perpallidus*), a Rare Minnow Endemic to Arkansas and Oklahoma

The Colorless Shiner (*Notropis perpallidus*) is a rare, diminutive minnow found exclusively in the Red and Ouachita river drainages of southeastern Oklahoma and southern Arkansas, and is currently under review by the U.S. Fish and Wildlife Service for listing. The last survey for the Colorless Shiner in Arkansas was completed from 1999 to 2001 by Robison (2006), and he reported a significant decline in distribution and abundance. Our objective is to provide a comprehensive survey of historical *N. perpallidus* sites in Arkansas and assess the species' current status, distribution, and detectability. Contemporary sampling for this project suggests a continuing decline of *N. perpallidus* in Arkansas. To date, we have detected *N. perpallidus* at 4 of 41 sites sampled. All four detections were in the Saline River, and we have failed to detect the species throughout the rest of its historical range in Arkansas, including the Upper Ouachita, Caddo, and Little Missouri river systems. Of the 1,001 seine hauls completed, *N. perpallidus* was collected in 31 hauls for a total capture of 110 individuals. With these data we will estimate probability of site occupancy in addition to using microhabitat covariates to estimate heterogenous detection probabilities of the species and habitat use. *Notropis perpallidus* occupancy and detection probability estimates will be presented alongside estimates of other minnow species encountered to provide greater context.

[1] University of Central Arkansas, Department of Biology

Keywords: Peppered Shiner, Colorless Shiner, Detection, Status, Notropis perpallidus
Email: mill4914@gmail.com

Courtney A. Weyand[1] and Jonathan W. Armbruster[1]
Taxonomic relationships within the genus, *Rhinichthys* using previously accessioned GenBank sequence data

Commonly known as riffle daces, *Rhinichthys* is a genus of freshwater fishes that has one of the broadest ranges of any North American fish group, existing from Atlantic to Pacific, and Gulf of Mexico to Bering Sea coasts. Currently, nine species are recognized with several of these representing species complexes. Six species (one extinct) have distributions west of the Continental Divide, two species are found east of the Continental Divide in the Atlantic, Great Lakes, Hudson Bay, Mississippi River, and upper Mobile Bay drainages, and one species, *R. cataractae*, spanning across from the Atlantic to Pacific coasts in the northern US and Canada (including Mackenzie, Churchhill, and Koksoak-Canapiscau River drainages and Hudson Bay tributaries) down the Rocky Mountains to Mexico and the Appalachians to Georgia. The taxonomic history of this group is complex with numerous species names in synonymy. To better elucidate the evolutionary relationships within the genus, phylogenetic relationships were assessed in a Bayesian framework using previously accessioned sequences of the mtDNA (COI & Cytb) and nDNA (RAG1 & S7) genes obtained from GenBank. Results from this study were used to better understand genetic variation throughout the range, evaluate the distinctiveness of populations (i.e. subspecies), and define current taxonomic boundaries to better evaluate conservation concerns. This study serves as a first pass at the current taxonomic status prior to embarking on phylogenomic analysis.

[1] Auburn University, Department of Biological Sciences

Keywords: phylogenetics; taxonomy; systematics; rhinichthys; riffle dace
Email: courtney.weyand@auburn.edu

Scott Meyer[1], Christian Cox[2], and Jamie Roberts[1]
Conservation genomics of eight imperiled freshwater mussel species

Like their piscine counterparts, many southeastern mussel species are poorly characterized with regard to population structure and relationships, demography, and evolutionary viability. This presentation summarizes preliminary results of our ongoing conservation genetic investigation of eight imperiled freshwater mussel species from the Gulf and Atlantic slopes of North Carolina. These eight species exhibit varying life histories, distributions, and habitat preferences, all features that should regulate genetic diversity and differentiation. In most cases, genetic material originated from buccal swabs of live mussels, which yielded surprisingly high qualities and quantities of DNA. We used a RADseq approach to characterize anywhere from 2,594 to 11,460 neutral SNP markers per species, all of which passed rigorous QA/QC standards. As such, this is the first study of its kind for unionids. Several interesting preliminary findings have emerged. Across species, we saw little evidence for fine-grained within-river population structure; rather, structure tended to emerge at the watershed or basin scale. Genetic diversity exhibited substantial variation among populations and species, suggesting that characterizing high- and

low-diversity populations could be an important precursor to developing conservation and translocation plans. Finally, although not the focus of this study, we detected cryptic diversity within multiple species, which merits further taxonomic evaluation. Due to the diversity of species and landscape attributes characterized by this study, these results should provide insight into the demography, evolution and conservation of other southeastern freshwater taxa, including other mollusks, fishes, and crayfishes.

[1] Georgia Southern University, Department of Biology; [2] Florida International University, Department of Biological Sciences

Keywords: RADseq; genomics; mussel; conservation
Email: sm30152@georgiasouthern.edu

Noah Daun[1] and Jake Schaefer[1]
Always Freckled, Rarely Spotted: Assessing Percina lenticula populations in Mississippi.

