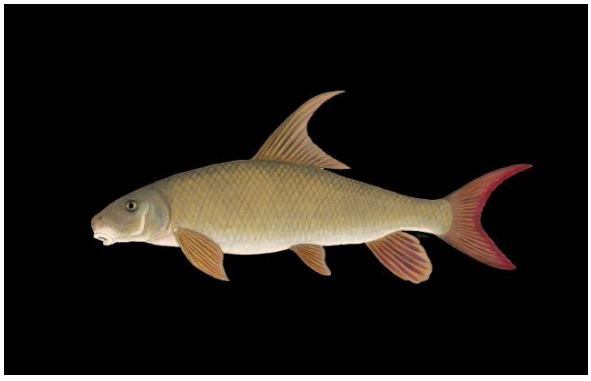
48th Annual Meeting

Southeastern Fishes Council

Fish Diversity Connections

November 16th-18th, 2022

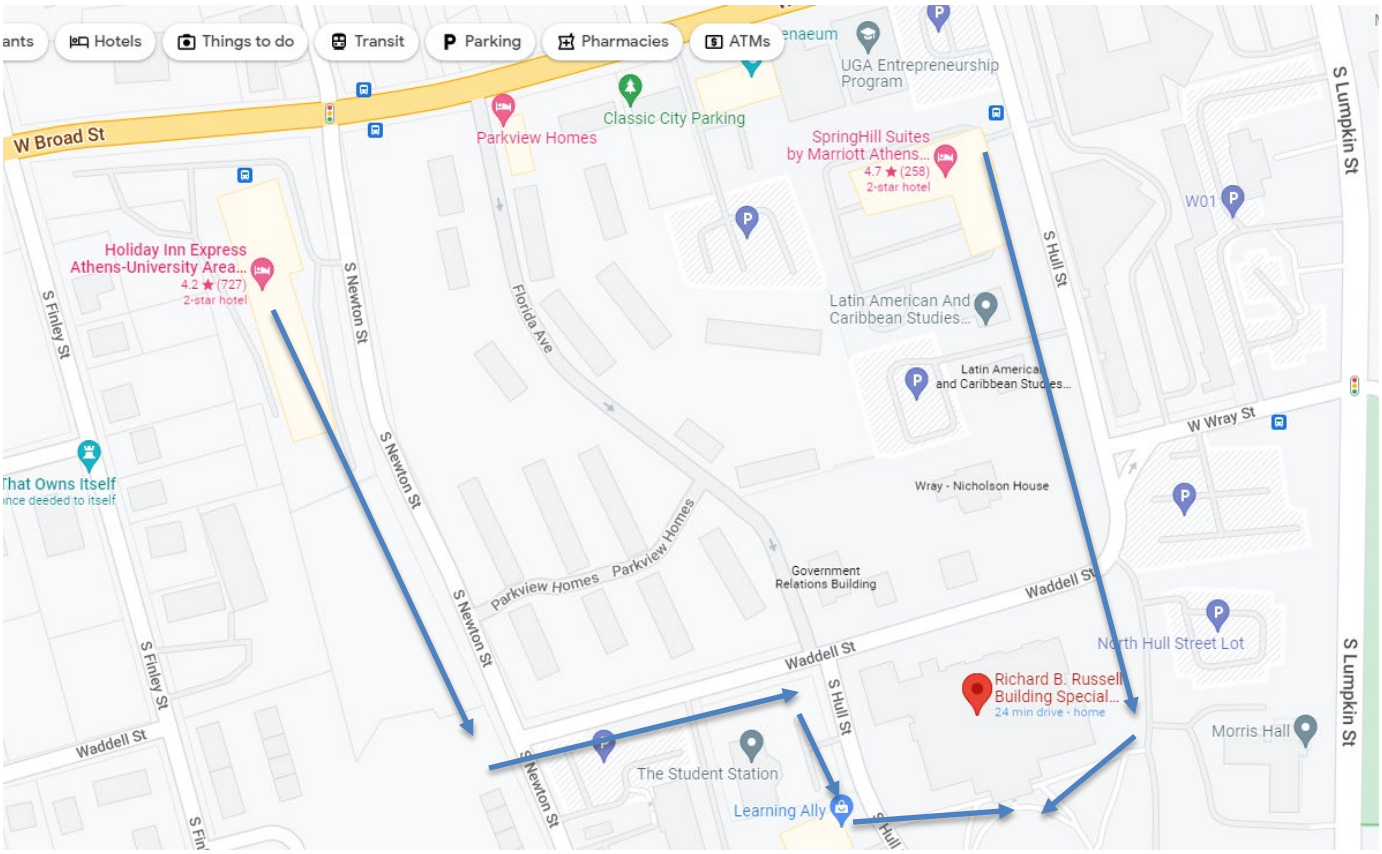


Richard B. Russell Special Collections Library

300 S Hull St, Athens, GA 30605

Important Notes about the Meeting

- **The Special Collections Building** is a 5-minute walk from both hotels (see map below). This building will open up early for us at 7:45 AM each morning, please arrive on time and proceed directly to the Auditorium. Our meeting will take place in the following rooms.



Room 285: Large Banquet Room, for breaks, meals and silent auction.
Room 271: Presentation Auditorium: **Absolutely no food or drink allowed.**
Room 258: Presentation overflow, where you can watch a live feed of the presentations. You can drink coffee here but will not be able to ask questions.
Exhibition Hallway: Poster Set up location that also links all meeting rooms.

- **Spring Hill Suites by Marriott**: 220 S Hull St, Athens, GA 30605 (706) 850-2072.

- **Holiday Inn Express**: 513 W Broad St, Athens, GA 30601 (706) 546-8122.

- **Parking:** Free parking for daily commuters to the meeting is available in the Spring Hill parking deck if you tell them the secret password: **SFC Fish Meeting.** Both

hotels have indicated that you can keep your car parked in their lot until 5PM on Friday. There is no available parking at the Special Collections Library, although you could be dropped off there if needed.

- **Regular Oral Presentations**, 10 minutes, with 2 minutes for questions.

- **Lightning Round Talks**: 5 minutes with no questions.

- **Posters** You will be able to set up your poster by your numbered space in the exhibition hallway sometime between lunch and the evening poster session on Thursday. Posters can stay up until the meeting adjourns on Friday.

- **Job Board**: Please bring a job announcement or student opportunities for posting in the banquet room.

- Students competing in presentation awards are highlighted yellow on the schedule below. Only presenting authors are listed in the meeting schedule. See abstracts for full list of authors and institutions.

- Please be considerate of people viewing the talks in the presentation overflow room. This room was reserved to provide more options for **social distancing**.

- **Free breakfast** is included with your room at both hotels from 6:30-9:00 AM and we have been told it is a real hot breakfast. Ideal Bagel and Farm Cart are also very good.

- **Lunch** Options in Walking Distance (< 10 min): Ted's Most Best, Clocked, Thai Spoon, Amici's, Mother Phở and many others. Please spread out. Lunch will be provided during the meeting on Friday.

- **Dinner** Options in Walking Distance: Trappeze Pub, Ted's Most Best, and The Last Resort. Depalma's and Seabear Oyster Bar are a longer walk or a short drive. Slutty Vegan and many other options available for a short drive. Dinner will be provided during the meeting on Thursday.

- *All food in the Special Collections Library will be served on **compostable plates**. Athens Clarke County is collecting the food scraps and serving ware and taking it to an industrial composter. Thanks to ACC, Dondero's Cafe and Pulaski Heights BBQ for offering this option. We are tipping the caterers. Please consider bringing a tip for the bartenders and the coffee baristas.

- Wesley Neal allowed us to use his portrait of a Sicklefin Redhorse for the meeting. Check out his website: https://www.facebook.com/LeakyCanoeArt/.
  The Georgia Museum of Natural History is providing a tour after the meeting. David Rhodes of the Special Collections Library was extremely helpful. **Thanks to all.**

Meeting Schedule

Wednesday, November 16th:

3:00-8:00 PM: Registration Desk Open (Name tags, t-shirts, etc.) Spring Hill Suites Lobby. We are hoping to complete most registrations during this time period.

6:00 PM: Dinner on your own, Downtown Athens, Georgia.

8:00-10:00 PM: No Host Social
https://creaturecomfortsbeer.com/taproom/, 271 W. Hancock Ave, Athens, GA 30601. Walkable from both hotels. You can bring food here from other restaurants if you want. Pace yourself, there are a lot of great talks coming up!

Thursday, November 17th:

8:00: Welcome (Auditorium, Room 271, 2nd Floor) Mark Cantrell, Duncan Elkins and Brett Albanese.

8:10- 10:00: Fish Diversity Connections, Moderator Jamie Roberts

8:10: Biodiversity connections: ties that bind. Mary Freeman.

8:30: Overview of freshwater mussels and their fish hosts in the Southeast. Matthew Rowe.

8:43: Dam good opportunities: making the most of increasing interest in dam removals. Kit Wheeler.

8:56: Stream restoration produces transitory, not permanent, changes to fish assemblages at Georgia compensatory mitigation sites. Edward Stowe.

9:09: Cryptic tolerant species and their potential effect on Index of Biotic Integrity (IBI) scores. Bryson Hilburn.

9:22: It's free real estate: benthic assemblage composition on Bluehead Chub nests in southeastern streams. Isabel Evelyn.

9:35: Can migratory suckers subsidize their spawning streams? Ryan Hudson.

9:48: Identifying mussel-host fish relationships in Georgia's Flint River using genetic barcoding techniques. Hayley Robinson.

10:00-10:30: Break: Coffee, Tea, and Treats in Room 285
Registration Desk Open

10:30-12:00: Connectivity and Dispersal, Moderator Kyle Piller

10:30**:** Effects of instream barriers on population connectivity of the Kentucky Arrow Darter (Percidae). River Watson.

10:43: The effects of surface mining on population connectivity and genetic diversity of *Etheostoma sagitta spilotum*, the Kentucky Arrow Darter. Alexis Culley.
10:56: Mark and sometimes recapture: detecting the movement of headwater fish in relation to culverts. Langston Haden.

11:09: An investigation of personality in the Creek Chub, *Semotilus atromaculatus.* Jacob Barrett.

11:22: Retracing pre-impoundment fish migrations in the Mobile Basin, Alabama. Henry Hershey.

11:35: A status update on Georgia's newest invasive fish, the Weather Loach (*Misgurnus anguillicaudatus*). Sarah McNair.

11:48: Integrating species-specific fish swimming ability into a stream-crossing assessment framework. Ridge Sliger.

12:00-1:30: Lunch Break (On Your Own)
Registration Desk Open

1:30-3:00: Conservation Genetics, Moderator Brook Fluker

1:30: Environmental DNA surveys for the threatened Pearl Darter (*Percina aurora*) in the Pearl and Pascagoula rivers in Mississippi. Ryan Lehman.

1:43: Conservation genetics and environmental DNA of the Bridled Darter. Mason Strickland.

1:56: The conservation genetics of the threatened Spring Pygmy Sunfish *Elassoma alabamae*. David Pounders.

2:09: Population structure and genetic diversity of the imperiled Striated Darter *Etheostoma striatulum.* Adam Bajo-Walker.

2:22: Evidence supporting the formal recognition and description of a new species of Spottail Darter endemic to the Clarks River drainage in Kentucky and Tennessee. Julia Wood.

2:35: Utilizing genetically informed habitat suitability models to delineate hybridization zones between Chattahoochee and Alabama Bass. Clayton Hale.

2:48: Species delimitation of a conservation icon: the Snail Darter, *Percina tanasi.* Ava Ghezelayagh.

3:00-3:30: Break (Tea and Treats, but no coffee),
Registration Desk Open for Last Time

3:30-4:30: Lightning Round 1, Moderator Anna George

1. Aquatic connectivity gone wrong... the Tennessee-Tombigbee Waterway: a bidirectional pathway for invasive species. Jim Williams.
2. Advancing aquatic connectivity through collaboration and partnerships. Shawna Fix.
3. Chattahoochee Bass distribution, genetic integrity, and habitat associations in the upper Chattahoochee River basin. Chad Kaiser.
4. Impact of road crossing barriers on karst headwater endemic species in northwest Arkansas. Anthony Zenga.

5. Simple methods for analyzing fish count time series data. Seth Wenger.
6. Population trends of shoal-dwelling fishes over 25 years of monitoring the Etowah River. Mackenzi Hallmark.
7. Effects of riparian scale landcover on fish assemblage metrics in spring fed streams of northwest Arkansas. Seth Drake.
8. Sicklefin Chub in the lower Mississippi River: insight on distribution, habitat and diet. Todd Slack.
9. Spatial distribution of the fishes of Running Reelfoot Bayou. David Ruppel.
10. A comparison of freshwater mussel populations in the Boeuf River, northeast Louisiana: 550 A.D. to recent time. Steven George.
11. Describing the status, detection, and occupancy of the Bluenose Shiner (*Pteronotropis welaka*) in Mississippi. Calvin Rezac.
12. Impacts of a large-scale freshwater diversion on estuarine fish assemblages. Kyle Piller.

4:30-5:00: Lightning Business Meeting, Auditorium.

One nominee will be elected as Associate Editor of the SFC Proceedings:

Amy Alford (Lake Erie, Island Nature and Wildlife Center)
Michael Floyd (USFWS)
Bruce Stallsmith (University of Alabama Huntsville – retired)
Steve Walsh (USGS – retired)
Kit Wheeler (Tennessee Tech University)

Thursday Evening

5:30-7:00: Dinner Pulaski Heights BBQ (Break Room, Room 285)*

6:00-8:30: Poster Session/Bar (Room 285 and Exhibition Hallway)
We have to vacate this room by 8:45.

9:00-10:30: Live Auction/Passing of the Bird
SpringHill Suites Meeting Room, Founders 1 and 2. This will be the most challenging room for social distancing.

Friday, November 18th:
We recommend checking out of your hotel room before the meeting.

8:00-10:00: Mira Varietas, Moderator Jim Long

8:00: Mussels of the Wolf River, TN: a resurvey of unionids in an inundated Cumberland tributary. Jack Fetters.

8:13: Local habitat characteristics for a narrow endemic crayfish, *Faxonius wrighti*. Brooke Grubb.

8: 26: Approaching competition in stream fishes with a long-term multi-scale dataset Loren Stearman.

8:39: Frozen in channel evolution time: long-term effects of grade control structures on channel morphology and fish beta diversity in Mississippi streams. Nicky Faucheux.

8:52: Reproductive timing and clutch parameters of the Pearl Darter (*Percina aurora*). Malia Davidson.

9:05: Is red coloration in *Chrosomus erythrogaster* an honest signal? Julie Kastanis.

9:18: Phylogenomic investigation of the resurrected leuciscid genus *Hydrophlox*. Zach Alley.

9:31: Phylogenomic analysis of the bowfin (*Amia calva*) reveals unrecognized species diversity in a living fossil lineage. Daniel Sinopoli.

9:44: Phylogenomics and species delimitation of Black Basses (*Micropterus*). Daemin Kim.

10:00-10:30: Break. Coffee, Tea and Treats in Room 285
Last chance to bid on silent auction items.

10:30- 12:30: Species Assessment and Conservation Tools, Moderator Amy Alford

10:30: Life history and fish conservation: using traits to investigate differential declines in fishes in the Conasauga River. Andrew Nagy.

10:43: Multi-pronged approach to fish conservation in the Conasauga River basin. Phillip Bumpers.

10:56: Searching for extinction debt in southeastern U.S. fish communities. Eric Walther.

11:09: Assessment of Freckled Darter (*Percina lenticula*) status in the Pascagoula and Pearl Drainages in Mississippi. Noah Daun.

11:22: The potential use of madtom catfishes as conservation tools for southeastern U.S. headwater streams. Brittany McCall.

11:35: Distribution and habitat associations of SGCN darter species in northwest Arkansas. Parker Brannon.

11:48: Movement of endemic Bartram's Bass and invasive Alabama Bass in Eastatoee Creek, South Carolina. Tyler Zumwalt.

12:01: Fish assemblage patterns across the South Central Plains of Arkansas: an insight into anthropogenic land use in low gradient streams. Ryne Lehman.

12:30-2:00: Lunch provided by Dondero's Café/Award Ceremony
Please pay for your silent auction item during lunch or right after the meeting

2:00-3:00: Lightning Round 2, Moderator Daniel Sinopoli

1. Hidden species diversity in an iconic living fossil vertebrate. Tom Near.
2. Rivers, geology, and the diversification of endemic darters. Maya Stokes.
3. Development of an eDNA tool for the Robust Redhorse. Daniel Farrae.
4. Development of a genetic tool for responsible stock enhancement of Southern Flounder (*Paralichthys lethostigma*). Jackie Allen.
5. Discharge mediates effects of temperature on Atlantic Sturgeon spawning migrations in the Great Pee Dee River. Colby Denison.
6. Status update of the Coal Darter (*Percina brevicauda*). Jenna King.
7. Non-lethal method to extract diet data from darters (Etheostomatinae). Kyler Hecke.

8. A recent reassessment of relative abundance patterns of Spotted Bullhead (*Ameiurus serracanthus)* throughout Florida. Jason O'Connor.
9. Population genomics research on freshwater fishes is needed to understand freshwater mussels. Nathan Whelan.
10. Survey of freshwater mussels in the Pearl River, Mississippi. Robert Ellwanger.
11. Florida's freshwater mussel conservation program. Amber Olson.
12. The international journal Ecology of Freshwater Fish as an outlet for papers on fishes of the southeastern United States. David Heins.

3:00: **Meeting Adjourns, safe travels home! Please make sure you pay for your silent auction item and take it with you.**

3:00-4:30: Break down and clean up space (volunteers needed)

4:30-6:00: Georgia Museum of Natural History, Optional Tour. Meet onsite at Georgia Museum of Natural History, 4435 Atlanta Highway, Athens, Georgia 30606. Free parking at the museum.

Posters

1. An assessment of thermal tolerance of a vulnerable minnow, Peppered Shiner. Cade Richesin.
2. Morphological variation in two minnows from the White River, Indiana. Jillian Campbell.
3. Litter and macroplastic contribution from an urban watershed to the Arkansas River and accompanying fish assemblage metrics. Nicole Carlisle.
4. Functional composition of Georgia's stream-fish communities: influences of stream size and ecoregion. Patrick Lewis.
5. Temporal changes to fish assemblages in the U.S. due to human impacts. Corwyn Hall.
6. Comparison of Redfin Darter (*Etheostoma whipplei*) diets from two spatially-distinct streams in the Arkansas River valley. Ben Johnson & Ethan Dodson.
7. Longitudinal assessment of fish communities in Moro Creek, Arkansas. Andrew Julian.
8. Seasonal assessment of Goldstripe Darter (*Etheostoma parvipinne*) condition in an unnamed tributary of Moro Creek, Arkansas. Autumn Henry.
9. Juvenile Striped Bass (*Morone saxatilis*) movement in the Great Pee Dee River. Robert Jackson.
10. Temporal and spatial variation in macroinvertebrates in the Ohio River. Esther Atutey.