[1] The University of Southern Mississippi, Department of Biological Sciences

Keywords: Conservation, eDNA, Survey, Electrofishing
Email: noah.daun@usm.edu

Jeff Stevens[1] and Xingli Giam[1]
Winners and Losers: Life History, Ecological, and Behavioral Trait Impact on Native Invasions in the Tennessee River System

Anthropologic activities have substantially affected freshwater fish diversity around the world. One, often overlooked, effect of anthropogenic change in aquatic ecosystems is the disproportionate changes in the abundance of native fish species. Commonly referred to as native invasions, this process occurs as certain species groups have developed traits and behaviors that are advantageous in the human - altered landscape, while other species' traits have become deleterious due to human change. The Tennessee River system of the southeastern United States is a heavily altered ecosystem and one of the most biodiverse aquatic communities in the world - an ideal situation for native invasions to occur. In this study, we use historic abundance data, trait data, and phylogenetic methods to evaluate native invasions in the system. Specifically, we calculate a total abundance change ratio for each native species in the system and test for correlation with shared traits and shared phylogeny. Overall, there is little evidence of phylogenetic constraint in the total abundance change ratio, but some support is found in trait-based methods.

[1] The University of Tennessee, Department of Ecology and Evolutionary Biology

Keywords: anthropogenic; invasion; diversity; abundance; native
Email: jsteve36@vols.utk.edu

Grace Davenport[1], Jennifer Main[1], George Gavrielides[1], Calvin Rezac[1], Ginny Adams[1], and Reid Adams[1]

Do Farm Ponds and Small Impoundments Influence Fish Assemblages in the Black River Watershed in Arkansas?

Although many studies have focused on the impacts of large reservoirs on stream fish assemblages, few data have been published on the influences of farm ponds and small impoundments. Impoundments are often negatively correlated with stream fish diversity and may lead to homogenization of fish assemblages due to species introductions and extirpations. This study investigates the relationship between data related to farm ponds and small impoundments with persistence and stability of fish assemblages in the Black River watershed (Strawberry, Eleven Point, and Spring rivers). The USGS StreamStats program was used to delineate upstream catchments of each site. Catchments were brought into Google Earth Pro where satellite imagery was used to determine distance of ponds from the stream, area of ponds and impoundments, whether connectivity to the stream was evident, and surrounding land use. We measured 323 farm ponds and small impoundments across 24 sites on the Strawberry River, 234 across 13 sites on the Eleven Point River, and 2,708 across 27 sites on the Spring River. Where historical data existed (57 of 64 sites), stability was positively correlated with mean distance of farm ponds and small impoundments to the stream ($r = 0.35$). Stability was negatively correlated with percent of farm ponds and small impoundments with obvious connection to the stream ($r = -0.39$), percentage of ponds classified as impoundments ($r = -0.31$) and percent of farm ponds and small impoundments within 50 m of the stream ($r = -0.30$). Persistence was negatively correlated with percent of farm ponds and small impoundments within 50 m of the stream ($r = -0.30$). Additional analyses on presence of likely stocked species (e.g., Bluegill, Redear Sunfish, Largemouth Bass, Western Mosquitofish), influence of ponds relative to instream impoundments, and species losses and additions will be discussed.

[1] University of Central Arkansas, Department of Biology

Keywords: farm ponds; small impoundments; fish assemblages; Black River watershed Arkansas; land use
Email: gdavenport3@cub.uca.edu

Chance Garrett[1], Ginny Adams[1], and Reid Adams[1]

Fish Community Dynamics in Two Intermittent Ozark Headwater Streams having Different Levels of Connectivity

Intermittent streams and fishes that inhabit them have been largely understudied. Recent literature has suggested intermittent streams are more biologically important than previously thought, and the ecology of fishes living in them should be further investigated. Current research shows intermittent reaches of aquatic networks host either a unique community distinct from the perennial community or a subset of the larger perennial community. Most of the research exploring fish community changes in response to stream drying has been conducted in arid ecosystems and less is known of community dynamics in intermittent spring-fed headwaters of the Southeast. This study explores fish community responses to summer drying in two tributaries of the Kings River having differing levels of connectivity to perennial reaches. Community samples were collected from Rockhouse Creek and Keels Creek during time periods

of connected surface flow (December 2019 and May-June 2020) and intermittency (August 2019, August 2020, and October 2020). These streams had continuous flowing water from November 2019 until June 2020 allowing for immigration of fishes from the Kings River. Beginning in June 2020 water began to retreat upstream with the loss of riffles followed by loss of pools beginning in July 2020. The source population of the Kings River host approximately 36 species. Community samples in Rockhouse Creek detected 11 species in August 2019, 21 in December 2019, 12 in May – June 2020, and 18 in August 2020. Community samples in Keels Creek detected 22 species in August 2019, 28 in December 2019, 21 in May – June 2020, and 23 in August 2020. An upcoming October sample will allow us to determine which of the detected species are tolerant to drying disturbance and identify those reliant on recolonization from the source population. These data are important as current climate projections predict perennial systems will shift toward intermittent flows while also facing increases in anthropogenic water use and land alterations.