11. Population genetic assessment of the endangered Cumberland Darter (*Etheostoma susanae*). Hilary Canada.
12. Variation in fish communities of Boston Mountain streams in the Ozark National Forest. Jackson Pav.
13. Diet of *Etheostoma fragi* in the presence of *Etheostoma caeruleum* in the Strawberry River. Sahara Morgan.
14. Distribution and population dynamics of Peppered Shiner, *Notropis perpallidus.* Jessica Rath.
15. Quantitative evaluation of River Chubs as a potential keystone species in the Little Tennessee Basin. Joelle Ciriacy.
16. Documenting darter diversity: systematic evaluation of *Etheostoma duryi* and *Etheostoma flavum*. Hannah Alloway.
17. Characterization of microbiome in coastal shark species. Anna Quintrell.
18. Population dynamics of the Western Blacknose Dace (*Rhinichthys obtusus*) in Alabama. Courtney Weyand.
19. Analysis of temporal trajectories for fish assemblages within North Carolina. Blaik Duran.
20. The effect of water quality parameters on eDNA yields of the Bridled Darter (*Percina kusha*) and the Etowah Bridled Darter (*Percina freemanorum*). Spencer Trimpe.
21. Life history of Pristine Crayfish (*Cambarus pristinus*). Kendell Hamm.
22. Mitochondrial introgression in crayfish species (*Cambarus rusticiformis*) and *C. tenebrosus*. Ivana Barnes.
23. Effects of increased water conductivity on hatch rate and larval development in Blackside Dace (*Chrosomus cumberlandensis*). Mason Ferrell.
24. Accentuating the positive: the ecological and environmental benefits of recreational fishing. Rachel Gallahan.
25. Niche and dispersal processes drive co-occurrence network topology in stream fish. Joseph Mruzek.
26. An update to the fishes of Mississippi checklist. Matthew Wagner.
27. Assessing imperilment risk for data-deficient freshwater fishes: a Bayesian Belief Network approach. Logan Sleezer.
28. Diet analysis of Piping Plover (*Charadrius melodus*), with metabarcoding of fecal samples. Cameron Doll.
29. Fish assemblages on two continents respond to valley-and reach-scale geomorphic variation. Mark Pyron.
30. Molecular status assessment of the Smallmouth Bass complex in the Central Interior Highlands. Andrew Taylor.
31. Managing for Black Bass diversity in the southeast: a linchpin connecting people to natural resources. Jim Long.

32. Phenology of Florida's freshwater mussels. Jacob Lanning.
33. Sound production in the Bluestripe Shiner (*Cyprinella callitaenia*). Daniel Holt.
34. Spiky heads, black bands, and gill rakers: a new guide to Kentucky's herbivorous minnows, the stonerollers (*Campostoma*). Matt Thomas.
35. Critical Thermal Maxima of Arkansas stream fishes determined using field acclimatization protocols. Reid Adams.
36. Genetic contributions of hatchery-stocked Walleye to Douglas Reservoir. Katherine Torrance.
37. Underwater photography and its use in social media outreach. Derek Wheaton.
38. Temporal and spatial dynamics of sympatric Redbreast Sunfish and Green Sunfish populations in an increasingly urbanized watershed. Peter Sakaris.

Abstracts and Authorship for All Talks and Posters*
(Optional Abstracts Included for Lightning Talks)

Critical Thermal Maxima of Arkansas stream fishes determined using field acclimatization protocols

Reid Adams, Ginny Adams, Willow Newman, Robert Remy, Chance Garrett, Cade Richesin, and Matthew Gifford

Department of Biology, Environmental Science Program, University of Central Arkansas, Conway
Presentation Type: Poster #35
6:00-8:30 Thursday 17 November

Upland fishes in the southeastern United States may be especially vulnerable to increased water temperatures due to climate change, yet thermal tolerances of these faunas have not been extensively quantified. Furthermore, existing data have been mostly collected using lab acclimation procedures that may not accurately reflect thermal tolerances in the field. To address these data gaps, we quantified Critical Thermal Maxima (CTMax) of 23 fishes in an Ozark River and 16 species from the Arkansas River Valley spanning seven families (Leucisidae, Catostomidae, Fundulidae, Poeciliidae, Cottidae, Centrarchidae, and Percidae). Fishes were collected with seines and held for 24-48 hours prior to testing. CTMax was measured using Precision CIR 19 heated water baths that were increased approximately 1.0℃ per minute until loss of equilibrium. Measures of CTMax in our study are among the highest recorded for several species (e.g., *Fundulus olivaceus*, *Lepomis megalotis*, and *Campostoma spadiceum*). Variation in CTMax was observed due to ecoregion, stream macrohabitat, range extent, and taxonomic groupings. On average Cottidae (34.9℃) and Cyprinidae (36.8℃) had the lowest CTMax, with Fundulidae (40.8℃), and Poeciliidae (41.8℃) tending to have the highest mean values. Lowest CTMax tended to be observed in Ozark fishes, species occupying run habitats, and fishes with restricted ranges. Summer thermal safety margins averaged near 8 to 9℃ for fishes in the Arkansas River Valley but were 3 to 5℃ for several Ozark fishes. By understanding thermal tolerances of fishes, we can better predict how community assemblages may change in the future as climate change continues.

Keywords: climate change, CTmax, thermal safety margin

Development of a genetic tool for responsible stock enhancement of Southern Flounder (*Paralichthys lethostigma*)

Jackie Allen, Matt Walker, and Tanya Darden

South Carolina Department of Natural Resources, Charleston
Presentation Type: Lightning Talk

2:15 Friday 18 November

The southern flounder (*Paralichthys lethostigma*) is a popular recreational and commercial species that has seen a dramatic decline in population abundance throughout its range from North Carolina to Texas. In response to this decline, the South Carolina Department of Natural Resources (SCDNR) has implemented regulation changes and started developing a responsible stock enhancement program for southern flounder in South Carolina. This includes the development of a genetic tool that can be used to assess the wild population, as well as manage broodstock and identify stocked fish in the wild after release. We used whole genome sequencing to identify potential microsatellite primers for southern flounder and 130 primer pairs were chosen for testing with samples collected from North Carolina, South Carolina, and Georgia. We used M13 tails to visualize PCR products on an automated sequencer allowing accurate estimations of allele size ranges and polymorphism. Twenty-five markers amplified consistently with 67 samples and were highly polymorphic. These markers were then tested for deviations from Hardy-Weinberg equilibrium (HWE), linkage disequilibrium, and frequency of null alleles. Nineteen markers were selected for inclusion in the final microsatellite panel and have been multiplexed into three optimized PCR panels that are ready to use in the assessment of the wild population and SCDNR's stock enhancement program.

Keywords: Southern Flounder; stock enhancement; genetic tool

Phylogenomic investigation of the resurrected leucicid genus *Hydrophlox*

Zachariah D. Alley[1,5], Fred C. Rhode[2], Derek Wheaton,[3], Andrew Nagy[4], Kayla M. Fast[5], and Michael W. Sandel[6]

[1]Department of Biological and Environmental Sciences, University of West Alabama, Livingston

[2]National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Beaufort, NC

[3]Conservation Fisheries, Inc., Knoxville, TN

[4]Odum School of Ecology, University of Georgia, Athens

[5]Edge Engineering and Science, Houston, TX

[6]Department of Wildlife, Fisheries and Aquaculture, Mississippi State University, Mississippi State

Presentation Type: Student Oral
9:18 Friday 18 November

The southeastern United States is home to the most diverse assemblage of freshwater fishes found anywhere in the temperate world. The genus *Hydrophlox*, formerly a subgenus of *Notropis*, is a charismatic group of leucicid minnows currently containing

five described species, ranging from Virginia to Alabama. Members of this group show considerable variation in nuptial coloration, and some inhabit wide ranges spanning multiple major river basins. Prior investigations focused on *Hydrophlox* have uncovered instances of potential hybrid zones, implications for stream capture, and the likelihood of undescribed diversity within the group, and no study to date has fully resolved relationships within the genus. This study aims to test results of prior research using high- throughput sequencing of unlinked nuclear loci. We present a novel phylogeny of *Hydrophlox* based on double-digest RADseq (DArTseq) data, with emphasis on the population structure of *Hydrophlox chrosomus*, *H. lutipinnis*, and *H. chlorocephalus*. We also characterize the nuptial traits in all clades of *Hydrophlox chrosomus* and the phenotypically diverse *H. lutipinnis* clade. Genetic material was accumulated from across the range of *Hydrophlox* via field collections and contributions from multiple fish tissue repositories, and nuptial phenotypes were documented in black background portrait photographs. Our analysis corroborates conclusions in prior investigations, with evidence for multiple independently evolving and geographically distinct metapopulations. Of the lineages identified in our analysis, the *H. chrosomus* clade confined to the upper Coosawattee River watershed is in great need of conservation management, due to their small range, low abundance and low genetic diversity.

Keywords: *Hydrophlox*; phylogeny; species

Documenting darter diversity: systematic evaluation of *Etheostoma duryi* and *Etheostoma flavum*

Hannah Alloway[1,2] and Benjamin Keck[1]

[1]University of Tennessee, Department of Ecology and Evolutionary Biology, Knoxville
[2]Austin Peay State University, Department of Biology, Center of Excellence for Field Biology, Clarksville, TN

Presentation Type: Student Poster #16
6:00-8:30 Thursday 17 November

Etheostoma duryi, the Black Darter, is found in smaller streams and rivers throughout much of the Tennessee River system. Previous work found geographic variation in pigmentation and genetic diversity indicating possible unrecognized species. We examined a standard suite of informative morphological traits including scale and fin-ray counts from specimens housed in the Etnier Ichthyological Collection at the University of Tennessee. The resulting dataset comprises 336 individuals from 39 sites spanning the range of *E. duryi*. We used frequency tables and principle components analysis (PCA) to asses geographic variation in traits. Preliminary results indicate variation within four different geographic regions of the Tennessee River system including: Duck River + Shoal Creek, Elk River, Sequatchie River + Emory River, and Tennessee River. We intend to expand our dataset to include contact zones with *Etheostoma flavum* and add genetic data to evaluate phylogeographic relationships and delimit undescribed diversity within *E. duryi* and *E. flavu*m. We will also explore the potential for gene flow

between *E. duryi* and *E. flavum* in zones of known or possible sympatry.

Keywords: *Etheostoma*; meristics; phylogeography

Temporal and spatial variation in macroinvertebrates in the Ohio River

Esther Atutey

Ball State University, Department of Biology, Muncie, IN
Presentation Type: Student Poster #10
6:00-8:30 Thursday 17 November

A history of industrialization, oil spills, fires, and silt pollution from agriculture and urbanization, led to the Ohio River being listed as the most polluted river in the United States. The Ohio River Valley Water Sanitation Commission (ORSANCO) and its members responded and conducted monitoring programs to improve water quality. ORSANCO collects annual macroinvertebrate samples at multiple locations. However, collection techniques changed from the early years with rock basket samplers to more recently with Hester-Dendy samplers (1968 to current). We evaluated the biological traits and taxonomic diversity of macroinvertebrates in the Ohio River to identify temporal or spatial variation. Collections using Hester-Dendy samplers resulted in 4,130,538 individual macroinvertebrates in 575 taxa. Family-level taxonomy for macroinvertebrates resulted in 114 families. For trait analyses, macroinvertebrate families were further classified by biological traits Poff et al. (2006). We were unable to classify all taxa into trait categories, resulting in excluding taxa from analyses. We used multivariate analyses to identify temporal and spatial patterns in abundance.

Keywords: Hester-Dendy sampler; macroinvertebrate; and biomonitoring.

Population structure and genetic diversity of the imperiled Striated Darter (*Etheostoma striatulum*)

Adam L. Bajo-Walker, Kit Wheeler, and Carla R. Hurt

Tennessee Tech University, Cookeville
Presentation Type: Student Oral
2:09 Thursday 17 November

Effective conservation strategies for imperiled species rely on information of historical corridors for gene flow and the demographic histories of populations. This information is especially important when evaluating the status of threatened riverine species, as physical and environmental barriers can have considerable effects on connectivity among populations. The Striated Darter (*Etheostoma striatulum*) is a small darter species of conservation concern as it is endemic to nine tributaries of the upper Duck River basin of Tennessee, and recent surveys have documented population declines.

Information about the geographic structure of genetic variation is needed to prioritize populations for protection and to develop management strategies that preserve the long-term adaptive potential of these populations. For this study, mitochondrial sequence and SNP genotype data were collected from 175 individuals to assess genetic variation within and between Striated Darter populations from eight isolated tributaries to the Duck River, Tennessee. Analyses identified two distinct ESUs for consideration in the design of management strategies aimed to conserve the long-term persistence of this species.

Keywords: darter; conservation genetics; molecular ecology; threatened; management

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Mitochondrial introgression in crayfish species *Cambarus rusticiformis* and *C. tenebrosus*

Ivana M. Barnes[1], Ava Ghezelayagh[1], Jeffrey W. Simmons[2], Oliver D. Orr[1], Carl E. Williams[3], and Thomas J. Near[1,4]

[1]Department of Ecology and Evolutionary Biology, Yale University, New Haven CT
[2]Fisheries and Aquatic Monitoring, Tennessee Valley Authority, Chattanooga TN
[3]Tennessee Wildlife Resources Agency, Morristown TN
[4]Peabody Museum, Yale University, New Haven, CT
Presentation Type: Student Poster #22
6:00-8:30 Thursday 17 November

Crayfishes in North America (Cambaridae) are important to freshwater ecosystems for their roles across trophic levels and in nutrient cycling. Despite their ecological significance, there is a surprising amount of uncertainty in the understanding of their species diversity and phylogenetic relationships. One possible cause for this uncertainty might be introgressive hybridization between species, which can weaken phylogenetic signal, especially when relationships are inferred from mitochondrial sequence data. We inferred a CO1 mtDNA gene tree that includes 307 specimens of Cambaridae, and it provides poor resolution for two very phenotypically distinct species of crayfishes: *Cambarus rusticiformis* and *Cambarus tenebrosus.* We tested for introgression by inferring a phylogeny of 90 specimens using double digest restriction-site associated DNA (ddRAD) sequencing. We found much stronger resolution for the *C. rusticiformis* and *C. tenebrosus* clades with the ddRAD data, which indicates a history of mitochondrial introgression between the species. Our results have important implications for crayfish systematics; although most molecular phylogenies of crayfishes are inferred using mtDNA sequence data, we find this approach to be poorly suited for species delimitation and phylogenetic inference in crayfishes.

Keywords: crayfish; Cambaridae; phylogenetics

An investigation of personality in the Creek Chub (*Semotilus atromaculatus*)

Jacob P. Barrett and Mollie F. Cashner

Austin Peay State University, Department of Biology, Clarksville, TN
Presentation Type: Student Oral
11:09 Thursday 17 November

An increasingly relevant topic in the field of behavioral ecology is the study of animal personality, or individual differences in behavioral traits that are consistent across time and contexts. Personality has been identified in a wide range of animal taxa and has been linked to several ecological characteristics, including dispersal, habitat use, and foraging activity. Importantly, extreme tendencies in traits such as boldness and sociability have been implicated in a number of well-documented range expansions and species invasions. However, few studies have investigated personality in native fauna with more localized dispersal patterns, and information regarding the existence of personality in fishes native to the southeastern United States is particularly lacking. To that end, we characterize personality traits of Creek Chub (*Semotilus atromaculatus*). *Semotilus atromaculatus* presents a unique opportunity to investigate personality-dependent processes due to its piscivorous diet, use of its nests by nest-associating minnows, and its status as a colonizer of intermittent streams. We measure sociability (tendency to shoal), boldness (latency to emerge from refuge), and exploration tendency (movement in a novel environment), and test the predictions that: (i) individual *S. atromaculatus* behave consistently and (ii) *S. atromaculatus* exhibit behavioral syndromes, or correlated suites of behaviors. Preliminary data suggests that *S. atromaculatus* individuals vary consistently along the shy-bold axis of behavior.

Keywords: personality; syndrome; boldness; sociability; exploration

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Distribution and habitat associations of SGCN darter species in northwest Arkansas

Parker Brannon and Susan Colvin

Arkansas Tech University, Department of Biological Sciences, Russellville
Presentation Type: Student Oral
11:35 Friday 18 November

The northwest corner of Arkansas (NWA) is one of the fastest-urbanizing regions in the state, it also has high species diversity and levels of endemism due to its unique karst habitat. The Least Darter (*Etheostoma microperca*), Arkansas Darter (*E. cragini*), Sunburst Darter (*E. mihilize*), and Plateau Darter (*E. squamosum*) are each darter species of greatest conservation need (SGCN) in Arkansas. Found in NWA, existing research indicates these darters inhabit spring-influenced headwater streams containing aquatic vegetation and backwaters, with substrate preferences varying by species. In summer 2022 we sampled thirty sites in the NWA Ozark Highlands and captured 1,222 SGCN darters collectively and 6,996 total fish comprising 27 species. *Etheostoma*

squamosum was detected at 90% of sites, *E. mihilize* 37%, *E. cragini* 27%, and *E. microperca* 17% respectively. *Etheostoma squamosum* was captured in high abundance across sites, while *E. microperca* was less frequently detected but showed high local abundance. *Etheostoma cragini* and *E. mihilize* were found in low abundance. Principal Component Analysis and classification trees indicated *E. cragini* had a higher tolerance for silty substrates, lower dissolved oxygen (DO) (<7.22 mg/L), and higher temperatures (>23°C) than *E. microperca* across sites. Analyses indicated that *E. microperca* and *E. squamosum* preferred substrates with a higher gravel percentage (>52%). However, *E. squamosum* showed a higher tolerance of low DO, high temperature, and varying substrate compositions. Preliminary analysis showed that *E. mihilize* may be more tolerant of low flow (<0.235 m/s) and embeddedness (<82%) than other species. These data largely support previous species-specific habitat descriptions yet these analyses will further elucidate the niche preference differences amongst NWA SGCN darter species, better enabling habitat specific protections.

Keywords: springs; SGCN; darters; karst; habitat

Multi-pronged approach to fish conservation in the Conasauga River basin

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Presentation Type: Oral
10:43 Friday !8 November

The Conasauga River, once considered a refuge for imperiled aquatic species, has experienced major declines of mussel and fish species over the last 25 years, particularly in the mainstem. In response, a coalition of federal agencies, state agencies and NGOs have launched a restoration campaign focused on Holly Creek, one of the largest tributary systems that could serve as a stronghold for species of concern. We have established a long-term monitoring program of fish and macroinvertebrates within the upper reaches of Holly Creek to track population trends in response to both natural environmental variation and restoration and management actions. The initial five years of sampling suggest some species such as Tricolor Shiner (*Cyprinella trichroistia*) could serve as source populations to the Conasauga River if the lower reaches of Holly Creek can be improved. However, Holly Creek alone is likely insufficient for long-term conservation of aquatic species in the larger basin. Thus, we are also testing potential restoration actions in the mainstem Conasauga. Specifically, we are testing the role that American Water-willow (*Justicia americana*) and Hornleaf Riverweed (*Podostemum ceratophyllum*) play in shaping physical habitat in the mainstem, with the idea that restoration of aquatic plants may initiate a cascade that improves physical habitat and, ultimately, increases the abundance and richness of animal species. The work is guided and informed by a long-term sampling program from the Conasauga mainstem that has been maintained since the 1990s. Our

hope is that this multi-pronged approach will provide short-term benefits to target taxa while simultaneously answering essential research questions about the cause of species declines.

Keywords: long-term data; fish declines; biodiversity; restoration; macrophytes

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Morphological variation in two minnows from the White River, Indiana

Jillian Campbell and Mark Pyron

Ball State University, Department of Biology, Muncie, IN
Presentation Type: Student Poster #2
6:00-8:30 Thursday 17 November

Urbanization changes the physical and chemical properties of waterways, which causes measurable morphological alterations to fishes. We use Central Stoneroller (*Campostoma anomalum*) and Bluntnose Minnow *(Pimephales notatus*) as model organisms. Urbanization can both reduce biodiversity and drive evolutionary diversification by modifying selection. The West Fork White River in Indiana is impacted by urbanization as it passes through Muncie, but little research has tested the effects of growing cities on aquatic ecosystems in Indiana. Our study focuses on Central Stoneroller and Bluntnose Minnow, from the White River in Delaware County, Indiana. Historical samples were collected and preserved from 1978 to today from both urban and rural sites in Delaware County. We used geometric morphometric analysis to quantify the temporal and spatial effects of urbanization on fish morphology in the White River. We predicted streamlined body shape to vary among urban and rural sites, with modified local hydrology. This information is important for identifying how fish respond to human impacts and can help in conservation efforts.

Keywords: urbanization, morphology, Bluntnose Minnow, Central Stoneroller

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Population genetic assessment of the endangered Cumberland Darter (*Etheostoma susanae*)

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Presentation Type: Student Poster #11
6:00-8:30 Thursday 17 November

The Cumberland Darter (*Etheostoma susanae*) is an endangered freshwater fish species endemic to the tributaries of the Cumberland River above Cumberland Falls in

Kentucky and Tennessee. Once recognized as a subspecies of Johnny Dater (*E. nigrum*), *E. susanae* was elevated to species level based on morphological and mtDNA variation. Habitat degradation and modification is a concern for the species with its preference for slow-flow streams. Fragmented populations increase the risk of disrupting historic gene flow between tributaries which could result in genetically distinct populations. Fin clips were obtained from eight localities across the range of *E. susanae* for a total of 188 samples. An additional 86 samples were collected for comparative purposes from four localities for *E. nigrum*, two of which were thought to be potential hybridization zones for *E. susanae* and *E. nigrum* in the Cumberland and Upper Kentucky River drainages. Samples for both species totaled to 274 individuals obtained from 11 sample sites. To better understand the evolutionary history, patterns of genetic structure, and the potential for hybridization between *E. susanae* and *E. nigrum*, we analyzed data from both mitochondrial DNA (mtDNA) and microsatellite DNA loci. Phylogenetic analysis of mtDNA corroborated the sister relationship of *E. susanae* to *E. nigrum* from the upper Cumberland and Kentucky river drainages. Microsatellites and mtDNA revealed no evidence of recent or ongoing hybridization or introgression between *E. susanae* and *E. nigrum*. Microsatellite data uncovered moderate to high levels of genetic structuring among several localities for *E. susanae*, with those closest to Cumberland Falls showing the highest levels of divergence. These results will be combined with ongoing RADSeq data analyses, providing a comprehensive genetic roadmap that will be useful for conservation and management strategies involving *E. susanae*.

Keywords: conservation; endangered species; endemism

Litter and macroplastic contribution from an urban watershed to the Arkansas River and accompanying fish assemblage metrics

Nicole Carlisle, Seth Drake, Aaron Norton, Anthony Zenga, Parker Brannon, and Susan Colvin

Arkansas Tech University, Department of Biological Sciences, Russellville
Presentation Type: Student Poster #3
6:00-8:30 Thursday 17 November

Small urban watersheds are thought to be major contributors of macroplastics to downstream waters though few studies quantify the amount and type of litter. We quantified litter and macroplastics in the Prairie Creek Watershed outlet which drains the majority of Russellville, Arkansas and empties into the Arkansas River. We additionally sampled the fish assemblage of the downstream portion of this stream. Fifty-five percent of litter items were constructed of plastic, 39% of Styrofoam or building foam, with small percentages of items composed of glass, metal, and wood. Though likely an underestimate, these data indicate based on watershed size 181 pieces of macroplastic and 334 pieces of litter were produced per sq. km per year in Russellville. Preliminary fish sampling indicated low overall species richness with most of the assemblage comprised of annual species (51%), and the entirety of the

assemblage highly tolerant species. Forty percent of the dominant predator, Largemouth Bass *Micropterus salmoides*, had tumors or lesions. The data collection phase of this project was accompanied by a large-scale stream clean up. Annual clean ups will allow us to quantify continued potential contributions of litter and macroplastics to the Arkansas River from Russellville, AR and determine if clean ups will aid in improving fish assemblage health.

Keywords: macroplastics; fish; litter

Quantitative evaluation of River Chubs as a potential keystone species in the Little Tennessee basin

Joelle Ciriacy and Kit Wheeler

Tennessee Tech University, Department of Biology, Cookeville
Presentation Type: Student Poster #15
6:00-8:30 Thursday 17 November

River Chubs, *Nocomis micropogon*, are known for their complex mound-building behavior that creates clean spawning substrate and protects eggs from predators. Many publications have noted the importance of this behavior to both *N. micropogon* and a cast of other minnows who also spawn over these mounds, a phenomenon known as nest association. However, there is still much left to be understood about quantitatively assessing the degree to which *N. micropogon* functions as a keystone species. Here, we used fish count data from the Tennessee Valley Authority's Index of Biological Integrity program for the Little Tennessee River basin, with both univariate and multivariate approaches to examine relationships between nest associates with *N. micropogon*. A chi-square analysis suggested that the occurrence of many nest associates is non-independent from that of *N. micropogon,* but also suggested a similar pattern amongst many species that are not documented nest associates, perhaps due to habitat preferences. We also applied hierarchical clustering to examine patterns in species groups across the basin and found that two nest associates--Warpaint Shiners, *Luxilus coccogenis,* and Tennessee Shiners, *Notropis leuciodus*, clustered significantly and most closely with *N. micropogon*, indicating a potential dependency of Warpaint Shiners and Tennessee Shiners on *N. mircopogon*. While best practices for quantifying the keystone role of individual species remain uncertain, attempts like ours are a potentially valuable tool for identifying biotic interactions that influence species diversity.

Keywords: mutualism; Cyprinidae; keystone species; nest association; multivariate analysis

The effects of surface mining on population connectivity and genetic diversity of *Etheostoma sagitta spilotum*, the Kentucky Arrow Darter

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Presentation Type: Student Oral

10:43 Thursday 17 November

The Kentucky Arrow Darter (KAD), *Etheostoma sagitta spilotum*, is endemic to headwater streams in the Upper Kentucky River Basin. The species is listed as threatened under the Endangered Species Act (2016) due to declines in occurrence and population size attributed to extensive habitat degradation, particularly from mining activities, across its range. We modeled population connectivity of KAD using correlations between genetic diversity from eleven microsatellite markers and resistance mapping of multiple landscape variables. We gathered and created multiple rasters to represent landscape variables, including elevation, flow direction, presences of dams, stream order, distance between sites, and percent landcover type. We created a cumulative resistance map from the raster layers with resistance values assigned from the existing literature and calculated least cost paths between populations using the R package ResistanceGA. Least cost paths between populations were correlated with F_{ST} values using a linear model to examine the impact of mining on population level genetic diversity and the degree of population isolation observed in this species. We found high population structure and fixation (F_{ST}) levels among all KAD populations. A significant relationship between F_{ST} and geographic distance was found, but several pairwise comparisons were higher than expected based on distance alone. We estimated that since 1985, an average of 192 km^2/year is actively mined for coal in the Upper Kentucky River Basin. ResistanceGA analyses are ongoing to estimate the effects of mining and other landscape variables on the levels of genetic diversity and population isolation observed in the KAD; these results will be presented and discussed.

Keywords: landscape genetics; microsatellites; darter; landscape modeling; conservation

Assessment of Freckled Darter (*Percina lenticula*) status in the Pascagoula and Pearl Drainages in Mississippi

Noah J. Daun, Nicole M. Phillips, Annmarie M. Fearing, Claire L. Gauci, Ryan N. Lehman, and Jake F. Schaefer

The University of Southern Mississippi, Department of Biological Sciences, Hattiesburg
Presentation Type: Student Oral
11:09 Friday 18 November

Historical occurrence data are foundational to effective management of a species and can be strongly influenced by the habitats they occupy. Species found in habitats challenging to sample may have occurrence data deficiencies, as it is difficult to separate true absence from insufficient sampling. The Freckled Darter (*Percina lenticula*) is a large darter species that inhabits deep, fast-flowing habitats and is associated with coarse woody debris (CWD) and deep potholes in bedrock. These habitats are difficult to effectively sample with traditional gear (seines) used for many surveys. The Freckled Darter is a species of conservation concern in the state of Mississippi due, in part, to the small number of historical collections. There was anecdotal evidence that this species, and these unique habitats, may be more effectively sampled through alternative approaches, such as electrofishing and environmental DNA (eDNA) analysis. We used these sampling techniques at historical sites, and other putative sites to assess the status of the Freckled Darter in the Pascagoula and Pearl drainages. EDNA results suggest the species was present in 10 of the 12 sites sampled in the Pascagoula drainage, with positives results obtained from the Leaf River, Upper Chickasawhay River, Chunky River, Tallahala Creek, Black Creek, and Red Creek. Species presence was further supported in these areas by the capture of 21 individuals among 10 different CWD patches via electrofishing. However, eDNA sampling in the Pearl drainage only resulted in one site in the Bogue Chitto, and ongoing electrofishing efforts have thus far failed to produce any specimens in that drainage. The combination of these two sampling techniques provides key information to make an accurate assessment of the populations of Freckled Darter in these drainages in Mississippi.

Keywords: conservation, darter, survey, electrofishing, eDNA

Reproductive timing and clutch parameters of the Pearl Darter, *Percina aurora*

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[2]U.S. Fish and Wildlife Service, Baton Rouge Fish and Wildlife Conservation Office, LA
Presentation Type: Student Oral
8:52 Friday 18 November

Understanding the timing, duration and effort put into reproduction is vital to successful management of any species. The Southeastern US is home to tremendous levels of aquatic biodiversity and was recently named one of the Earth's biodiversity hotspots. Within this region, growing human populations continue to pressure aquatic ecosystems and the resident species. Darters (Percidae) represent a large proportion of the freshwater fish diversity in the region. However, for some species the fundamentals of age, growth, reproduction timing, effort and ecology remain poorly understood. The Pearl Darter, *Percina aurora*, has been recently listed as threatened due to its contracting range, likely due to anthropogenic pressure on these systems. Little is known of Pearl Darter life history as surprisingly few reproductive adults have been captured. Thus, there remains a major knowledge gap in terms of the life history and reproductive ecology of this species. The purpose of this project was to examine the age, growth, and reproductive ecology of *Percina aurora* and other coexisting *Percina* species in the Pascagoula River basin. We sampled darters and examined gonadosomatic index (GSI) over time of four *Percina* species to better understand the reproductive effort and timing. The species collected included *P. aurora* (Pearl Darter), *P. vigil* (Saddleback Darter), *P. sciera* (Dusky Darter) and *P. suttkusi* (Gulf Logperch). We present analyses describing the spawning windows of each species based on 2021 and 2022 sampling. We also describe clutch parameters (GSI, egg size etc.) to infer reproductive output during the spawning period for *Percina aurora.*

Keywords: life history; darter; clutch parameters; threatened species

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Discharge mediates effects of temperature on Atlantic Sturgeon spawning migrations in the Great Pee Dee River

Colby D. Denison[1], Amy M. Cottrell[2], Troy M. Farmer[1], Dewayne A. Fox[3], David M. Hood[4], William C. Post[4], Gregory Sorg[4], Ellen Waldrop[4], and Brandon K. Peoples[1]

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Presentation Type: Lightning Talk
2:20 Friday 18 November

Understanding important timing and drivers of life history events is critical for identifying threats to the conservation and recovery of imperiled species, especially those with diadromous life histories. In this study, we investigated environmental drivers of spawning migration behavior for an endangered Atlantic Sturgeon *Acipenser oxyrinchus oxyrinchus* population in the Great Pee Dee River, South Carolina. From 2016 to 2021, a total of 147 Atlantic Sturgeon were captured, implanted with acoustic transmitters, and monitored using a stationary array of 40 receivers located every 5-20 km along a 302-

km section of the Great Pee Dee River from the river mouth at Winyah Bay to the first movement barrier at Blewett Falls Dam, North Carolina. We observed 47 Atlantic Sturgeon attempt 74 spring migrations and 39 Atlantic Sturgeon attempt 76 fall migrations across four years (2018-2021). Environmental variables predictive of migration initiation and upriver movement differed among spring and fall migratory cohorts and reflected potentially unique adaptations to ambient river conditions during respective spawning seasons. Though temperature was the primary factor constraining putative spawning migrations in the Great Pee Dee River, discharge mediated the effects of temperature on migratory behavior in this system. Identifying differences in the environmental factors that drive, and thereby limit, migrations among cohorts in the Great Pee Dee River informs regional recovery efforts and highlights the importance of studying and managing this species at the population level.

Keywords: diadromous; movement; telemetry; spawning

Diet analysis of Piping Plover, *Charadrius melodus*, with metabarcoding of fecal samples

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Presentation Type: Poster #28
6:00-8:30 Thursday 17 November

The Piping Plover, *Charadrius melodus*, is an endangered shorebird that utilizes beaches along the Southeast United States coast as a rest stop on their migration to nesting grounds in the Northern United States and Canada. One of the major threats to Piping Plover is habitat loss along its migratory route. Part of protecting critical habitat for this species requires knowledge about its diet and prey preferences. This study applies metabarcode sequencing to fecal samples for building a comprehensive picture of the Piping Plovers' diet. Fecal samples were collected from flocks of Piping Plover observed on South Carolina barrier islands. DNA was extracted and PCR was used to amplify the Cytochrome Oxidase subunit 1 (COI) gene. After high-throughput sequencing, raw sequencing reads were filtered, merged and mapped against a metazoan COI database derived from NCBI GenBank. Genetic data confirmed several prey species that had been previously determined through other methods, such as the polychaete worm *Laeonereis culveri* and haustorid amphipod *Nehaustorius schmitzi,* but also identified several new probable prey species. Among these are two species of pea crabs and a soft bodied Nemertean worm (Nemertean). Due to the lack of sequences for local invertebrate species on the NCBI database, 11%-100% of sequences per sample were unable to be assigned taxonomy. To fill this gap, targeted COI sequencing of 23 intertidal invertebrate species that are likely prey items will be used to build a local database. Metabarcoding as a tool for diet characterization has ecological applications

across taxa, including freshwater fish. However, methodological considerations are required to minimize contamination, reduce sample degradation, and ensure limited sample volumes are processed efficiently.

Keywords: metabarcode; diet study; Piping Plover

Effects of riparian scale landcover on fish assemblage metrics in spring fed streams of northwest Arkansas

Seth Drake, Anthony Zenga, Parker Brannon, and Susan Colvin

Arkansas Tech University, Department of Biological Sciences, Russellville
Presentation Type: Lightning Talk
4:00 Thursday 17 November

No Abstract.

Keywords: land cover; riparian; karst

Analysis of temporal trajectories for fish assemblages within North Carolina

Blaik Duran and Mark Pyron

Ball State University, Department of Biology, Muncie, IN
Presentation Type: Student Poster #19
6:00-8:30 Thursday 17 November

Humans have long had a significant role on the environmental impacts of river systems. These impacts have led to long-term changes in the hydrological regimes of watersheds. Research has shown that fish assemblages can shift in response to these changes. Therefore, we wanted to examine how fish assemblages within the four geographic regions of North Carolina have been affected by these anthropogenic impacts. Using the RIVFishTime database, sites with a minimum of 10 sample years were selected from the North Carolina sites. We then used Canoco 5 to run a principal components analysis (PCA) for each site comparing year to species present. We then examined each site for temporal trajectories based on Matthews et al. (2013). Temporal trajectories patterns were then compared to land use, which was classified as either urban, agricultural, pristine (undisturbed), or lumber plantations. We hypothesized that fish assemblages that have directional trajectories were significantly impacted by human impacts. While river fragmentation has been well documented, few studies have shown how hydrologic alternations cause shifts in assemblages in small tributaries. Therefore, understanding how temporal trajectories of fish assemblage data can be interpreted and applied can help researchers to develop stream hydrology management plans to avoid future stress on riverine ecosystems.