[1] University of Central Arkansas

Keywords: Intermittency, Disturbance, Connectivity
Email: cgarrett11@cub.uca.edu

Jessica Rath[1], Reagan Spinelli[1], Ginny Adams[1], and Reid Adams[1]
Does Gut Length of *Luxilus pilsbryi* Vary in Response to Stream Drying?

While they do not provide refuge year-round, intermittent streams play an important role in maintaining biotic diversity and health of perennial streams. Adaptations of fishes to these unique environments include increased diet breadth and, in one study, changes in gut length during summer months when food quality and quantity decreased. As global climates continue to change, we can expect a downstream expansion of intermittent stream segments. We were interested in examining the gut morphology and body condition of *Luxilus pilsbryi* that inhabit intermittent streams in the Kings River watershed of the Ozarks in northwest Arkansas. *Luxilus pilsbryi*, the Duskystripe Shiner, is found in both intermittent and main channel perennial streams and feeds primarily on aquatic insects in perennial streams. Individuals were collected during summer, winter, and spring from Rockhouse Creek, an intermittent tributary of the Kings River. Total length, standard length, body mass, gut mass, and gut length were recorded. Body condition was significantly lower in winter and summer compared to spring (ANCOVA, $P<0.01$); however gut length (adjusted for total length) was not significantly different across seasons. These results could indicate that *L. pilsbryi* does not experience seasonal dietary changes, or that the species does not exhibit plasticity in gut morphology. In order to examine these possibilities, we will be conducting a diet content analysis on these specimens.

[1] University of Central Arkansas, Department of Biology, Environmental Science Program

Keywords: Intermittent stream; plasticity; gut morphology; Luxilus pilsbryi
Email: jrath1@cub.uca.edu

Calvin Rezac[1], Daniel Morrill[1], Ginny Adams[1], Reid Adams[1], and Robert Hrabik[2]
Rediscovery of the Pallid Shiner, *Hybopsis amnis*, in the Black River System of Arkansas and Missouri

The Pallid Shiner, *Hybopsis amnis*, is a rare and understudied minnow with little information about its ecology. This species is listed as a Species of Greatest Conservation Need (SGCN) throughout much of its range and is generally considered to be declining because of excessive siltation. It had not been detected in the Black River system of Missouri and Arkansas in over 75 years, or the state of Missouri in over 60 years. However, this may be because the Black River system has been relatively under studied since the late 1980s. We sampled over 100 sites in the Black River system using seines within Arkansas and Missouri between 2017 and 2020 to assess temporal trends in fish assemblage structure and to update the status of SGCN species in this drainage. We collected 159 *H. amnis* at six different sites in four tributaries of the Black River system. We measured total lengths to estimate age classes and year of spawning. Corresponding habitat and year-class data indicate this species may spawn in late winter to early spring and rely on floodplain habitat for spawning and recruitment. The vast majority of our individuals collected were estimated to be from the 2018 reproductive season, characterized by late winter flooding corresponding with the spawning period and continued elevated flood events through the early recruitment period. We also detected *H. amnis* at degraded sites having high turbidity and soft substrates that contradict previous reports. Apparent decline of *H. amnis* in other systems may be a result of reduced floodplain connectivity in addition to other anthropogenic disturbances. We suggest the recent detection of *H. amnis* in tributaries is likely due to transient movement and increased recruitment of resident populations in the mainstem Black River associated with flood events recent years rather than a range expansion.

[1] University of Central Arkansas, Department of Biology; [2] Missouri Department of Conservation, Fisheries Division

Keywords: Species Distribution; Life History; Ecology; Hydro Response; Declining Species
Email: crezac1@cub.uca.edu

Jessica K. Wilks[1], Gregory J. Glotzbecker[1], Gary D. Grossman[2], and Michael J. Blum[3]
Fitness of interspecific hybrids in the genus *Cyprinella*: An evaluation of swimming performance in stream fishes

As a result of anthropogenic disturbance, freshwater ecosystems are rapidly being destroyed worldwide. Accordingly, such impacts are also resulting in the loss of aquatic biodiversity. Specifically, the introduction of non-native aquatic species is becoming an increasing concern. Historically, many non-native freshwater fish introductions have been the result of commercial baitfish aquaculture and private aquarium release. *Cyprinella lutrensis* (the red shiner) is endemic to much of the central U.S., and its natural range does not extend east of the Mississippi River. Since the 1950s, red shiner have been cultivated and transported across the globe as both bait and aquarium fish. During the early 1990s, invasive red shiner populations were first observed in the Coosa River Basin, located in northwest Georgia, USA. Originating from bait bucket releases, invasive Red Shiner have quickly established in this area, and readily compete and hybridize with at least one native species of *Cyprinella* (*Cyprinella venusta*), the Blacktail Shiner. Over the past thirty years,