Keywords: fish assemblages; human impacts; temporal; land use

Survey of freshwater mussels in the Pearl River, Mississippi

Robert J Ellwanger, Calvin R Rezac, and Abigail Shake

Mississippi Department of Wildlife, Fisheries, and Parks, Jackson
Presentation Type: Lightning Talk
2:45 Friday 18 November

No Abstract.
Keywords: Unionids; freshwater; diversity

It's free real estate: benthic assemblage composition on Bluehead Chub nests in Southeastern streams

Isabel Evelyn, John Morse, Kyle Barrett, and Brandon Peoples

Clemson University, SC
Presentation Type: Student Oral
9:22 Thursday 17 November

The Bluehead Chub (Leuciscidae: *Nocomis leptocephalus*) is a keystone species and ecosystem engineer widely abundant throughout much of the eastern United States. Male Bluehead Chub construct gravel mound nests to spawn on, creating a unique microhabitat within the streambed. Nest associates such as the Yellowfin Shiner (*Notropis lutipinnis*) also spawn on the chub nest, and benthic macroinvertebrates and salamanders have been observed within the interstitial spaces. Our study aimed to quantify the composition of benthic assemblages on and off Bluehead Chub nests, and as part of a greater reach-wide assemblage. To address this question, we sampled Bluehead Chub nests and corresponding comparable stream benthos, as well as representative habitat of the entire stream reach, for benthic macroinvertebrates in ten second- and third-order streams in and around Clemson, South Carolina. Bluehead Chub nests hosted significantly more abundant and diverse communities than paired non-nest substrate; however, nests and paired substrate are similar subsets of a more diverse stream reach community. Assemblage associations were often distinct at the genus level and are likely due to genus- and species-specific differences in microhabitat usage, where Bluehead Chub nests provide habitat and food availability differentially exploited by these aquatic taxa. Bluehead Chub nests may provide temporary habitat for aquatic macroinvertebrates and may even potentially facilitate aquatic macroinvertebrate communities that rely on the interstitial spaces, structure, and food provided by the nests in urban streams with greater sedimentation.
Keywords: Bluehead Chub; nests; benthic macroinvertebrates; aquatic insects; community

Development of an eDNA tool for the Robust Redhorse

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[1]South Carolina Department of Natural Resources, Charleston
[2]University of Georgia, Athens
Presentation Type: Lightning Talk
2:10 Friday 18 November

Robust Redhorse (*Moxostoma robustum)* is a large-bodied catostomid that occurs in several large southeastern Atlantic Slope rivers. After being lost to science for about 100 years, documentation of Robust Redhorse in the Pee Dee, Savannah, and Oconee Rivers in the 1980s and 1990s represents an extraordinary scientific rediscovery. Because of their limited range and the low number of fish collected during extensive surveys, Robust Redhorse is considered an imperiled species. The status of the three natural populations (Oconee, Savannah, and Pee Dee rivers) also creates uncertainty about the long-term persistence of Robust Redhorse. The Savannah River population is considered the largest and most stable, whereas the Oconee River population has declined dramatically since the 1990s and the Pee Dee River population is small. Until recently, survey efforts have been limited to the spawning season when adults are accessible to collection on the shallow gravel shoals over which they spawn. As detections decrease in the Pee Dee and Oconee river populations, an alternative passive method for detection of adult presence in the rivers would provide critical information that will be needed when considered for federal listing. Additionally, although intensive field efforts have occurred recently to identify juvenile habitat utilization patterns, detections have been low. A passive detection tool to determine appropriate areas to focus future traditional field collections in the pursuit of understanding juvenile habitat use would also provide relevant data for the species' evaluation. Here we describe the development and testing of an environmental DNA (eDNA) tool for the Robust Redhorse. This tool will allow for the passive detection of juveniles and/or adults in habitat reaches that are challenging to sample with traditional gears/methods and to identify the presence or absence of the species in locations where status is unknown.

Keywords: eDNA; molecular tool; sucker

Frozen in channel evolution time: long-term effects of grade control structures on channel morphology and fish beta diversity in Mississippi streams

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Type of Presentation: Student Oral
8:39 Friday 18 November

The hills of Yazoo Basin have a long history of land use modification and subsequent erosion control issues. To address widespread instream erosion, over 160 low-drop grade control structures (GCS) were installed in the late 1980s and early 1990s as part of the federally funded Demonstration Erosion Control project. We assessed the effects of these GCS on channel morphology and fish assemblages approximately 30 years post-installation. To assess GCS effects on channel morphology, stream cross-sections were used to calculate Bank Height Ratio, Width/Depth Ratio, and Entrenchment Ratio, while point estimates made along the transects were used to calculate the average sediment size distribution. Analyses revealed that the GCS were successful in checking channel incision moving headward in the streams: sites upstream of the GCS were less incised and had greater accumulations of fine substrates compared to downstream sites and sites on streams lacking erosion control structures. The GCS could potentially affect fish assemblages through habitat modification or by selectively filtering the assemblages as a barrier to upstream migration. Analysis of beta diversity revealed that diversity was driven by species replacement rather than nestedness, which indicates GCS were not acting as filters on the assemblages. Analysis of catch per effort data confirmed differences in assemblage structure that echoed the instream habitat differences revealed in stream morphology analysis.

Keywords: erosion; channel morphology; stream fish; beta diversity

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Effects of increased water conductivity on hatch rate and larval development in Blackside Dace (*Chrosomus cumberlandensis*)

Mason Ferrell and Mollie F. Cashner

Austin Peay State University, Department of Biology, Clarksville, TN
Presentation Type: Poster #23
6:00-8:30 Thursday 17 November

Blackside Dace (*Chrosomus cumberlandensis*), a federally threated species, has been extirpated from 31 streams throughout northeast Tennessee and southeastern Kentucky. Increased water conductivity caused by coal mining and other types of habitat destruction and alteration have been linked to their disappearance. Increased water conductivity negatively impacts the aquatic macroinvertebrate community and has been the mechanism used to explain the reduction in fish populations; however, few studies have explicitly tested the direct impact water conductivity has on fish taxa. There is a significant negative correlation in egg survival in the congner Southern Redbelly Dace (*Chrosomus erythrogaster*) with overall reduction in egg hatch rate among water treatments above 650mS/cm; however, their base line conductivity is out of the range of conductivity tolerance detected for Blackside Dace (200mS/cm). The goals of this study

are to demonstrate how increased water conductivity impacts hatch rate and larval development in Blackside Dace. To achieve this, induced spawning will occur in an aquarium setting and eggs will be collected then exposed to different conductivity levels. We will manufacture water using ions common in Appalachian streams such as MgSO4, CaSO4, NaCO3, KCl, and use water quality data to mimic both “unimpacted” ionic concentrations and those found in impacted streams. We will then hatch eggs under normal conditions and expose the larvae water of varying ionic conditions to assess impact on larval development and survivorship.

Keywords: Blackside Dace; water conductivity; proposal

Mussels of the Wolf River, TN: a resurvey of Unionids in an inundated Cumberland tributary

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Presentation Type: Student Oral
8:00 Friday 18 November

Tennessee has the second most diverse freshwater mussel fauna in the United States, most of which, have some form of conservation status. The Cumberland River system in Tennessee and Kentucky has one of the most diverse assemblages in the world, including several species that are federally listed as endangered. The Obey River system, a large tributary of the Cumberland River, once contained 35 species. Most of these historical occurrences are now inundated by Dale Hollow Reservoir and have been nearly eliminated due to acid mine drainage in the river headwaters. The Wolf River, the largest tributary of the Obey River, remains a critically important stronghold of the Cumberland River mussel fauna. In this study, we revisited 45 sites from a previous survey in 2005-2006 to determine the distribution and habitat status of freshwater mussels in the Wolf River. Using qualitative and quantitative sampling methods, we located seven of the nine species found in the previous study, with live mussels at 33 of the 45 sites, compared to 24 of the 45 sites in the sites previously sampled. Moreover, several comparatively species-rich sites were identified that contained the federally endangered Fluted Kidneyshell *Ptychobranchus subtentus* as the most abundant species. We analyzed multiple habitat and environmental variables to determine site and landscape characteristics of the Wolf River around these mussel concentrations. These findings have potential to be used to target areas for potential restoration and recovery.

Keywords: freshwater mussels; multivariate analyses; snorkel surveys; quadrats

Advancing aquatic connectivity through collaboration and partnerships

Shawna Fix and Kat Hoenke

Southeast Aquatic Resources Partnership
Presentation Type: Lightning Talk
3:35 Thursday 17 November

Fragmentation of river and stream habitats by anthropogenic barriers is one of the primary threats to aquatic species in the Southeast. The Southeast Aquatic Resources Partnership (SARP) facilitates teams across the Southeast United States with the common goal of increasing aquatic connectivity. These Aquatic Connectivity Teams (ACTs) work together to identify, prioritize, and remove structures such as dams and culverts that block aquatic organism passage. There are currently 8 ACTs in the Southeast including Alabama, Arkansas, Tennessee, Georgia, North Carolina, South Carolina, Florida and Virginia. The ACTs work directly with SARP, who has developed a comprehensive living inventory of dams and assessed road-stream crossing barriers. Teams are able to contribute to this database through a user-friendly online tool that can prioritize barriers for removal or remediation. The Aquatic Barrier Prioritization Tool provides summaries of barrier densities within user specified areas of interest and allows users to prioritize barriers for removal or remediation based on ecological metrics using various filters. The results provided by the tool help identify high priority projects to implement and allow resource managers to access information regarding barrier locations and attributes that were not readily accessible prior to SARP's work. In the Southeast, over the past 10 years, this inventory and tool process has resulted in or contributed to the remediation of 20 road crossing barriers and 19 dam removals, a positive example of success as the inventory and tool expands further into the western United States. Completing a successful barrier removal project is a collaborative effort and one that can be eased with the participation in an Aquatic Connectivity Team.

Keywords: collaboration; partnership; connectivity

Biodiversity connections: ties that bind

Mary C. Freeman

U.S. Geological Survey, Eastern Ecological Science Center, Athens, GA
Presentation Type: Oral
8:10 Thursday 17 November

Ichthyologists have long centered biodiversity connections in the study and conservation of southeastern fishes. Systematics, ecological studies, and conservation efforts each ultimately focus on connections that bind fishes though time, across and within ecosystems, and to human culture. Species descriptions address the products of evolutionary lineages, connections across geologic time. Advanced molecular techniques are allowing ever more refined tests of phylogenetic hypotheses and are

helping resolve divergence within complexes of taxa previously considered to represent cosmopolitan species. Will this better understanding of evolutionary divergence help us anticipate effects of global change on faunal diversity? Ecology rests on a framework of connections: ecosystems connected by fish migration; populations and communities connected by dispersal; individuals connected through competition, predation, and facilitation. Nest associations and group foraging are examples of potentially facilitative relationships among fish species. Do unexplored communication networks also enhance persistence within fish assemblages? How would we approach conservation differently if this were true? Finally, conservation itself relies on connecting the concerns and values of people to the well-being of fishes and the streams that support them. The SFC community and its partners have developed extraordinary outreach tools to build support for fish conservation. Can we now envision a society in which people from all walks of life value streams and rivers as living infrastructure, and biodiversity as an amenity rather than a constraint on water extraction or development projects? Perhaps the next generation of research and conservation for southeastern fishes will center in part on the ties that bind species to one another, and their habitats to people.

Keywords: divergence, adaptation, mutualism, conservation, outreach

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Accentuating the positive: the ecological and environmental benefits of recreational fishing

Rachel Gallahan, Kate Herod, Greg Hyche, and Malorie Hayes

Southern Union State Community College, Opelika, AL
Presentation Type: Poster #24
6:00-8:30 Thursday 17 November

One in six Americans is a recreational fisher, and the numbers are growing. As the number of fishers increases, so do their effects on the environment. Recreational fishing can be a strong economic force in a community, but economic impact must be balanced against ecological repercussions. In this study, we evaluate the effects hobby fishing has on the economics of a region and on the environment in which the fishing is done. We present selected impacts and identify methods that ameliorate negative outcomes. In areas where we see a positive impact, we examine strategies to enhance the benefits. Understanding key areas where behavioral changes can positively impact a community will aid in awareness and education on alternative behaviors and methods to improve the balance of the ecological and environmental effects of recreational fishing in the southeastern United States. Phi Theta Kappa (PTK) is the official Honors Society of two-year community colleges. Every year, participating clubs have the opportunity to do a research project on a given theme. This year's theme is The Art and Science of Play. Our members have directed their research efforts to understanding the financial, physical, and psychological costs and benefits of play. We have identified recreational fishing as a form of play and our Action Item is presenting our findings to the Southeastern Fishes Council.

Keywords: recreational fishing; sport fishing

A comparison of freshwater mussel populations in the Boeuf River, northeast Louisiana: 550 A.D. to recent time

Steven G. George and W. Todd Slack

USACE Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS
Presentation Type: Lightning Talk
4:15 Thursday 17 November

In 1996, the Department of Geosciences at the University of Louisiana at Monroe conducted an archeological dig in the middens of Landerneau Mounds (16CA87) on the Boeuf River to determine the food resource of Native Americans. Many species of fishes and mammals were excavated along with freshwater mussels. Nineteen species of freshwater mussels were identified. Dominant species from 2,504 mussel valves were Threeridge (*Amblema plicata*) 33%, Pyramid Pigtoe (*Pleurobema rubrum*) 20% and Wabash Pigtoe (*Fusconaia flava*) 14%. Numerically less abundant mussels included: Washboard (*Megalonaias nervosa*) 7.9%, Pimpleback (*Cyclonaias pustulosa*) 5.3%, Southern Hickory Nut (*Obovaria jacksoniana*) 4.9%, Bankclimber (*Plectomerus dombeyanus*) 4.7%, Mapleleaf (*Quadrula quadrula*) 4%, Spike (*Eurynia dilatata*) 2.6%, and Louisiana Fat Mucket (*Lampsilis hydiana*) 1.2 %. Rare mussel species represented by < 1% were: Western Mapleleaf (*Quadrula apiculata*), Threehorn Wartyback (*Obliquaria reflexa*), Wartyback (*Cyclonaias nodulata*), Lilliput (*Toxolasma parvum*), Yellow Sandshell (*Lampilis teres*), Bleufer (*Potamilus purpuratus*), Pistolgrip (*Tritogonia verrucosa*), Black Sandshell (*Ligumia recta*) and Round Pearlyshell (*Glebula rotundata*). Recent mollusk surveys in the Boeuf River at five stations yielded twenty-one species of native mussels and the exotic Asiatic Clam, *Corbicula fluminea*. Threeridge (*Amblema plicata*) was the dominant mussel at one of the stations sampled and appeared to show no changes in its relative abundance since 550 A.D. Preliminary comparisons of long-term changes in all the other mollusks were apparent. Five species of mussels found at Landerneau Mounds were absent from the recent survey. Changes in the mollusk assemblage are likely due to anthropogenic impacts to streams which included: channelization, weirs and deforestation resulting in increased sedimentation. As a result, several of these species are likely extirpated from the Boeuf River. The use of freshwater mussels discarded by Native Americans not only provides records of their diet, but gives insight of the prehistoric mollusk assemblages.

Keywords: freshwater mussels; Landerneau Mounds; Boeuf River; Louisiana

Species delimitation of a conservation icon: the Snail Darter (*Percina tanasi*)

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[3]Resources and River Management, Tennessee Valley Authority

Presentation Type: Student Oral
2:48 Thursday 17 November

The subject of the U.S. Supreme Court's first interpretation of the Endangered Species Act in 1978, *Percina tanasi* (the Snail Darter) is a biological conservation icon distributed across much of the Tennessee River system. For decades, protection of *P. tanasi* depended on its validity as a species that is morphologically distinct from its sister taxon, *P. uranidea* (the Stargazing Darter), located in the White and Ouachita River systems of Arkansas, northern Louisiana and southern Missouri. Using double-digest RAD sequencing and meristic trait morphology, we examine the species boundary drawn between *P. tanasi* and *P. uranidea*, comparing it to the boundaries delimiting 14 other pairs of darter sister species. Our findings confirm that despite *P. tanasi*'s legacy as a symbol of the Endangered Species Act, it is genetically and morphologically indistinct from *P. uranidea*. Our results thereby inform future discussions on the ichthyological definition of species and its role in conservation biology.

Keywords: species delimitation; conservation; phylogenomics; darters

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Local habitat characteristics for a narrow endemic crayfish, *Faxonius wrighti*

Brooke Grubb and Hayden Mattingly

Tennessee Technological University, School of Environmental Science, Cookeville

Presentation Type: Student Oral
8:13 Friday 18 November

Many imperiled crayfishes lack ecological data for successful management practices to be developed. *Faxonius wrighti*, the Hardin Crayfish, is a narrow endemic species that is patchily distributed throughout six tributaries of the Tennessee River. Prior surveys highlighted lower abundance or absence at sites with high levels of fine sediments relative to sites with high abundance. We measured several environmental variables across the range of *F. wrighti* to explore habitat variation among sites. We quantified habitat characteristics for *F. wrighti* using ordination methods. We also examined the effectiveness of detecting *F. wrighti* via kick-seining using a logistic regression approach. *Faxonius wrighti* abundance was associated with greater proportions of riffle

habitat, reduced fine sediments, and increased substrate size variability. We detected *F. wrighti* in ~25% of our kick-seine samples across all sites. We detected *F. wrighti* at least once at ~50% of sites sampled.

Keywords: crayfish, habitat, detection, conservation, endemic

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Mark and sometimes recapture: detecting the movement of headwater fish in relation to culverts

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Presentation Type: Student Oral
10:56 Thursday 17 November

Riverine ecosystems are dendritic networks which have become increasingly threatened by fragmentation due to in-stream barriers. Within riverine networks, culverts are the most common type of barrier to aquatic organismal passage (AOP). Barrier surveys have been developed to rapidly assess culverts for AOP, but research on headwater fishes and the efficacy of these surveys are lacking. Additionally, more information is needed to understand the connectivity of small-bodied headwater fish which account for much of the freshwater biodiversity in the southeastern U.S. The goal of this study was to 1) use a novel experimental approach to assess the efficacy of a common barrier survey, 2) to determine the connectivity of stream fish within the range of the federally threatened Louisiana Pearlshell Mussel (*Margaritifera hembeli*), and 3) begin basin wide sampling in order to gain a broader understanding of the efficacy of the SARP protocol. We conducted SARP (Southeast Aquatic Resource Partnership) barrier assessments at all accessible sites across two watersheds. 6 sites with varying SARP AOP scores were selected to conduct mark-recapture studies and an additional 35 were selected for community samples. Of the 89 culverts surveyed, 20 (22%) were identified as moderate barriers and 13 (15%) were identified as significant or severe. Mark-recapture survey's resulted in the marking of 5,947 fish across 41 species. The mean recapture percentage was (11.6%), but varied depending on the site. Our results suggest the SARP protocol is relatively representative of AOP. However, this data is only representative of the few species with high recapture rates, and the limited spatiotemporal scale calls for further larger scale studies. Based on our results, we have recommended several culverts for removal or restoration as they represent significant barriers to AOP. Preliminary results from basin scale assemblage samples are also reported.