Red x Blacktail Shiner hybrids are becoming more abundant and demonstrate an uncertain level of viability. To date, little is known about the relative fitness of Red x Blacktail Shiner hybrids compared to parental species. If hybrids exhibit a higher level of fitness compared to parental species, then this could result in regional extinctions of native stream fishes. To better understand the relative fitness of native Blacktail Shiner vs. Hybrid Shiner, we examined swimming performance as a widely accepted proxy. Blacktail, Red, and Hybrid Shiner were collected in Northwest Georgia during the months of August and September 2020. Individual swimming performance trials were then conducted in a recirculating flow chamber. During these trials, a suite of physiological and morphometric measurements were recorded. Here, we present an analysis of our preliminary data, investigating differences in fitness among native and hybrid shiner.

[1] Georgia College & State University, Department of Biological and Environmental Science; [2] University of Georgia, Warnell School of Forestry and Natural Resources; [3] University of Tennessee, Department of Ecology & Evolutionary Biology

Keywords: cyprinella; invasive species; hybridization; fitness
Email: jessica.wilks@bobcats.gcsu.edu

Reagan Spinelli[1], Jessica Rath[1], Ginny Adams[1], and Reid Adams[1]
Morphological and Dietary Responses of Fishes to Stream Drying

Due to the increasing global temperatures, hydrological environments are beginning to show changes, especially in marginal habitats like headwater streams. Intermittent headwater streams experience seasonal drying and are expected to become more prevalent over time. If intermittency increases, it is important to understand how fishes may alter their diet and morphology with changes in resource availability. Based on previous research in Arkansas, we expected *C. erythrogaster* to switch their diet to amorphous organic matter during summer stream drying which may cause an increase in gastrointestinal tract length. We collected *C. erythrogaster* from Rockhouse Creek, an intermittent tributary to the Kings River in northwest Arkansas during summer, winter, and spring seasons. Each *C. erythrogaster* was measured to determine standard length (mm), total length (mm), mass (g), eviscerated mass (g), gut mass (g), gastrointestinal tract length (mm), empty gut mass (g), and gonad mass (g). Gut lengths were measured using ImageJ software. Condition of *C. erythrogaster* varied seasonally with highest condition in the spring, intermediate in the winter, and lowest in the summer (ANCOVA, $P<0.01$). Gut length (adjusted for total length) was significantly higher in winter and spring compared to summer (ANCOVA, $P<0.01$). Although we did see seasonal variation in gut length, it was counter to previous research on *C. erythrogaster* and may indicate another food resource was available or abiotic conditions in this stream (e.g., temperature) differed from previous research. A future diet study will seek to explore seasonal diet changes in Rockhouse Creek.

[1] The University of Central Arkansas, Department of Natural Sciences and Mathematics

Keywords: diet study; phenotypic plasticity; gut length; intermittency; southern redbelly dace
Email: rspinelli1@cub.uca.edu

Jason O'Connor[1], Christopher Anderson[1], Travis Tuten[1], Rick Stout[2], Nia Morales[3], and Ramesh Paudyal[4]

Who really cares about rare fish conservation? Awareness and attitudes about rare fish and their management in Florida

Stakeholder support is critical to the success and persistence of effective conservation programs. More than 40 fish species in Florida are of conservation concern, most of which are non-game. However, public awareness and attitudes regarding rare fish conservation are poorly understood. We sought to evaluate whether differences in rare fish awareness exist among the general public and potential stakeholder groups. We also wanted to know whether stakeholder groups differ in their attitudes regarding potential conservation actions that could be taken to benefit rare fish. To achieve these goals, we distributed an online survey to a representative sample of Florida residents, conservation organization members, outdoor-recreationists, citizen-scientists, and native fish enthusiasts between March and May 2020. Knowledge and awareness of rare fish was lowest among the general public and citizen science groups and highest among fish enthusiasts. Regardless of group, most respondents believed that proper management could prevent the loss of rare fish species but didn't know enough to judge current conservation efforts. Given alternative management options, most respondents expressed a preference for improving existing habitat and regulating harvest over creating new habitat and stocking. Fish enthusiasts and conservation groups expressed the greatest support for regulating water use and quality for the benefit of rare fish, while recreation groups expressed lower support than the general public. Only fish enthusiasts expressed greater support than the general public for stocking rare fish. Rare fish conservation actions that have a negative effect on sportfish entailed a significant support cost for every group, but the loss of support was greatest among recreation groups and lowest among the general public. These results highlight areas where outreach efforts may benefit rare fish conservation support and encourage management decisions that are congruent with stakeholder attitudes.

[1] Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute; [2] Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fish Management; [3] University of Florida, Wildlife Ecology and Conservation Department; [4] Florida Fish and Wildlife Conservation Commission, Center for Conservation Social Science Research

Keywords: public support; human dimensions; non-traditional stakeholders; fish conservation
Email: jason.oconnor@myfwc.com

Bernie R. Kuhajda[1] and Shawna M. Fix[1]

Imperiled Mobile Basin shiners and darters: doing better than you might think!

We performed range-wide status surveys on six federally listed fishes found at and above the Fall Line in the Mobile Basin to assess population trends and inform USFWS where to implement appropriate conservation measures as needed. Surveys were conducted from 2017-2019. These six species include Blue Shiners (*Cyprinella caerulea*), Cahaba Shiners (*Notropis cahabae*), Goldline Darters (*Percina aurolineata*), Rush Darters (*Etheostoma phytophilum*), Vermillion Darters (*E. chermocki*), and Watercress Darters (*E. nuchale*). Populations of Rush, Vermilion, and Watercress Darters were stable or increasing (abundance maintained at historical levels or increasing, and multiple age classes present), with significant range

extensions discovered for Rush and Vermilion Darters. Because Watercress Darters live in isolated spring habitats within the Birmingham metropolitan area, they still require active management and habitat protection. Blue Shiners were stable in three of the four watersheds they currently occupy, but abundance was low, habitat was degraded, and fish passage barriers were present in Weogufka Creek, Alabama. Goldline Darters were found at almost every site sampled, but they were on average 60% more abundant at sites in the Cahaba River watershed compared to sites in the Coosawattee River watershed. Within the Locust Fork system, Cahaba Shiners were stable and more common than closely related Mimic Shiners (*N. volucellus*), but Cahaba Shiners were rare in the Cahaba River and only adults were collected. Overall these results show that past conservation efforts on water quality improvement and removal of fish passage barriers have resulted in stable or increasing populations within these six upland Mobile Basin imperiled fishes. But specific populations within most of these species need additional or continued habitat improvement and protection.

[1] Tennessee Aquarium Conservation Institute

Keywords: Cahaba & Blue Shiners; Goldline Darters; Vermilion Darters; Rush Darters; Watercress Darters
Email: brk@tnaqua.org

Thomas J. Near[1], Liam U. Taylor[1], and Jeffrey W. Simmons[2]
Genomics and museomics inform translocation strategies in the endangered Bluemask Darter, *Etheostoma akatulo*

Translocation, the movement of organisms for conservation purposes, can result in artificial introgression if genetic material flows between populations in new ways. The Bluemask Darter (*Etheostoma akatulo*) is a federally endangered freshwater fish currently inhabiting four tributaries of the Caney Fork River system in Tennessee: Collins River, Rocky River, Cane Creek, and Caney Fork. The current conservation strategy for Bluemask Darters involves the translocation of adults from the Collins River, in the western portion of the Caney Fork system, to extirpated habitats in the Calfkiller River, which is in the eastern portion of the Caney Fork system. Here, we use genetic and phenotypic data from Bluemask Darters across the species range to uncover translocation boundaries established through evolutionary and ecological processes. We use genome-scale sequencing to analyze population structure, phylogeny, and demography with thousands of loci obtained using ddRAD and specimens in museum collections to assess morphological disparity between populations. We find that the populations in the Collins River and eastern populations in the Rocky River, Cane Creek, and upper Caney Fork are two independent lineages with robust genetic and phenotypic differences. The morphological data collected from invaluable museum specimens show that 12 of the 13 known specimens from the extirpated population in the Calfkiller River are classified with phenotypes observed in other eastern populations. These results suggest that translocation from the Collins River in the west to the eastern portion of the Caney Fork system will break genetic, phylogenetic, and phenotypic boundaries between the two populations. Given low effective population size estimates for the eastern population, we recommend the that Calfkiller River should be populated via translocation of juveniles from the Rocky River that are annually trapped in impounded waters. Beyond conservation concerns, the microgeographic structure of Bluemask Darter populations adds another puzzle to

the evolutionary history of the hyper diverse freshwater fish fauna in eastern North America

[1] Yale University, Department of Ecology and Evolutionary Biology and Peabody Museum of Natural History; [2] Tennessee Valley Authority, River and Reservoir Compliance Monitoring

Keywords: conservation; darter; Etheostoma; ddRAD; translocation
Email: thomas.near@yale.edu

Shawna M. Fix[1]
Life History of the Federally Endangered Laurel Dace (*Chrosomus saylori*)