Keywords: connectivity; barrier assessment; mark-recapture; movement ecology

Utilizing genetically informed habitat suitability models to delineate hybridization zones between Chattahoochee and Alabama Bass

Clayton W. Hale[1], Brittany L. McCall[2], Bryant Bowen[3], and Chad Kaiser[3]

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[2]Arkansas State University, Department of Environmental Science, Jonesboro
[3]Georgia Department of Natural Resources, Wildlife Resource Division
Presentation Type: Student Oral
2:35 Thursday 17 November

Hybridization threatens many imperiled species by replacing alleles from the imperiled species with a common congener until only hybrids and the common congener persist within the system, a process known as genetic swamping. Recent work has raised concerns about the persistence of the state-imperiled Chattahoochee Bass (*Micropterus chattahoochae*) due to hybridization with the more common Alabama Bass (*Micropterus henshalli*). Utilizing a genetically informed maximum entropy (Maxent) habitat suitability model, we assess the differences in suitable habitat between pure Chattahoochee Bass and Chattahoochee x Alabama Bass hybrids within the upper and mid-Chattahoochee watersheds. Both models were considered useful with AUCs of 0.81 and 0.74, respectively. Our results indicate Chattahoochee x Alabama Bass hybrids are more generalist compared to pure Chattahoochee Bass. Further, Chattahoochee x Alabama Bass hybrids have higher habitat suitability in larger streams, while the majority of suitable habitat for pure Chattahoochee Bass is within headwater streams. Additionally, Chattahoochee x Alabama Bass hybrids demonstrate an additional 50 km of stream within the highest bin of habitat suitability (0.9-1). Modeling these species' habitat suitability allows conservationists to focus limited human and financial resources on portions of the Chattahoochee watershed most likely to support the Chattahoochee Bass while limiting resource allocation to the portions of the watershed likely to support the hybridization of Chattahoochee and Alabama Bass. Lastly, if ecologically appropriate, these models can inform the introduction of Chattahoochee Bass into streams with high habitat suitability for the Chattahoochee Bass but low suitability for the Chattahoochee x Alabama Bass hybrids.

Keywords: conservation; hybridization; distribution models: Alabama Bass; Chattahoochee Bass

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Temporal changes to fish assemblages in the US due to human impacts

Corwyn Hall and Mark Pyron

Ball State University, Department of Biology, Muncie, IN
Presentation Type: Student Poster #5
6:00-8:30 Thursday 17 November

Humans have long influenced watersheds and their fish assemblages. This resulted in the creation and implementation of the US Clean Water Act in 1972. Although water quality improved and mitigated human impacts, human impacts on watersheds are still present. This led to examination of individual watersheds and the temporal changes of fish assemblages, but there is a lack of literature for studies with more than 3-5 watersheds. Ours is a large-scale study where we selected as many watersheds in North America to quantify temporal changes in fish assemblages and associated watershed land use. We used the RIVFishTime database and selected US sites with 10 or more annual sampling events. Our analyses used Canoco 5 for redundancy ordination analyses. Sites were classified as agricultural, urban, pristine (untouched/mostly natural land), or timber plantation land use using Google Earth for the first and last year of sampling. We hypothesized that areas of agricultural and urban land use have greater temporal changes in fish assemblages due to increased human impacts.

Keywords: fish assemblages; land use; human impacts; temporal

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Population trends of shoal-dwelling fishes over 25 years of monitoring the Etowah River

Mackenzi Hallmark[1], Phillip Bumpers[1], Seth Wenger[1], Mary Freeman[2], Edward Stowe[1], and Bud Freeman[3]

[1]Odum School of Ecology, University of Georgia, Athens

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Presentation Type: Lightning Talk
3:55 Thursday 17 November

No Abstract.

Keywords: long-term monitoring, fishes, population dynamics

Life history of Pristine Crayfish (*Cambarus pristinus*)

Kendell Hamm and Hayden Mattingly

Tennessee Technological University, Cookeville

Presentation Type: Student Poster #21
6:00-8:30 Thursday 17 November

The southeastern United States represents a global hotspot for freshwater biodiversity. Approximately one-third of the world's crayfish species are found in the Southeast with

>80 species known from Tennessee. The Pristine Crayfish (*Cambarus pristinus*) is a rare species endemic to the Cumberland Plateau in Tennessee that is under consideration for federal listing under the U.S. Endangered Species Act of 1973. To inform conservation and potential recovery efforts, we conducted a 12-month life history study for two populations of pristine crayfish from November 2021 to October 2022. Two morphologically and genetically distinct forms of the species are known. The study populations were located in Pokepatch Creek, representing the Caney Fork form, and Camp Creek, representing the Sequatchie form. Male and female Pristine Crayfish reach reproductive maturity near one year of life at ~19 mm total carapace length (TCL). Adult Pristine Crayfish (>19 mm TCL) have an average size of 23-24 mm TCL. Mating occurs throughout the fall and winter, females are ovigerous in the spring, and young-of-year recruitment occurs during the summer. Interestingly, Camp Creek trailed Pokepatch Creek by approximately one month for many aspects of life history events. Pristine Crayfish likely has a maximum longevity of 2-3 years.

Keywords: crayfish; life history; Cumberland Plateau

A non-lethal method to extract diet data from darters (Etheostomatinae)

Kyler B. Hecke, Ben. S. Johnson, and Ethan H. Dodson

Arkansas Tech University, Department of Biological Sciences, Russellville

Presentation Type: Lightning Talk
2:30 Friday 18 November

No Abstract.

Keywords: diet; ecology; freshwater; streams

The international journal Ecology of Freshwater Fish as an outlet for papers on fishes of the southeastern United States

David C. Heins

Tulane University, Ecology and Evolutionary Biology
Presentation Type: Lightning Talk
2:55 Friday 18 November

This presentation will present the journal to those scientists at the meeting, including researchers from the southeast who are on the editorial board, the progress of the journal, and editorial practices. Those biologists with research of interest to an international audience are invited to submit their reports to the journal.

Keywords: ecology, evolution

Seasonal assessment of Goldstripe Darter (*Etheostoma parvipinne*) condition in an unnamed tributary of Moro Creek, Arkansas

Autumn F. Henry, Andrew J. Julian, and Kyler B. Hecke

Arkansas Tech University, Department of Biological Sciences, Russellville
Presentation Type: Student Poster #8
6:00-8:30 Thursday 17 November

Goldstripe Darters (*Etheostoma parvipinne*) are a species of conservation concern in many states across their range and have been widely studied. However, there is still much we do not know about this species, especially in Arkansas. We wanted to assess seasonal relationships in condition of this species in a spring-run creek in south-central Arkansas. Goldstripe Darter individuals were collected seasonally (every three months; starting in July 2022) in an unnamed headwater-tributary of Moro Creek, Arkansas. Fish were sampled with d-frame kick nets for one-hour during each sampling period. Total length and weight data, and abundance data were also collected during each sampling period. Total length and weight measurements were used for estimation of condition factor (k). Mean condition factor was assessed between the two sampling periods using a two-sample t-test. During the July sampling period, 27 individuals were sampled, and median (range) length was 35 (30-55) mm, median weight was 0.4 (0.1-1.1) g, and median condition factor was 0.79 (0.23- 1.35). During the October sampling period, 21 individuals were sampled, and median length was 48 (37-60) mm median weight was 0.9 (0.37-1.78) g, and median condition factor was 0.79 (0.56-1.02). The length weight-relationships for both sampling periods ($y = 3.66x – 6.17$, $R^2=0.69$; $y = 3.51x - 5.97$, $R^2=0.92$) suggests positive allometric growth for this species. There was no significant difference in mean condition factor between the two groups ($t_{46} = 0.208$, $p = 0.86$). The preliminary results from this study, suggest so far that there are no seasonal changes in condition for this species. However, more research is being conducted to encompass a whole seasonal component to this study. This research will aid in the understanding of Goldstripe Darter biology. Future research will consist of mark-capture techniques to assess Goldstripe Darter population size.

Keywords: darters; condition; seasonal; biology

Retracing pre-impoundment fish migrations in the Mobile Basin, Alabama

Henry Hershey, Dennis DeVries, and Russell Wright

Auburn University, School of Fisheries, Aquaculture, and Aquatic Sciences, AL
Presentation Type: Student Oral
11:22 Thursday 17 November

Conservation of imperiled migratory fishes in the Southeastern US is impeded by historical data deficiency, particularly information on the historic ranges of their

migrations. In Alabama, migratory ranges of a number of migratory species are restricted by dams and the fall line, a biogeographic barrier for many taxa. However, given that many of the dams on major Mobile Basin tributaries were built at or near the fall line about a century ago, it is unclear from the scientific record just how far upstream pre-dam diadromous migrations reached. Furthermore, the history of dam construction in Alabama is murky due to the construction and removal of several locks and dams in the late 19th century. In an effort to generate as complete a historical database as possible, we searched newspaper archives (1857-present) for all records of migratory fish captured in Mobile Basin waters. Using provided or gleaned location data from most records, we reconstructed migratory ranges for four species: Gulf Sturgeon (*Acipenser oxyrhynchus desotoi;* 98 records), American Eel (*Anguilla rostrata;* 66 records), Lake Sturgeon (*Acipenser fulvescens*; 11 records), and Alabama Sturgeon (*Scaphirhynchus suttkusi*; 6 records). American Eel records came from much farther inland than documented in the scientific record, and well upstream of the fall line in the Coosa, Cahaba, and Black Warrior rivers. Interestingly, only one record of American Eel came from above the fall line in the Tallapoosa River. Similarly, sturgeon records came from above the fall line in all basins except the Tallapoosa River. Sizes of sturgeon captured in the middle Coosa River indicate that ranges of Lake Sturgeon and Gulf Sturgeon may have overlapped. While sufficient spawning habitat may exist downstream of extant migration barriers in the Mobile Basin, restoration of these species may benefit from increased access to their historic habitats above the fall line.

Keywords: fish migration, history, fish passage, biogeography

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Cryptic tolerant species and their potential effect on Index of Biotic Integrity (IBI) scores

Bryson G. Hilburn[1], Steven J. Rider[2], Katelyn M. Lawson[3], and Carol E. Johnston[1]

[1]Auburn University, School of Fisheries, Aquaculture, and Aquatic Sciences, AL

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Presentation Type: Student Oral
9:09 Thursday 17 November

Metrics such as the Index of Biotic Integrity (IBI) are often used by management agencies to estimate the abstract property of stream health. These metrics are usually predicated on the belief that certain species are tolerant while others are sensitive. Species are usually designated as either tolerant or sensitive in these analyses based on inherent ecological or taxonomic characteristics. However, previous literature has shown that certain species from ecological or taxonomic “sensitive” groups experience increased abundance in degraded streams. We term such species “cryptic tolerant species”. Using a stream fish assemblage dataset of 433 unique sample locations across the state of Alabama and the National Landcover Dataset (NLCD), our objectives were to 1) identify the most common cryptic tolerant species, 2) investigate

how cryptic tolerant species might inflate metrics of stream health, and 3) entertain an alternative metric of stream health in which species are statistically defined rather than defined using a trait-based approach. We identified cryptic tolerants using Nonmetric Multidimensional Scaling in all ecoregions. A series of regressions revealed that the proportion of cryptic tolerant species decreased in response to the proportion of forested land in catchments while the proportion of true sensitives increased in all ecoregions except for the Cumberland Plateau. A metric that simply used the percentage of statistically defined, non-tolerant species generally had lower p-values and higher r^2 values than IBI scores when both were regressed against percentage of forest in catchment. However, both metrics had low degrees of correlation with expected disturbance, indicating a univariate metric may be inadequate to characterize stream health. Our results highlight a potential issue of applying the IBI to diverse southeastern systems. We recommend that agencies base species sensitivity designations on statistical or empirical bases rather than taxonomic or ecological characteristics of fishes.

Keywords: stream fish assemblages; environmental monitoring; NMDS; species sensitivity

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Sound production in the Bluestripe Shiner (*Cyprinella callitaenia*)

Daniel Holt, Joshua Hill, Kimberly May, and Abigail Harmon

Presentation Type: Columbus State University, GA
Presentation Type: Poster #33
6:00-8:30 Thursday 17 November

Sound is an important mode of communication for freshwater fishes, as turbidity and unidirectional flow can put severe limitations on the efficacy of visual and chemical signals. Although freshwater constitutes less than 0.5% of the earth's water, nearly half of the currently recognized fish species (which currently approximates 32,500 total) are considered freshwater species, comprising nearly a quarter of all vertebrate diversity (Reid *et al.* 2013). Despite this concentrated diversity, only a small portion of freshwater fishes have been formally investigated for sound production. The genus *Cyprinella* represents a unique group of fishes when it comes to studying sound production. The genus includes 32 species, of which only a handful have been formally investigated for the use of acoustic communication in reproductive agonistic contexts. Our study presents the first recordings of sound produced by the Bluestripe Shiner (*Cyprinella callitaenia*), with a comparison to vocalizations from a sympatric species, the Blacktail Shiner (*C. venusta*). Sounds from *C. callitaenia* differ significantly from those of *C. venusta* in one important parameter, pulse rate. Pulse rate is the signal parameter that is subject to the least distortion during propagation in shallow aquatic environments and is thought to play a role in species isolation. Recent studies have shown that anthropogenic noise from bridge crossings can elevate background noise in streams, potentially making it more difficult for species to glean information from acoustic signals in order to make appropriate decisions concerning reproductive efforts. By documenting

and describing acoustic signals from freshwater fishes, we provide information that may aid our understanding of how changes to the natural soundscape impact freshwater fish populations.

Keywords: communication; acoustic; noise; hearing; conservation

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Can migratory suckers subsidize their spawning streams?

Ryan Hudson and Kit Wheeler

Tennessee Tech University, Cookeville
Presentation Type: Student Oral
9:35 Thursday 17 November

Ecologists recognize the capacity for animals to move substantial quantities of resources across ecosystem boundaries that can subsidize the functioning of recipient ecosystems. Spawning migrations of fishes have become a common case study for examining the magnitude of resource subsidies; however, few studies have evaluated this phenomenon in iteroparous migrations of the family Catostomidae (i.e., suckers), and none have evaluated the genus *Moxostoma* (i.e., redhorses). Nutrient subsidies from fishes are usually represented as inputs of nitrogen (N) and phosphorus (P), and migratory redhorses can transport these nutrients via excretion and eggs. Therefore, we evaluated whether redhorses could deliver N and P subsidies to Brasstown Creek – a Hiwassee River tributary – during their spawning migration. We measured individual-level nutrient contributions from excretion and eggs and extrapolated those values to calculate population-level nutrient contributions based on daily abundances of redhorses. We compared total daily nutrient inputs to total daily nutrient exports from the system under the assumption that inputs exceeding exports would indicate retention of redhorse-derived nutrients and a potential subsidy. We estimated 71.6 kg of N and 4.4 kg of P were delivered to the spawning system over the course of the migration. P input never exceeded P export, but N input exceeded N export on 15 of the 98 observed days. Eggs accounted for the majority of N and P input at 51.0 % and 100 %, respectively. Our results indicate that spawning migrations of redhorses have the potential to deliver subsidies of N to their spawning streams; however, this only occurs during days of peak abundance. With several species of redhorses being imperiled, our results could provide these species with an ecological value that was otherwise overlooked.

Keywords: subsidy; migration; Catostomidae; excretion; nitrogen

Juvenile Striped Bass (*Morone saxatilis*) movement in the Great Pee Dee River

Robert Jackson[1], Jason Doll[1], Jason Marsik[2], and Jarrod Gibbons[2]

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[2]South Carolina Department of Natural Resources, Charleston

Presentation Type: Student Poster #9
6:00-8:30 Thursday 17 November

Striped Bass *Morone saxatilis* are potamodromous species native to South Carolina. A small population exists in the Great Pee Dee River and the South Carolina Department of Natural Resources (SCDNR) began supplemental stockings in 2019 to enhance this population. The objective of this study is to evaluate movement patterns of juvenile Striped Bass after they are stocked in the Great Pee Dee River. Twenty-eight juvenile Striped Bass were tagged with hydroacoustic tags prior to stocking into the Great Pee Dee River. All fish were held at the hatchery for one week for mortality observation prior to stocking. Juveniles were stocked in the Great Pee Dee River at Samworth Wildlife Management Area Landing and Dewitts Bluff Landing in December 2020. Fish locations were recorded by the fixed receiver array managed by SCDNR. Survival was estimated using an open Cormack-Jolly Seber model. Twenty- three juveniles were recorded between 12/16/2020 and 11/03/2021 while 5 were never detected. All transmitted fish initially migrated to the lower Great Pee Dee River and Winyah Bay. During the spring, most individual fish stayed in Winyah Bay and the Sampit River. Four fish were still being detected by receivers during the fall in Winyah Bay, Sampit River and lower Great Pee Dee River. Results suggest that juvenile Striped Bass primarily inhabit the lower portions of the Great Pee Dee and Waccamaw River system near Winyah Bay. Mean weekly apparent survival was 96.5% which equates to an annual survival of 16% for Striped Bass in the Great Pee Dee system. Future studies evaluating nursery habitat should occur in the lower portions of the Great Pee Dee and Waccamaw River system near Winyah Bay.

Keywords: movement; survival; tracking; fisheries; management

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Comparison of Redfin Darter (*Etheostoma whipplei*) diets from two spatially-distinct streams in the Arkansas River Valley

Ben. S. Johnson, Ethan H. Dodson, and Kyler B. Hecke

Arkansas Tech University, Department of Biological Sciences, Russellville

Presentation Type: Student Poster #6
6:00-8:30 Thursday 17 November

Diet-data collection is increasingly difficult for darters, as most methods require the dissection of each specimen and the removal of the digestive tract, which is fatal. In

result, the diets of many darter species have been relatively understudied. The Redfin Darter (*Etheostoma whipplei*) is one species where there is very little information on its diet. We wanted to use a non-lethal diet extraction method to explore how the diet of this species varied between two spatially-distinct streams, Bakers Creek and Shoal Creek, tributaries of Lake Dardanelle in Arkansas. We employed two sampling gears (kick-nets and seines) to collect this species. Small-scale gastric lavage was used to extract diet data from all individuals in two different streams. All prey items were preserved and identified to the genus level. Bray-Curtis dissimilarity was used to assess the composition of prey item in fish from the two streams. A total of 176 different prey items from 17 fish (37-69 mm), covering 10 orders were extracted from Redfin Darters sampled in Bakers Creek. Diptera was the most abundant (59.1%) order for diets from Bakers Creek. Dipterans from the family Chironomidae and sub-family Tanypodinae comprised (47.2%) majority of diet items from Bakers Creek. In Shoal Creek, a total of 187 different prey items from 18 fish (32-67 mm), covering 10 orders were extracted from Redfin Darters sampled. Diptera was the most abundant (63.6%) order for diets from Shoal Creek. Dipterans from the family Chironomidae and sub-family Tanypodinae comprised (47.6%) majority of diet items from Bakers Creek. The composition of prey items from the two streams were relatively similar (Bray- Curtis distance = 0.125). Diets from both streams were comprised mostly of chironomids, suggesting that this prey item is an important part of Redfin Darter diets. This research will aid in the understanding of darter diets. Future research will assess the seasonality of diets in Redfin Darters.

Keywords: diets, ecology, biology, freshwater streams

Longitudinal assessment of fish communities in Moro Creek, Arkansas

Andrew J. Julian and Kyler B. Hecke

Arkansas Tech University, Department of Biological Sciences, Russellville
Presentation Type: Student Poster #7
6:00-8:30 Thursday 17 November

Longitudinal differences in fish communities are due to several factors, both abiotic and biotic. These differences shape the functional diversity for an aquatic system. However, these longitudinal relationships are seldom assessed in freshwater streams. Moro Creek, a tributary of the Ouachita River in Arkansas, is one system that has been understudied in the last ~50 years. New research is needed on this system to fully understand the variation in species occurrences throughout this watershed. We assessed the spatial relationships of fish communities on longitudinal scale in Moro Creek. Eleven sites (6 main stem, 5 tributary) were sampled on a longitudinal scale (4 upper reach, 4 middle reach, 3 lower reach) in the Moro Creek watershed. A depletion sampling approach with multiple gears (seining, and kick-nets) was employed to increase detection of species. Species abundance was estimated at each of the sites. Various environmental and habitat data were collected at each site. We used non-metric multidimensional scaling models (NMDS) to assess how species compositions varied across a longitudinal gradient. The three most abundant species at upper reach sites

were Western Mosquitofish (250), Banded Pygmy Sunfish (87), ad Flier (51). At middle reach sites, the three most abundant species were Western Mosquitofish (92), Blackspotted Topminnow (55), and Ribbon Shiner (42). At lower reach sites, the three most abundant species were Ribbon Shiner (114), Western Mosquitofish (61), and Bluegill (34). NMDS suggests that fish assemblages may be influenced by spatial location. Preliminary data analyses suggest that fish communities exhibit similarities relative to their position within a watershed and could be related to associated environmental and habitat parameters. This research is important for the management of fish communities in south central plain streams. Future research should consider longitudinal relationship of fish communities on a temporal scale.

Keywords: ecology; spatial; modeling; community; fisheries

Chattahoochee Bass distribution, genetic integrity, and habitat associations in the Upper Chattahoochee River basin

Chad Kaiser and Bryant Bowen

Georgia Department of Natural Resources
Presentation Type: Lightning Talk
3:40 Thursday 17 November

Historically, Georgia is home to the richest diversity of *Micropterus* species in the world. To conserve this amazing diversity, Georgia DNR is conducting surveys to better understand how our Black Bass populations are partitioned across the landscape and what issues they face. With advancements in current genetic research, the Redeye Bass complex has diverged into seven potential species throughout the southeast. Georgia shares three of the seven species with surrounding states, one undescribed Altamaha River drainage Redeye species (*Micropterus* cf. *coosae* Altamaha), that is endemic to the state, along with the Chattahoochee Bass which has been extirpated from Alabama and is now only found in Georgia. The Georgia DNR Stream Survey Team began assessing the distribution and genetic integrity of Chattahoochee Bass throughout its range in 2018. Our objectives were to delineate the current distribution of Chattahoochee Bass; assess the genetic integrity of Chattahoochee Bass populations; and to characterize the watershed and reach level habitat impacts on Chattahoochee Bass distribution. We sampled 154 sites from 2018 to 2020. Pure Chattahoochee Bass were found at 42 (27%) sites. Molecular surveys revealed that the genetic integrity of Chattahoochee Bass populations is threatened by introgression with the non-native Alabama Bass, *M. henshalli*. While genetically intact populations persist in places above barriers in minimally disturbed watersheds, abundances have largely declined and have become fragmented, with populations declining by an estimated 88% of their historic range. Some historic populations appear to have been extirpated completely. The two forces driving range restriction of Chattahoochee Bass are introgression through hybridization with non-native Black Bass species and habitat changes from increased anthropogenic disturbance.

Keywords: Black Bass; Redeye Bass; Chattahoochee

Is red coloration in *Chrosomus erythrogaster* an honest signal?

Julie Kastanis and Mollie Cashner

Austin Peay State University, Clarksville, TN
Presentation Type: Student Oral
9:05 Friday 18 November

Color can play a vital role in fish ecology by impacting social interactions, species identification, mate attraction, and predator-prey interactions. Carotenoids are the source of red and yellow pigments in fishes, and are synthesized by organisms such as algae, plants, fungi, and bacteria, thus fish must obtain them through diet. The Southern Redbelly Dace (*Chrosomus erythrogaster*) display red and yellow coloration, most prominently during the breeding season. Red coloration in both male and female *C. erythrogaster* may play a key role in conspecific recognition within this social species as well as mate quality (i.e. is an honest signal), but little research has been done to measure individual variation. We hypothesized that red coloration in *C. erythrogaster* acts as an honest signal of individual health and therefore the trait is under sexual selection. Our alternative hypothesis, that red coloration is used primarily for conspecific recognition and does not require sexual selection as a mechanism. Using spectrometry, we examined multiple parameters related to red coloration, and asked which factors best explained any patterns in variation: sex, individual body condition (i.e. metric for health), or locality. We found that habitat quality was positively correlated with body condition. Trends in the data also revealed that individuals at our Dry Fork site had lower spectral whiteness, indicating brighter individuals. Males with higher body conditions showed significant variation in spectral whiteness. Dominant wavelength was not significant between the sexes, suggesting conspecific recognition could be at play. The patterns we observed do not support sexual selection as the mechanism driving variation, therefore, the variation observed is within a range most likely needed for conspecific recognition, which can be important for shoaling rather than a signal of mate quality.

Keywords: red; minnow; spectrometry; fish

Phylogenomics and species delimitation of Black Basses (*Micropterus*)

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Presentation Type: Oral
9:44 Friday 18 November

The Black Basses (*Micropterus*) are iconic freshwater fishes of North America and well known for the biogeographical, ecological, and global recreational importance. The

understanding of *Micropterus* phylogeny and species diversity have dramatically increased with the application of molecular data. However, there is a need for genetic markers with greater phylogenetic informativeness and a more comprehensive geographic sampling to better address the systematics and species delimitation hypotheses in *Micropterus*. The present study deploys a double-digest restriction-site associated DNA (ddRAD) genomic dataset based on complete sampling of all currently recognized and undescribed species of *Micropterus* with broad geographic sampling. Phylogenies from our analyses resolve the Spotted Basses (*M. punctulatus*, *M. henshalli*, *M. treculii*, and the undescribed Choctaw Bass) as a clade, support the delimitation of species in the Redeye Bass complex (*M. coosae*, *M. warriorensis*, *M. cahabae*, *M. chattahoochae*, *M. tallapoosae*, and the undescribed Altamaha and Bartram's Basses), and delimit genetically and geographically distinct lineages within the Smallmouth Bass (*M. dolomieu*). Analysis of the ddRAD data reveal a high degree of genetic divergence between Largemouth Bass (*M. salmoides*) and Florida Bass (*M. floridanus*), which will serve as a basis for our species delimitation study of the two species. The phylogenomic analyses identify "intergrade" zones among species of *Micropterus* and patterns of ancient introgression among lineages, some of which are previously unrecognized.

Keywords: species delimitation; phylogenomics; conservation; taxonomy; systematics

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Status update of the Coal Darter (*Percina brevicauda*)

Jenna King[1], Evan Collins[1], Stuart McGregor[2], Christopher Haynes[2], Nathaniel Sturm[2]

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Presentation Type: Lightning Talk
2:25 Friday 18 November

The Coal Darter (*Percina brevicauda*) is endemic to the Mobile River basin in Alabama. Historically, the species occupied habitat in the Black Warrior River system, the Cahaba River, and the Coosa River system. After range contraction as a result of impoundment of the Black Warrior and Coosa rivers, the Coal Darter currently occupies the Locust Fork of the Black Warrior River system, the Cahaba River, and Hatchet and Weogufka creeks of the Coosa River system. The species was petitioned for listing under the Endangered Species Act in 2010 with an upcoming listing decision to be made in 2023. To update occurrence records and range extent for the Species Status Assessment, the Geological Survey of Alabama and the US Fish and Wildlife Service conducted range-wide targeted surveys. The surveys filled data gaps and explored potential new localities of Coal Darters. We present the results of these surveys and identify current and emerging threats to the species.

Keywords: Coal Darter; petitioned species; status update

Phenology of Florida's freshwater mussels

Jacob S. Lanning, Amber Olson, Lauren Patterson, and Susan Geda

Florida Fish and Wildlife Conservation Commission
Presentation Type: Poster #32
6:00-8:30 Thursday 17 November

Native freshwater mussels are benthic, sessile organisms with unique reproduction strategies. North American species require a short parasitic phase in which mussel larvae, called glochidia, must attach to the gills and/or fins of a host fish. Freshwater mussels are the most imperiled group of species in the United States. Data gaps exist in freshwater mussel reproduction, brooding strategies, fish host requirements, and timing of gravidity; information which would aid in the restoration and conservation of these species. The Freshwater Mussel Conservation Program within the Florida Fish and Wildlife Conservation Commission works to help fill these data gaps for Florida's 61 species by surveying waterbodies across the state. Gravidity status of an individual species is evaluated by checking either up to 10 individuals for non-sexually dimorphic species or 10 females for sexually dimorphic species per site. The data is then used to curate the Freshwater Mussel Gravidity Almanac, an interactive website which displays the gravidity stage over the year for all freshwater mussel species found in Florida. Recent edits to this calendar included the addition of 2,000+ observation records and updates of 71 reproductive timing records among 40 species. Currently, there are over 12,000 records in the Almanac with more to be incorporated. Expanding this gravidity dataset and identifying the requirements needed for reproduction will allow for a broader understanding of these species and will aid in the management and conservation of freshwater mussels and fishes.

Keywords: mussel, gravidity, Almanac, reproduction

Environmental DNA surveys for the threatened Pearl Darter, *Percina aurora*, in the Pearl and Pascagoula Rivers in Mississippi

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Presentation Type: Student Oral
1:30 Thursday 17 November

The Pearl Darter, *Percina aurora*, was once common throughout the Pearl and Pascagoula river drainages in Mississippi and Louisiana, but experienced a dramatic reduction in range and number in the last half century. Both published and anecdotal

data suggest that *P. aurora* was locally extinct in the Pearl River drainage by the 1970s, with remaining populations restricted to the Pascagoula River drainage. In 2017, *P. aurora* was listed as Threatened on the U.S. Endangered Species Act of 1973, with critical habitat designations proposed over 832 km of both systems in 2021; specifically, portions of Black and Okatoma Creeks, the Chickasawhay, Chunky, Leaf, and Pascagoula rivers in the Pascagoula drainage, and a portion of the Strong River in the Pearl drainage. However, their full extent of occurrence in the Pascagoula River drainage is uncertain, and surveys are needed to further support their absence in the Pearl River drainage. To address these needs, three × 3-liter water samples were collected at 17 sites in both river drainages in 2020 and 2021 for environmental DNA (eDNA) analysis. Water was filtered, DNA was extracted from the particulate matter collected on the filters, and then screened for *P. aurora* DNA on the Droplet Digital™ PCR (ddPCR™) platform using a species-specific assay targeting the mitochondrial *CytB* gene. The ability of ddPCR™ technology to detect a single copy of target DNA means this approach can provide evidence of species presence with greater sensitivity than traditional approaches when abundance is low. Positive detections of *P. aurora* could help refine delineation of critical habitats and inform on promising locations to target for future ecological studies. The absence of *P. aurora* at sampled locations in the Pearl River drainage could contribute to the growing evidence that the species is extinct in this system, catalyzing additional conservation initiatives.

Keywords: Droplet Digital PCR™; monitoring; recovery

Fish assemblage patterns across the South Central Plains of Arkansas: an insight into anthropogenic land use in low gradient streams

Ryne Lehman, Molly Wozniak, Hal Halvorson, Ginny Adams, and Reid Adams

[1]The University of Central Arkansas, Department of Biological Sciences, Conway
Presentation Type: Oral
12:01 Friday 18 November

Anthropogenic land use alterations can have negative impacts on physical in-stream habitat, water quality, and community structure within aquatic ecosystems. Low gradient streams are understudied, and little research has investigated the potential impacts of anthropogenic land use on these systems. Within Arkansas, low gradient streams located across the South Central Plains Ecoregion represent a major monitoring gap. Quantifying the relationship between land use and fish assemblage structure can provide important data which will be useful for developing criteria toward future ecosystem management within the region. Thirty sites across the South Central Plains Ecoregion of Arkansas were sampled during the summers of 2021 and 2022 for fish, physiochemistry, and physical in-stream habitat data. A total of 6,019 individuals and 51 fish species were collected across all sites and species richness varied from 10 to 29 species per site. Fish communities varied across sites based on an NMDS ordination using fish relative abundance data. In addition, water samples were collected monthly across all 30 sites starting in February 2021 to provide a more detailed analysis of water

chemistry data. Patterns of fish community structure in relation to land use, water chemistry, and physical in-stream habitat data will be discussed.

Keywords: land use; fish assemblage; South Central Plains; Arkansas

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Functional composition of Georgia's stream-fish communities: influences of stream size and ecoregion.

Patrick Lewis and James Roberts

Department of Biology, Georgia Southern University, Statesboro
Presentation Type: Student Poster #4
6:00-8:30 Thursday 17 November

Models like the River Continuum Concept (RCC) and Habitat Template Concept (HTC) predict consistent changes in habitat conditions – and as a result, the functional composition of fish communities – as stream size increases. These predictions are well supported in mountain and plains ecoregions, but scarcely investigated in lowland streams. We analyzed an extensive fish-community dataset (> 1800 records), collected by the Georgia Department of Natural Resources across five of Georgia's major ecoregions (two in the mountains, one in the Piedmont, and two in the coastal plain), asking 1) how the trophic, reproductive, and morphological composition of communities varied with stream size, and 2) how such relationships were mediated by ecoregion. As predicted, species richness, body size, and age-at-maturity increased with stream size, while omnivory decreased with stream size. Conversely, other trophic strategies, parental care, fecundity, and longevity were unrelated to stream size. Moreover, stream-size relationships tended to be stronger in upland than lowland ecoregions, and the shift from upland to lowland habitats coincided with a general shift toward "maneuverer" morphologies (e.g., sunfish) and away from benthic morphologies. These preliminary findings support the distinctiveness of lowland ecoregions from upland ones, the potentially poor transferability of "upland" models to these ecoregions, and the challenges of developing regionally appropriate bioassessment criteria that suit these distinctive-yet-understudied ecoregions.

Keywords: ecoregions; functional traits; community composition

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Managing for Black Bass diversity in the Southeast: a linchpin connecting people to natural resources

James Long[1] and Andrew Taylor[2]

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[2]University of North Georgia, Dahlonega
Presentation Type: Poster #31
6:00-8:30 Thursday 17 November

Black Bass are iconic sport fishes and are collectively the most sought-after species in freshwaters of the US. As a sport fish, the Black Bass group provides a direct link to humans via angling and are thus particularly valued by state natural resource agencies. There is a great deal of cryptic biodiversity within the genus in the region, particularly within Gulf of Mexico drainages. Many of these species are fluvial-specialists, endemic to smaller river basins, and are often identified as Species of Greatest Conservation Need (SGCN) in their respective states. As apex predators, Black Bass are often considered keystone species and changes in their abundance can alter food webs. Black Bass also serve as important (yet understudied) hosts for imperiled freshwater mussels. In fact, Black Bass diversity coincides with elevated aquatic biodiversity across the southeast, so Black Bass could serve as umbrella species for non-game fishes that often receive less public visibility. Efforts to conserve Black Bass diversity in the region can have cascading benefits for other freshwater fauna by protecting free-flowing rivers and limiting landscape alterations within watersheds. Ultimately, management of Black Bass diversity could benefit humans by providing for more natural environments to enjoy.

Keywords: *Micropterus*; endemic; sportfish; Species of Greatest Conservation Need

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The potential use of madtom catfishes as conservation tools for southeastern U.S. headwater streams

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[3]Department of Biological Sciences, Arkansas State University, Jonesboro
Presentation Type: Student Oral
11:22 Friday 18 November

Headwater ecosystems are essential resources for downstream ecological interactions, refugia for aquatic fauna, and provisional water sources for surrounding communities. Despite their ecological value, these ecosystems have the least amount of environmental funding and regulatory protection. We used species distribution models (SDM) to examine the distributional changes of four madtom catfishes to assess if these species could be used as proxies to predict and better understand the threat aquatic fauna in headwater systems are combating under current climate policies. SDMs included 15 variables that were biologically significant to the life histories of each species. SDMs were assessed using the presence-only algorithm, maximum entropy (Maxent). Model parameters and environmental variables used were selected using the R package ENMeval to reduce overfitting and overestimation of extrapolated conditions. Final models of present-day habitat suitability were compared to two climate models, IPSL and CNRM, representing the socioeconomic scenario of active global climate change (ssp126). The best-fit models highlighted stream order, land use, elevation,

temperature, precipitation, flow, and physiographic provinces to be the most significant variables affecting present and future habitat suitability. These models resulted in predictions of extreme shifts of species distributions that alluded to potential extirpation or extinction of the specialized headwater community and range expansions of opportunistic, generalist species. These maxent models provide an alternative perspective of how synergistic effects of climate change and anthropogenic activities could exacerbate negative conditions in headwater systems and could be used as a tool that can inform targeted, proactive conservation efforts in predicted stressed regions.