The Laurel Dace (*Chrosomus saylori*) is a federally endangered species endemic to the upper Tennessee River Basin in Tennessee. Their populations have suffered from heavy siltation and poor water quality from agriculture. Laurel Dace historically occupied only eight streams on Walden Ridge of the Cumberland Plateau, however recent sampling indicates this species is only relatively common in two streams, Bumbee Creek and Youngs Creek and juveniles were recently found in a third stream, Horn Branch. Tennessee Dace (*Chrosomus tennesseensis*) are not listed in Tennessee and are a close relative to the Laurel Dace. Tennessee Dace are very abundant in Laurel Ford Branch which is just off the escarpment from where Laurel Dace are found in the Piney River System. Since we cannot study some aspects of the life history of an endangered species, using a surrogate species like the Tennessee Dace will help us greater understand the conservation needs of the Laurel Dace. Two hundred fifty-five Tennessee Dace were collected from May 2018 to October 2019. Peak gonadosomatic index (GSI) for females was in April (average: 10.59) and for males was in June (average: 2.23), indicating spawning occurs from April to June. Female mature oocyte counts range from 64-273, with the oocyte diameters averaging 1.06mm. The use of otolith analysis for age determinations was not a successful method and only showed accurate results if fish were greater than 3 years old, however length-frequency data indicates that Tennessee Dace have 4+ size classes. If Laurel Dace have a similar life history to Tennessee Dace, our results indicate that they could have small clutch sizes and that anthropogenic influences to their environment could negatively affect their already small recruitment. Also, Laurel Dace could be potentially spawning until June, so regulations need to limit species sampling efforts through the month of June.

[1] Tennessee Aquarium Conservation Institute

Keywords: Life History; Conservation
Email: smitchell@tnaqua.org

Jessica Grady[1], Chris M. Gienger[1], Luke M. Bower[2], and Rebecca E. Blanton[1]
Environment and phylogeny influence scale shape variation in Etheostomatinae darters

Variation in scale number and type has been well studied in Teleost fishes however, variation in scale shape has received less attention. Given the well-documented role of environment and phylogeny on multiple aspects of phenotype, we evaluated the impact of both on scale shape variation in darters (Percidae: Etheostomatinae). We predicted that darters with close phylogenetic relationships and/or shared ecologies would have more similar scale shapes, but this relationship would be mediated by

their use of the boundary layer. We used geometric morphometrics and 7 homologous scale landmarks from 30 individuals each for 92 species of darters representing all genera and terminal clades. Variables describing habitat, spawning mode, maximum body size (Size), and phylogeny were summarized from the literature. We used ordinations to examine scale shape variation among phylogenetic and ecological groups. To test for relationships between scale shape and ecological characteristics we conducted Partial Least Squares and Phylogenetic Generalized Least Squares analyses. Scale shape variation occurred within and among darter clades, and was significantly related to phylogeny, suggesting some variation is evolutionarily constrained. However, after accounting for phylogenetic signal, Size and water column position (WCP) were related to scale shape such that extra-large, midwater species had longer, narrower scales that may decrease laminar drag, and sub-benthic darters had scales that were narrower at the anterior insertion, had longer scale bodies and longer, wider ctenial margins that may facilitate burying. Among benthic darters, Size was significantly related to scale shape and may indicate that boundary layer use reduces selective pressures of drag. Consistency between our results and others from the literature provide support for environmental influences on scale shape in Teleost fishes.

[1] Austin Peay State University, Center of Excellence for Field Biology; [2] Clemson University, Department of Forestry and Environmental Conservation

Keywords: ecomorphology, geometric morphometrics, darter, scales
Email: Rodkey10@gmail.com

Bryn H. Tracy[1], Fred C. Rohde[2], and Gabriela M. Hogue[3]
An Annotated Atlas of the Freshwater Fishes of North Carolina

The rich history of the study of fishes in North Carolina dates all the way back to 1682 when Thomas Ash wrote a general description of the fish fauna of "Carolina", which referred to all of the coastal lands between Florida and Virginia. North Carolina's first state-specific checklist of freshwater fish species was published in 1709 by John Lawson and subsequent checklists included: Brickell (1737), Cope (1870a), Jordan (1889a), Jordan and Evermann (1896-1900), Smith (1907), Jordan et al. (1930), Fowler (1945), Louder (1962), Ratledge et al. (1966), and Menhinick et al. (1974). In 1991, Menhinick published "*The Freshwater Fishes of North Carolina*", which is still widely in use today. The increase in the availability of historical records in globally accessible databases and the surge of collections post-1991 made by federal and state resource agencies, and many others, made the timing perfect for the creation of an update of North Carolina's freshwater fish species in an annotated atlas. Annotations for each species include a distributional map with type locality noted where appropriate, remarks concerning questionable records and misidentifications, extirpations, introductions and interbasin transfers, and imperilment status. Herein, we will discuss the process of determining the distribution of the 257 currently described and undescribed freshwater fish species within North Carolina.