Keywords: Maxent, climate, water stress, species distribution

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A status update on Georgia's newest invasive fish, the Weather Loach (*Misgurnus anguillicaudatus*)

Sarah McNair, Wesley Gerrin, Brian Shamblin, and Jay Shelton

University of Georgia, Athens
Presentation Type: Oral
11:35 Thursday 17 November

Aquatic nuisance species are an ongoing issue in the Southeast. The introduction of new invasive species is especially concerning when those species thrive in our waters and are capable of remaining undetected for long periods of time. The Weather Loach *Misgurnus anguillicaudatus* is native to eastern Asia from Siberia to northern Vietnam including Japan. It is invasive in at least 5 countries and 20 states in the United States. It is also a popular species in the aquarium trade and an important food fish in some cultures. Researchers at the University of Georgia first found Weather Loaches in Georgia waters in 2020. During Summer 2022, a University of Georgia team used backpack electrofishing to seek out new populations of Weather Loach. As a result, over 100 individuals were collected at five locations in the Middle Oconee watershed and two locations in the Yellow River watershed. Genetic analysis of these individuals has shown that there is no interrelatedness between watersheds, meaning that at least two separate introductions of this invasive species have occurred. Almost all collected fish were found downstream of barriers such as dams, suggesting that the species is actively attempting to move upstream. Ongoing research projects with this species include reproductive timing, gut content analysis, otolith microchemistry, and continued genetic analysis.

Keywords: invasive species; Georgia; Weather Loach; aquatic nuisance species

Diet of *Etheostoma fragi* in the presence of *Etheostoma caeruleum* in the Strawberry River

Sahara Morgan, Blake Mitchell, Ginny Adams, and Reid Adams

University of Central Arkansas, Department of Biology, Environmental Science Program, Conway
Presentation Type: Student Poster #13
6:00-8:30 Thursday 17 November

Etheostoma fragi, the Strawberry Darter, is only endemic to the Strawberry River in the Ozark Highlands of Arkansas and is currently listed as a Species of Greatest Conservation Need. In a previous study, both the Strawberry Darter and the Rainbow Darter, *Etheostoma caeruleum*, were sampled in intermittent, perennial, and groundwater flashy streams to study differences in habitat use and body morphometrics. It was found that when *E. caerlueum* was dominant, the body condition of *E. fragi* was significantly lower. We are further investigating the relationship between these two species by determining diet of *E. fragi* when it is the dominant and non dominant species. We hypothesized that when dominant, *E. fragi* will have a broader niche breadth and a higher gut fullness. When determining diet, first the gut lengths and mass were measured; after dissection, gut contents were separated and examined, and guts weighed without contents. The contents were identified to the lowest possible taxon and weighed separately. Preliminary results indicate *E. fragi* feed on a diversity of macroinvertebrates, including Chironomidae, Ephemeroptera, Saldidae.

Keywords: diet; darter; *Etheostoma*

Niche and dispersal processes drive co-occurrence network topology in stream fish

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Presentation Type: Poster #25
6:00-8:30 Thursday 17 November

Environment and space control metacommunity composition through filtering and dispersal limitation, respectively. However, it is not understood to what extent these processes constrain the structure of co-occurrence networks and the patterns of phylogenetic relatedness across co-occurring taxa, including phylogenetic niche conservatism. To address this, we constructed co-occurrence networks of stream fish, which allow for the visualization of metacommunity structure, and the quantification of the extent that this structure is due to environmental or spatial processes. We found that

both environment and space majorly contributed to network topology, both in terms of connectedness and in modularity. Network structure, namely a decrease in the density of connections, and an increase in modularity, was observed when the effects of environment, or of space, were accounted for in network construction. This similarity in results suggests a strong spatial structure to co-occurrences due to overlapping environmental niches. Finally, we found that fish taxa which co- occurred due to shared environmental niches were more closely related than expected by chance, suggesting that closely related taxa had similar traits – evidence of phylogenetic niche conservatism.

Keywords: co-occurrence networks; dispersal limitation; environmental filtering; niche conservatism

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Life history and fish conservation: using traits to investigate differential declines in fishes in the Conasauga River

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Presentation Type: Oral
10:30 Friday 18 November

Life history strategies have long been recognized to influence responses to environmental variables. In recent years, there has been growing interest in using species traits to explain and predict variable fish population responses to anthropogenic stressors such as climate change and land-use change. Despite the usefulness of life history information, comprehensive data for many fish species are sparse. Small-bodied fishes such as darters and minnows remain understudied, particularly rare taxa with limited distributions. The Conasauga River, a tributary located in the upper Coosa River system in northwest Georgia and southeast Tennessee, is home to over 75 fish species including several listed as Threatened or Endangered under the Endangered Species Act. Furthermore, recent studies using long-term population monitoring data have noted declines in at least some Conasauga River fish populations. Our objective was to investigate the relationship between traits and population trends among taxa in the Conasauga River. First, we conducted 30 snorkel surveys and 21 collections in 2021 to collect data on spawning timing, habitat use, behavior, and reproductive investment for shoal-dwelling taxa. We observed 67 occurrences of spawning across 15 taxa and estimated clutch sizes and egg masses for 63 individuals across 9 taxa. Combining our observations with information from available literature, we organized trait information for 32 shoal-dwelling fish species in the Conasauga River. Using a 19-year time-series of abundances for these taxa in 6 sites in the Conasauga River, we analyzed the relationship between traits and variable temporal trends. We revealed a ~2% decline

per year in abundance across the entire community, with traits describing spawning timing and substrate, diet, fecundity and body size explaining some variance in population trends among taxa. Better understanding of fish life histories may enhance our ability to Identify and address mechanisms of population decline.

Keywords: life history; community ecology; time-series analysis; fish declines

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Hidden species diversity in an iconic living fossil vertebrate

Thomas J. Near[1], Daemin Kim[1], Oliver D. Orr[1], Gabriela M. Hogue[2], Bryn H. Tracy[2], M. Worth Pugh[3], Randal Singer[4], Chelsea Myles-McBurney[5], Jon Michael Mollish[6], Jeffrey W. Simmons[6], Solomon R. Davis[7], Gregory Watkins-Colwell[8], Eva A. Hoffman[9], and Chase D. Brownstein[1]

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[2]North Carolina Museum of Natural Science
[3]University of Alabama, Department of Biological Sciences
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[5]Florida Fish and Wildlife Research Institute
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[8]Yale Peabody Museum
[9]American Museum of Natural History, Division of Paleontology

Presentation Type: Lightning Talk
2:00 Friday 18 November

Ancient, species-poor lineages persistently occur across the Tree of Life. These unique lineages are likely to contain unrecognized species diversity masked by the low rates of morphological evolution that characterize living fossils. Halecomorphi is a lineage of ray-finned fishes that diverged from its closest relatives over 200 million years ago and is represented by only one living species in eastern North America, the Bowfin *Amia calva* Linnaeus. We use double digest restriction-site associated DNA (ddRAD) sequencing and morphology to illuminate recent speciation in bowfins. Our results support the delimitation of a second living species of *Amia* with the timing of diversification dating to the Plio-Pleistocene. This delimitation expands the species diversity of an ancient lineage that is integral to studies of vertebrate genomics and development yet is facing growing conservation threats driven by the caviar fishery.

Keywords: Amiidae, Bowfin, species delimitation

A recent reassessment of relative abundance patterns of Spotted Bullhead *Ameiurus serracanthus* throughout Florida

Jason O'Connor[1], Travis Tuten[1], Chris Anderson[1], and Josh Wilsey[2]

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[2]Florida Fish and Wildlife Conservation Commission, Division of Freshwater Fish Management, Panama City

Presentation Type: Lightning Talk

2:35 Friday 18 November

Spotted Bullhead *Ameiurus serracanthus* are primarily riverine ictalurids,which are narrowly distributed across eastern Gulf coast drainages. In 2020, Spotted Bullhead were discovered in a limited portion of the southern Withlacoochee River (Citrus County, FL), which expanded their known southern range limit. Although the provenance of this population is unclear, this discovery prompted a reevaluation of their distribution and abundance across Florida's gulf drainages. In the fall of 2021 and late spring of 2022, we conducted a range-wide survey for Spotted Bullhead using standardized low-pulse electrofishing to target catfish species. Spotted Bullhead relative abundance was highest in the southern Withlacoochee River (2.3 ± 0.6 fish/min). Spotted Bullhead were the most abundant catfish species collected in the Suwannee and Withlacoochee drainages. Flathead Catfish *Pylodictus olivaris* was the most abundant ictalurid collected in all panhandle drainages (mean cpue = 0.7 ± 0.3 fish/min). Spotted Bullhead were rare in the panhandle drainages (mean cpue = 0.03 ± 0.03 fish/min). Spotted Bullhead were not detected in the Yellow River, nor in any of the minor Gulf drainages between the Ochlocknee and Suwannee River.

Keywords: Spotted Bullhead, Flathead Catfish, low-pulse electrofishing, ictalurids

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Florida's Freshwater mussel conservation program

Amber Olson, Jacob Lanning, Susan Geda, and Lauren Patterson

Florida Fish and Wildlife Conservation Commission

Presentation Type: Lightning Talk

2:50 Friday 18 November

Freshwater Mussels (Unionidae) are one of the most imperiled groups of organisms in North America, with over 65% of species either of Special Concern, Threatened, Endangered or Extinct. As infaunal filter feeders, mussels provide unique ecological functions such as improving the quality and clarity of water, nutrient cycling, stabilizing substrate, and providing habitat that supports higher in-stream secondary production.

However, native mussels are susceptible to threats such as sedimentation, damming, and climate change. North America contains over 290 species of mussels, with the southeastern United States having the highest diversity. In Florida, there are currently 61 known species, with 16 being federally listed as threatened or endangered. Florida's Fish and Wildlife Conservation Commission (FWC) established the Freshwater Mussel Conservation Program (FMCP) in 2013 with the goal of monitoring and expanding the body of scientific knowledge regarding freshwater mussel populations within the state. Since its inception, the program has conducted 1,129 discrete mussel surveys, both qualitative and quantitative, across 20 major drainages in Florida, with over 134,195 individual mussels collected. As a result of these surveys, mussels previously thought to be extinct or extirpated, such as the Suwannee Moccasinshell (*Medionidus walkeri*), the Ochlockonee Moccasinshell (*Medionidus simpsonianus*) and populations of Threeridge (*Amblema plicata*) have been rediscovered. Other FMCP projects related to mussel management include host fish trials, research into the phenology of native mussels, and monitoring the temperature of the major rivers in the state, mussel gravidity data collection, and host-fish trials. The FMCP will continue to monitor and report trends of mussel distribution and abundance to researchers and stakeholders alike, as well as continue research into the life history, phenology, ecology, and taxonomy of unionids in the state.

Keywords: mussel; conservation; Florida; survey

Variation in fish communities of Boston Mountain streams in the Ozark National Forest

Jackson Pav, Ginny Adams, and Reid Adams

The University of Central Arkansas, Department of Biology, Conway
Presentation Type: Student Poster #12
6:00-8:30 Thursday 17 November

The Boston Mountains of the Ozark-St. Francis National Forest have a rich and diverse timber industry spanning hundreds of years. This Pennsylvanian aged mountain range yields high amounts of sandstone and shale, resulting in aquatic ecosystems unique to the state of Arkansas. Fish community data from sixty-five sites across Point Remove Creek, Illinois Bayou, Big Piney Creek, Mulberry River, and Lee Creek watersheds were analyzed using NMS to assess community-level differences using relative abundance data. Fish community composition was significantly different across all watersheds (MRPP, $p<0.01$) and between each watershed (Pairwise Comparison Test, $p<0.05$). An indicator species analysis identified fifteen species of fish as significant ($p<0.05$) indicators of watersheds. These fishes were *Etheostoma whipplei, Lepomis cyanellus,* and *Percina fulvitaenia* in Point Remove Creek; *Etheostoma blennioides*, *Micropterus dolomieu*, and *Notropis greenei* in Illinois Bayou; *Semotilus atromaculatus* in Big Piney Creek; *Hypentelium nigricans, Pimephales notatus,* and *Percina caprodes* in Mulberry River; and *Etheostoma mihileze, Fundulus catenatus, Luxilus cardinalis, Moxostoma duquesnei,* and *Notropis nubilus* in Lee Creek. Stream catchment size was one of the strongest factors influencing fish community patterns. Additional variation is related to

abiotic factors such as substrate and water physicochemical properties. Current land-use practices in the Ozark National Forest (e.g., prescribed burns, agriculture, logging) and their effects on fish communities will be discussed. This study will provide useful insight into the community structure and habitat associations of fishes in streams of the Boston Mountains.

Keywords: Boston Mountains, relative abundance, indicator species

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Impacts of a large-scale freshwater diversion on estuarine fish assemblages

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Presentation Type: Lightning Talk
4:25 Thursday 17 November

Understanding the impacts of assemblage or community recovery following a disturbance event is one of the most studied questions in ecology. Lake Pontchartrain, in southeast Louisiana, is a large estuarine system that has been subjected to substantial anthropogenic modifications and natural perturbations over the last half century. One of the most pervasive, but intermittent impacts, is the opening of the Bonnet Carré Spillway (BCS), an artificial canal that connects the Mississippi River to Lake Pontchartrain. The goal of this study was to use eDNA metabarcoding to examine fish assemblages at three artificial reefs and paired controls before, during, and after the historic 2019 openings of the BCS. eDNA data detected 64 species across the entire study period, with 19-43 species detected at reefs and 18-38 species at open-water control sites. The fish assemblages changed from predominantly estuarine species assemblages prior to the opening of the BCS to predominantly freshwater species during and after the closure of the BCS. Both the salinity levels and the fish assemblages did not return to pre-BCS opening conditions nearly three months after the final 2019 closure of the BCS.

Keywords: eDNA; Lake Pontchartrain; fish assemblages

The conservation genetics of the threatened Spring Pygmy Sunfish *Elassoma alabamae*

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Presentation Type: Oral
1:56 Thursday 17 November

The Spring Pygmy Sunfish *Elassoma alabamae* is endemic to one small area of the Tennessee River drainage in North Alabama and is the only member in the family Elassomatidae found above the fall line. The species was first discovered in 1937 in Cave Spring in Lauderdale County Alabama then in 1941 an additional population was found in Pryor Spring in Limestone County. The species was rediscovered in 1973 in the Beaverdam Creek watershed and is found in many of its tributaries such as Moss Spring, Lowes' Ditch, and Beaverdam Spring. In 1993, the Spring Pygmy Sunfish was distinguished as a new species of pygmy sunfish. No in-depth population genetics studies have been performed on the Spring Pygmy Sunfish which is necessary for a federally threatened isolated species. The effects of genetic drift will be more pronounced on species like the Spring Pygmy Sunfish which have a limited range. Not only is this information necessary for evolution but it is also necessary for conservation. We examined the population structure of the Spring Pygmy Sunfish using Diversity Arrays Technology sequencing (DArTseq). We analyzed single nucleotide polymorphism (SNP) data in PCA plots and ancestry charts, showing three distinct lineages. A phylogenetic tree was constructed from all currently included populations. We plan to sequence the mitochondrial genome of the Spring Pygmy Sunfish to aid in noninvasive eDNA detection methods. Insight into the genetic structure of this species yields an amazing opportunity to aid the conservation of other species with limited ranges that have limited gene flow.

Keywords: Spring Pygmy Sunfish; *Elassoma alabamae*; conservation; genetic drift; threatened

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Fish assemblages on two continents respond to valley- and reach-scale geomorphic variation

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Presentation Type: Poster #29
6:00-8:30 Thursday 17 November

Fish assemblages defined by taxonomy or functional traits respond to regional and local habitat variation. Our hypothesis was that fish assemblages could be predicted using valley-scale hydrogeomorphology or reach-scale hydrology. We evaluated reach- and valley-scale hydrogeomorphology of rivers in the US and Mongolia in each of three ecoregions, grassland, forest, and endorheic. Fishes were collected using backpack electrofisher following standard protocols. Ordination analyses included three scales: two continents combined, individual continents, and individual ecoregions on continents. We found that fish assemblages were structured by hydrogeomorphic processes occurring at valley- and reach-scales, and that variables predicting fish assemblages varied with scale and whether fishes were classified by taxonomy or traits. Although anthropogenic impacts were substantially higher for western US rivers than for Mongolia rivers, we were unable to detect strong differences in our ability to predict fish assemblage variation from reach- and valley-scale habitat variables.

Keywords: fish assemblages, geomorphology, macroecology

Characterization of Microbiome in Coastal Shark Species

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Presentation Type: Student Poster #17
6:00-8:30 Thursday 17 November

The bacteria living in and on an organism (the microbiome) are essential for development, immunity, and nutrition; yet, this has been studied sparingly in most fishes, particularly sharks. The importance of understanding how bacterial communities within the microbiome of sharks apply not only to the health of an individual but also to the quality of the surrounding marine environment in which they inhabit has increased given the biological and ecological significance of these species. Our primary objective is to identify the bacterial communities hosting on Bonnethead *(Sphyrna tiburo*), Blacknose (*Carcharhinus acronotus*), and Finetooth Sharks (*Carcharhinus isodon*), specifically, those of the epidermal tissue, mouth, gills, and gastrointestinal tract. We hypothesize that bacterial communities are species specific among both individuals and between areas sampled. Similarly, we hypothesize that elasmobranch microbiome composition is unique from the surrounding environment. To determine the bacteria which make up the microbiome of shark species, sharks will be swabbed and DNA will be extracted. Extracted DNA will be PCR amplified using primers targeting the V3V4 region of the SSU rRNA gene for taxonomic analysis. From the sequence data, we will be able to determine variation in host species, sample type, and host range. Examination of the bacterial communities across the microbiome is critical for predicting how sharks will respond to a changing ocean and for managing healthy populations in managed care. Therefore, this study will lay the groundwork for future research into

shark health.

Keywords: microbiome; elasmobranch

Distribution and population dynamics of Peppered Shiner, *Notropis perpallidus*

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Presentation Type: Student Poster #14
6:00-8:30 Thursday 17 November

Originally described by Hubbs and Black in 1940, *Notropis perpallidus*, the Peppered Shiner, is a rare minnow endemic to eastern Oklahoma and southern Arkansas. *Notropis perpallidus* inhabits pools and runs in warm, medium-sized rivers, and this habitat affinity can lead to increased risk of imperilment, as small to medium-sized rivers are subject to point and nonpoint pollution, urban sprawl, channelization, and damming. Peppered Shiner was designated as a Species of Greatest Conservation Need by the Arkansas Game and Fish Commission in 2015 and was petitioned for Federal listing during 2010. There has been a notable contraction in the range of *Notropis perpallidus*, having only been detected in the Saline River of Arkansas in recent years. We sampled 75 sites across the historic range in Arkansas, and the species was detected at only 13, all within the Saline River. Our data suggest that Peppered Shiner may be extirpated, or nearly extirpated from the Ouachita, Caddo, and Little Missouri rivers, but still inhabiting the Saline River, with all detection sites occurring downstream of Benton, Arkansas. Temporal changes in abundance, distribution within pool/run complexes, and size-frequency distribution were quantified at three sites on the Saline River. With continued sampling, we aim to further understand the distribution and population dynamics of *Notropis perpallidus* to aid conservation of this rare minnow.