[1] Apex, NC; [2] National Marine Fisheries Service, Beaufort, NC; [3] North Carolina Museum of Natural Sciences, Raleigh, NC

Keywords: North Carolina; atlas; freshwater fish species
Email: bryntracy12558@att.net

Ian Hurst[1], **Matthew Wagner**[1], **and Robbie Ellwanger**[1]

The Distribution and Status of Ironcolor Shiner (*Notropis chalybaeus*) within the Coastal Plain of Mississippi

Notropis chalybaeus is a small cyprinid historically found along the coast of Mississippi. The species is considered state endangered in Mississippi and, with the exception of the Escatawpa River population, has not been sampled for across its range in Mississippi since 1998. To reassess the status of the species we used a twenty-five foot seine to sample 60 sites across the Jourdan River, Wolf River, Biloxi River, Old Fort Bayou, and Escatawpa River during summer of 2020. During the survey a total of 1,255 N. chalybaeus were collected, all of which were found within a 7.5 kilometer stretch of the Escatawpa River. We noted that water lilies (Nuphar sp.) were the dominant vegetation at all sites where N. chalybaeus were collected. Our findings indicate that the Escatawpa River should be the primary target of conservation efforts for N. chalybaeus in Mississippi and that the species should maintain the conservation status of state endangered.

[1] Mississippi Department of Wildlife, Fisheries, and Parks

Keywords: N. chalybaeus, Cyprinidae, Freshwater Conservation, Distribution, Mississippi
Email: inh15@msstate.edu

Robert J. Ellwanger[1] **and Matthew D. Wagner**[1]

The Distribution and Status of Freshwater Mussels in the Bear Creek Watershed in Mississippi

Bear Creek watershed is the only natural tributary to the Tennessee River drainage in Mississippi and has historical records of 36 species of freshwater mussels throughout the watershed. In Mississippi, the federally endangered Cumberlandian Combshell (*Epioblasma brevidens*), Snuffbox (*Epioblasma triquetra*), and Slabside Pearlymussel (*Pleuronaia dolabelloides*) and the federally threatened Rabbitsfoot (*Theliderma cylindrica*) are all historically found in the watershed. Bear Creek also contains the state endangered Purple Wartyback (*Cyclonaias tuberculata*), Flutedshell (*Lasmigonia costata*), Mountain Creekshell (*Villosa vanuxemensis*), and the Kidneyshell (*Ptychobranchus fasciolaris*) in Mississippi. Historic surveys have been completed within the watershed; however, typical surveys only included 1-3 sites per year. As no intensive drainage wide surveys have been completed in the state, we sampled 52 sites throughout the Bear Creek watershed in Mississippi. Live federally listed mussel observations included 1 Cumberlandian Combshell, 6 Rabbitsfoot, and 5 Slabside Pearlymussel; however, no Snuffbox were observed. Live state endangered mussel observations included 2 Purple Wartyback and 8 Flutedshell. No live Kidneyshell were collected. Three individual Mountain Creekshell were collected (including 2 relics and one fresh dead individual) representing the first occurrences of the species in Mississippi.

[1] Mississippi Department of Wildlife, Fisheries, and Parks: Mississippi Museum of Natural Science

Keywords: Mussels, Bear Creek, Federally Endangered, Mississippi
Email: robert.ellwanger@mmns.ms.gov

Dustin R. Thomas[1], Hilary K. Canada[1], Brett Timmons[2], Leah Berkman[3], Chelsea Titus[3], Allison Asher[2], and Brook L. Fluker[1]

Genetic assessment of Walleye in the Eleven Point River, Arkansas, following a six-year stocking gap

The Eleven Point River in Arkansas and Missouri contains a native population of Walleye that is genetically distinguishable from populations at northern latitudes. Supplemental stocking of non-native northern strain Walleye (Great Lakes region stock) occurred in the Arkansas portion of the Eleven Point River from 1986 to 2011. Previous analyses in 2002 indicated that 52% of Walleye sampled were non-native genetic strain (based on mitochondrial [mt] DNA haplotypes) and constituted approximately half of each year-class. The objective of this project was to assess the genetic composition of Walleye in the Arkansas portion of the Eleven Point River following a six-year cessation of stocking. During fall of 2017 and 2018, 216 Walleye were sampled and genotyped for eight microsatellite DNA loci and sequenced for mtDNA control region. An additional 30 Walleye from Greers Ferry Lake were included in analyses, representing a hatchery source for non-native Walleye stocked in the Eleven Point River. Phylogenetic analysis of mtDNA data recovered native Eleven Point River Walleye (or "Black River Strain" haplotype) in a "Highland Strain" clade with Walleye from Ohio, New, and Cumberland rivers. In total, 205/216 (95%) carried the native "Black River Strain" mtDNA, and 5% carried the non-native "Great Lakes Region" mtDNA type. Microsatellite-based assignment tests identified 85% of Walleye in the Arkansas portion of the Eleven Point River as native strain, 8% as non-native strain, and 7% as putative hybrids. Results from this study suggest three main conclusions: (1) Eleven Point River Walleye are a part of the unique "Highland Strain" clade described in previous studies; (2) mtDNA assignments suggest a sharp decline in non-native Walleye strains from 2002 to 2017 likely associated with a six-year stocking cessation; and (3) inter-strain hybridization has occurred (in both directions) in the Eleven Point River, but pure "Black River Strain" remains the predominant type.

[1] Arkansas State University, Department of Biological Sciences; [2] Arkansas Game and Fish Commission; [3] Missouri Department of Conservation

Keywords: Ozark Highlands; mtDNA; microsatellites; stocking
Email: bfluker@astate.edu

Steven L. Powers[1] and Dakota R. Spruill[2]

Habitat Partitioning and Associated Morphological Differences Among Three Species of Catostomidae (Teleostei: Actinopterygii) in the South Fork Roanoke River, VA.

The upper Roanoke River has 11 species of Catostomidae including *Thoburnia rhothoeca*, Torrent Sucker; *Moxostoma cervinum*, Blacktip Jumprock; and *Moxostoma ariommum*, Bigeye Jumprock. Resource partitioning appears to be a key component of maintaining diverse fish assemblages with habitat and food partitioning cited as especially important in communities containing members of the same family. The diets of these species have been documented in previous work revealing only modest differences among them. Snorkeling observations and subsequent quantification of microhabitat were conducted to illuminate habitat partitioning among these morphologically and ecologically similar species. *Thoburnia rhothoeca* inhabited the shallowest, fastest water, over the smallest substrate,

and *Moxostoma ariommum* inhabited the deepest, slowest water, over the largest substrate, with *M. cervinum* intermediate for all habitat variables. In an effort to correlate morphological adaptations to these different microhabitats, 22 body measurements were included in a Principal Components analysis revealing more fusiform bodies for *T. rhothoeca* and *M. cervinum* consistent with findings in other species inhabiting faster waters. Other correlations among morphology and microhabitat were less clear.

[1] Roanoke College; [2] Austin Peay State University

Keywords: Thoburnia rhothoeca; Moxostoma cervinum; Moxostoma ariommum; snorkel; microhabitat
Email: powers@roanoke.edu

Scott A. Smith[1], Fred C. Rohde[2], and Bryn H. Tracy[3]
NCfishes.com: a website devoted to North Carolina's freshwater and saltwater fishes

[1] North Carolina Division of Marine Fisheries, Morehead City, NC; [2] National Marine Fisheries Service, Beaufort, NC; [3] Apex, NC

Keywords: North Carolina; website
Email: scott.smith@ncdenr.gov

Nathaniel P. Hitt[1] and Michael Floyd[2]
Modeling occupancy of rare stream fishes in the Upper Cumberland and Kentucky River Basins: effects of environmental quality and the detection process

We used spatial replicates to investigate effects of environmental quality and the detection process on occupancy of 3 rare stream fishes in the upper Cumberland and Kentucky River basins: Blackside Dace (BSD, *Chrosomus cumberlandensis)*, Kentucky arrow darter (KAD, *Etheostoma spilotum*), and Cumberland Arrow Darter (CAD, *Etheostoma saggita*). The sampling design included 2,050 electrofishing quadrats (2 m x 5 m) across 205 sites. We found that (1) detection probability was influenced by sampling effort (electrofishing seconds), flow velocity, and substrate size; (2) elevated stream conductivity decreased occurrence probabilities for KAD and CAD, and agriculture decreased BSD occurrence probability; (3) predicted effects of conductivity became more precise above approximately 400 uS/cm (i.e., nonlinear effects); and (4) maximum potential occupancy rates (accounting for imperfect detection) were relatively low in all cases and were comparable to other rare stream fishes in the southeastern US.

[1] US Geological Survey, Leetown Science Center; [2] US Fish and Wildlife Service, Kentucky Ecological Services Field Office

Keywords: ESA; occupancy; Blackside Dace, Kentucky Arrow Darter, Cumberland Arrow Darter
Email: nhitt@usgs.gov

Bruce Stallsmith[1]

Luxilus chrysocephalus, Striped Shiner, Spawns March - May in North Alabama

Like many southeastern stream leuciscids, *Luxilus chrysocephalus,* the Striped Shiner, has been observed to spawn in the Spring. I am interested in examining the timing of spawning and reproductive effort of this species in the Flint River of Madison County, Alabama. Monthly collections of the species were made in calendar year 2014, resulting in 336 fish collected. I report several measures of reproductive effort including gonadosomatic index (GSI), average oocytes per mature female, and average clutch size (oocytes that are fully mature or nearly so). Peaks in GSI data show that the spawning season was March - May, with a peak in April. The average number of maturing oocytes was 2,970 in March, 4,280 in April, and 1,850 in May. Average clutch was 450 in March, 1,438 in April, and 1,236 in May. The relative numbers of maturing versus clutch oocytes shifted from mostly maturing oocytes in March to mostly clutch oocytes in May as ovaries neared seasonal cessation of oocyte production. This places the time of Striped Shiner reproduction in the middle of the sequence of other observed leuciscids in the Flint River. *Notropis photogenis* has been observed to spawn in February and March, *Erimystax insignis* and *Hybopsis amblops* have been observed to spawn in March and April, *Lythrurus fasciolaris* has been observed to spawn April through June, and *Cyprinella galactura* has been observed to spawn May through July.

[1] University of Alabama in Huntsville, Department of Biological Sciences

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Email: stallsb@uah.edu