Keywords: distribution; population dynamics; endemic; minnow; Species of Greatest Conservation Need

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Describing the status, detection, and occupancy of the Bluenose Shiner (*Pteronotropis welaka)* in Mississippi

Calvin R. Rezac[1], Robert J. Ellwanger[1], Abigail J. Shake[1], Chris P. Flaherty[1], and David A. Schumann[2]

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[2]University of Wisconsin-La Crosse
Presentation Type: Lightning Talk

4:20 Thursday 17 November

No Abstract.

Keywords: occupancy; detection; status; declining species; fish conservation

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An assessment of thermal tolerance of a vulnerable minnow, Peppered Shiner

Cade Richesin, Krista Yari, Peyton Manry, Matthew Gifford, Ginny Adams, Reid Adams

The University of Central Arkansas, Department of Biology, Conway

Presentation Type: Student Poster #1
6:00-8:30 Thursday 17 November

The Peppered Shiner (*Notropis perpallidus*) is endemic to Arkansas and Oklahoma and has experienced a significant range decline. Recent research throughout the range of Peppered Shiner suggests the species may be currently restricted to the Saline River in Arkansas. Peppered Shiner, like other small-bodied freshwater species with narrow geographical ranges, might be susceptible to rapidly rising temperatures due to their limited ability to shift their distribution. Although there are currently no thermal tolerance data for the Peppered Shiner, we consider this variable a possible factor in the reduced range of this species. Researchers have historically used the Critical Thermal Maximum (CTmax) to assess the highest temperatures fish are able to physiologically tolerate. A field acclimatization approach better represents the thermal environment of an individual immediately prior to capture and might provide a more biologically realistic assessment of thermal tolerance. Rather than laboratory acclimation for extended periods of time, we conducted all thermal trials *in-situ* on the day of collection. In addition to environmentally relevant CTmax values, this stream-side method provides a safer testing environment to vulnerable species like Peppered Shiner. Temperature loggers were placed in the Saline River to collect thermal histories to inform CTmax trials and calculations of thermal safety margins. Critical Thermal Maximum data will be compared to their corresponding thermal histories to evaluate how closely related CTmax values of the Peppered Shiner are to naturally occurring temperatures in their environment. In addition, CTmax of Peppered Shiner will be compared with thermal tolerances of co-occurring, more widespread leuciscids.

Keywords: CTmax; thermal tolerance; climate change

Identifying mussel-host fish relationships in Georgia's Flint River using genetic barcoding techniques

Hayley Robinson[1], Pete Hazelton[1], John Wares[1], Gail Cowie[2], Ben Scott[3], and Shayla Williams[4]

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[4]Albany State University, GA
Presentation Type: Student Oral
9:48 Thursday 17 November

Freshwater mussels have a unique life history in which larval mussels (glochidia) act as obligate parasites to fish hosts. Host selectivity is often species specific, and identification of host fish is a critical step in conservation planning for individual mussel species. The Flint River harbors approximately 23% of the freshwater mussel (Order Unionioda) diversity in the state of Georgia. Nine species in the basin are state or federally listed, and local diversity is threatened by shifting hydrologic conditions, increasing habitat loss, and sedimentation. Currently, knowledge on host species is lacking in nearly 40% of mussel species in the Flint. This study surveyed host use for mussels in the lower Flint and its tributaries, specifically evaluating naturally encysted mussels on wild caught fish. Wild infected fish were collected in 2021 and 2022 and held in laboratory conditions such that glochidia and juvenile mussels were collected as they excised from their hosts. Mussels were then identified using genetic barcoding of the cytochrome oxidase c subunit I (COI) locus. From the 271 successful mussel sequence samples to date, 38 unique mussel-host relationships were identified. Of these, 32 relationships are considered novel when cross referenced to the Illinois Natural History Survey mussel-host database. This highlights potentially novel records of interactions in this basin between 20 fish species, 5 distinct mussel species, and one mussel genus (*Elliptio)* for whom genetic identification to species is often not possible. Multiple cases of coinfection were also observed on several fish species: a rarely documented phenomenon. Future directions of this study will include comparison of mitochondrial loci performance in mussel species identification and assessment of fish infection rates between sites.
Keywords: COI, mussel hosts, genetic barcoding, Unionids, mussel life history

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Freshwater mussels and their fish hosts in the Southeast: an overview

Matthew Rowe

Georgia Department of Natural Resources
Presentation Type: Oral
8:30 Thursday 17 November

The southeastern United States is recognized as a global hotspot for freshwater mussel diversity. Despite this high diversity, they are one of the most imperiled groups of animals in the world. Native freshwater mussels are, in almost all cases, obligate parasites of freshwater fish; they are often restricted to specific fish species, or groups of species, to facilitate their lifecycle. It is critical to understand these parasitic relationships in order to conserve native freshwater mussel diversity. Knowledge gaps

are a pressing concern for conservation biologists. In most cases, relationships are only assumed based on closely related species. This presentation will provide an overview of the current state of knowledge of freshwater mussel/host fish relationships in the Southeast, methods of determining these relationships, and major research needs.

Keywords: mussels; host fish

Spatial distribution of the fishes of Running Reelfoot Bayou

David S. Ruppel, Nicky M. Faucheux, Steven G. George, Bruce A. Pruitt, K. Jack Killgore, and W. Todd Slack

U.S. Corps of Engineers ERDC Fish and Invertebrate Ecology Team, Vicksburg, MS
Presentation Type: Lightning Talk
4:10 Thursday 17 November

Spatial distributions of fishes are driven by regional species pool, dispersal capabilities, and a multitude of environmental factors. Within a system, species segregation is often linked to differences in water chemistry, current velocities, depths, and substrate affinity. Running Reelfoot Bayou, a tributary to the Obion River in western Tennessee (Lake and Dyer Counties), provides a great chance of understanding species distributions because of the hydrological dynamics of this system. During the spring of 2022, we sampled three locations on the mainstem Running Reelfoot Bayou, two locations in Reelfoot Lake, and multiple tributaries as part of a future USACE restoration project. In non-wadable habitat, fish sampling was conducted using hoop nets set for a 72-hour period and seining was conducted in wadable habitats. A total of 1,708 individuals were collected among all sites sampled, with Leuciscidae and Percidae being the dominant families. Species composition differed among habitat types, with species collected in Reelfoot Lake and Isom Lake resembling a slackwater community, whereas species collected in the tributaries were dominated by fluvial specialists. However, patterns in species distribution varied across the different tributaries. Understanding what factors drive the differences in the community composition will ultimately lead to a better understanding of the system and help guide the development and implementation of future restoration and management efforts.

Keywords: fish community; Delta streams; Tennessee

Temporal and spatial dynamics of sympatric Redbreast Sunfish and Green Sunfish populations in an increasingly urbanized watershed

Peter C. Sakaris[1] and Victoria D. Davis[2]

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[2]Warnell School of Forestry and Natural Resources, University of Georgia, Athens

Presentation type: Poster #38
6:00-8:30 Thursday 17 November

We studied the dynamics of sympatric Green Sunfish (*Lepomis cyanellus*) and Redbreast Sunfish (*Lepomis auritus*) in an urban tributary of the Yellow River in Lawrenceville, GA. Specifically, we investigated temporal trends in recruitment and abundance of both species in an increasingly developed watershed. Standardized backpack electrofishing was conducted to sample and measure sunfish (mm TL) at four fixed transects, with two transects established upstream and two downstream (near the confluence with Yellow River) to account for spatial variation in sunfish abundance. Total shock time (sampling effort in min.) was recorded to calculate CPUE for each species. Eighty-one total sampling surveys were conducted from 2016 to 2020, with 39 surveys performed at upstream transects and 42 downstream over the five-year period. A major deforestation event in spring 2018 adjacent to our upstream transects coincided with significant changes in recruitment and abundance of each species, although annual hydrologic and temperature variation also played a role. Over time, recruitment and abundance of Redbreast Sunfish declined, while recruitment and abundance of Green Sunfish markedly increased (species*year interactions; abundance: $F = 7.59$, $P < 0.001$, recruitment: $F = 2.61$, $P = 0.03$). We accounted for a highly significant spatial effect in both models (higher recruitment and abundance at upstream transects; $P < 0.001$). Analysis of the annual hydrologic regime also provided evidence that Green Sunfish may thrive in disturbed aquatic habitats with increased recruitment in years with higher variation in waterflow and in years with highest maximum flows. Our study highlights the importance of considering temporal and spatial effects of urbanization on stream fish populations in relation to increased urban land use. Additional analyses will incorporate 2021-22 data and examine size structure shifts and comparisons of age, growth, and mortality between species.

Phylogenomic analysis of the bowfin (*Amia calva*) reveals unrecognized species diversity in a living fossil lineage

Jeremy Wright[1], Spencer Bruce[2], Daniel Sinopoli[3], Jay Palumbo[4], and Donald Stewart[4]

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[2]SUNY Albany, Department of Information and Technology Services
[3]Louisiana State University, Department of Biological Sciences, Museum of Natural Science
[4]SUNY College of Environmental Science and Forestry, Department of Environmental Biology

Presentation Type: Student Oral
9:31 Friday 18 November

The Bowfin (*Amia calva*), as currently recognized, represents the sole living member of the family Amiidae, which dates back to approximately 150 Ma. Prior to 1896, 13 species of extant Bowfins had been described, but these were all placed into a single species with no rationale or analysis given. This situation has persisted until the present day, with little attention given to re-evaluation of those previously described nominal forms. Here, we present a phylogenomic analysis based on over 21,000 single nucleotide polymorphisms (SNPs) from 94 individuals that unambiguously demonstrates the presence of at least two independent evolutionary lineages within extant *Amia* populations that merit species-level standing, as well as the possibility of two more. These findings not only expand the recognizable species diversity in an iconic, ancient lineage, but also demonstrate the utility of such methods in addressing previously intractable questions of molecular systematics and phylogeography in slowly evolving groups of ancient fishes.

Keywords: Bowfin; phylogenomics; gene otology; diversity; pre-teleost;

Sicklefin Chub in the lower Mississippi River: insight on distribution, habitat and diet

Todd Slack, Steven George, David Ruppel, Audrey Harrison and Jack Killgore

US Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Presentation Type: Lightning Talk
4:05 Thursday 17 November

The Sicklefin Chub, *Macrhybopsis meeki*, is a big-river minnow generally confined to the main channels of the Missouri and Mississippi rivers, occurring in swift, deep waters. Historically, only a few records of this species were noted in the Mississippi River downstream from the confluence with the Ohio River with individuals often considered as waifs from northern populations. The species has been petitioned in the past for listing by USFWS under the Endangered Species Act and is currently the focus of a Species Status Assessment (SSA). From 2005 through 2021, the ERDC Fish and Invertebrate Ecology Team has documented 28 specimens ranging 31-110 mm TL during 14 sampling events with the majority occurring within the Lower Mississippi River (LMR). Chub collections have been episodic ranging 1-3 per year during non-targeted sampling focused primarily on Pallid Sturgeon recruitment and LMR secondary channel monitoring projects. Four collections occurred in Missouri, five in Arkansas and five in Mississippi with the greatest concentrations of records occurring at Mhoon Bend (RM 686; Tunica Co., MS) and Old White River Chute (RM 595; Desha Co., AR). All specimens were taken with a 10' Missouri Trawl, with one captured on a trotline while fishing for Pallid Sturgeon. Individuals were documented primarily over sand and gravel, occasionally with some mud in main channel dike fields and secondary channel habitats. Our samples have occurred primarily (64%) during the spring (Feb-May) at a

water depth of 3.3 – 41.5 feet (mean: 20.7 ft.) with water temperature ranging 3.48-26.7 C (mean: 17.1 C). The Sicklefin Chub will continue to be an important target species as part of our ongoing research program in the LMR.

Keywords: Sicklefin Chub; Mississippi River; distribution; habitat

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Assessing imperilment risk for data-deficient freshwater fishes – a Bayesian Belief Network approach

Logan J. Sleezer[1], Corey G. Dunn[2], Michael E. Colvin[3], David A. Schumann[4], Matthew Wagner[5], D. Todd Jones-Farrand[6], Erin Rivenbark[7], Sarah McRae[8], and Jessica Gilbert[8]

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[4]University of Wisconsin-La Crosse, Department of Biology and River Studies Center

[5]U.S. Fish and Wildlife Service, Mississippi Ecological Services

[6]U.S. Fish and Wildlife Service, Science Applications and Migratory Birds Program

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[8]U.S. Fish and Wildlife Service, Ecological Services, South Atlantic Gulf and Mississippi Basin

Presentation Type: Poster #27
6:00-8:30 Thursday 17 November

The rich freshwater biodiversity in the southeastern US can challenge the capacity of the US Fish and Wildlife Service to complete Species Status Assessments (SSAs) for the 100s of species petitioned for listing under the Endangered Species Act. Most southeastern freshwater fish species are data- deficient, which can limit analytical options for modeling imperilment risk. Moreover, analytical procedures for determining imperilment risk in SSAs often lack standardization, which can limit the efficiency and repeatability of SSAs. We developed a standardized Bayesian belief network model for implementing Species Status Assessments that estimates imperilment risk for data-deficient southeastern freshwater fishes. Our risk-assessment model is built around the conservation biology principles of resiliency, redundancy, and representation (the 3 R's framework) and can be informed by disparate data sources including distributional occurrences, species traits, expert input, and barriers to population connectivity. We examine whether our model can replicate results from two species with recently completed SSAs that differ in life-history strategies and perceived levels of imperilment risk: Carolina Madtom (*Noturus furiosus,* with current condition deemed as having "very

limited resiliency") and Ozark Chub (*Erimystax harryi,* with current condition deemed "moderately high"). We found that our models generally agreed with findings in these SSAs and that imperilment risk was higher for *N. furiosus* than *E. harryi*. These results indicate our modeling approach could help overcome some challenges when assessing imperilment risk of data-deficient species within a repeatable and efficient framework. We will officially implement our modeling approach with the upcoming SSA of Piebald Madtom (*Noturus gladiator*).

Keywords: Imperilment; risk assessment

Integrating species-specific fish swimming ability Into a stream-crossing assessment framework

Ridge Sliger and Brandon Peoples

Clemson University, Department of Forestry and Environmental Conservation, SC
Presentation Type: Oral
11:48 Thursday 17 November

Aquatic habitat fragmentation has caused population declines in fish species globally. A factor contributing to this fragmentation is the installation of stream- crossing structures such as culverts. Stream-crossing structures often create impassable conditions for various fish species, but the extent to which they do so is poorly understood. While some efforts to assess stream-crossing passage barriers at a large scale have been conducted, these studies often rely on simplifying assumptions that may limit the reality of their results. Variability in fish swimming speed creates differences in barrier permeability among species and barrier conditions; including swimming ability in barrier assessment will aid in the process for prioritizing barrier removal. Here, we demonstrate the use of standardizable methods to include fish critical swimming speed (U_{crit}) into the Southeast Aquatic Resources Partnership's (SARP) stream-crossing assessment protocol. We use Yoknapatawpha Darters in Mississippi's Yocona River watershed as a case study. Darter U_{crit} ranged from 16.8 to 79.4 cm/s, with a mean of 46.9 cm/s. Integrating this data into SARP's assessment protocol resulted in changes to barrier severity estimates in the Yocona River watershed. Specifically, multiple stream-crossing structures were estimated to be more severe barriers to passage after integrating species-specific U_{crit} data. Our results indicate the importance of including species-specific swimming ability data when assessing stream-crossing barriers.

Keywords: swimming speed; passage; culverts

Approaching competition in stream fishes with a long-term multi-scale dataset

Loren Stearman[1], Jake Schaefer[1], and Scott Clark[2]

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[2]U.S. Fish and Wildlife Service
Presentation: Student Oral
8:26 Friday 18 November

Despite being one of the oldest subjects in ecology, the factors which mediate coexistence of ecologically similar species are still hotly debated. Laboratory experiments suggest competitive exclusion is common; however, field experiments have supported processes such as niche partitioning, environmental stochasticity, keystone predation, dispersal, and even competitive equivalency, among others, in maintaining coexistence. Stream fishes are a fascinating group for addressing this research area as experimental support for competitive exclusion in structuring their communities is highly ambiguous. In this paper we utilize a long-term multi-scale stream fish ecological dataset to address two primary questions: first, can we detect evidence of competitive exclusion in community assembly, and second, can we discern mechanisms driving the patterns we observe? We constructed a binary ecological dataset for five niche axes to describe niche overlap and utilized trial-swap models on observed data to construct null communities with no competitive structuring. Species pair coexistence was not correlated to degree of niche overlap at any scale (subreach, plot, HUC10). Patterns of coexistence between species across spatial scales were more strongly correlated than expected by chance, suggesting that coexistences were stable across spatial scales. We detected few species pairs which avoided at subreach scales but coexisted at site scales, suggesting little intra-assembly competitive structuring. Community-scale niche overlap was higher than expected from random models, while overall niche fill and niche overlap skew were lower than expected, suggesting at the regional scale species in a community tended to have more ecological similarity than expected by chance alone. Our data suggest community structure in these streams is more congruent with the mechanism of environmental filtering. We further explore these patterns at smaller watershed scales and within three diverse and ecologically disparate groups (Minnows, Leuciscidae, Sunfishes, Centrarchidae, and Darters, Percidae).

Keywords: coexistence; competition; community assembly; niche space

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Rivers, geology, and the diversification of endemic darters

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Planetary Sciences
Presentation Type: Lightning Talk
2:05 Friday 18 November

Allopatric speciation of fishes of the southeastern United States has often been linked to perturbations in river networks, from small headwater river captures to continental-scale drainage reorganization. However, for darter species that appear to have diversified at small scales within river basins, an allopatric mechanism of speciation has been elusive. We propose a new model for geologically mediated within-basin allopatric speciation. As rivers erode through layers of different kinds of rock, the spatial distribution of rocks at the surface of the landscape changes. For fish with habitat specificity linked to rock type, erosion can progressively expose either favorable or unfavorable rock types, creating barriers or corridors. We present two case-studies that illustrate each scenario. First, we show that populations of the Greenfin Darter (*Nothonotus chlorobranchius*) are genetically isolated within tributaries flowing over metamorphic rocks making up the Blue Ridge geologic province. In contrast, they are not found in rivers flowing over sedimentary rock. We show that over time, more sedimentary rock has been exposed, which has progressively isolated *N. chlorobranchius* populations from one another. In this case, river incision is introducing more barriers (sedimentary rock), leading to lineage diversification. In the second case-study, we explore the diversification of a species complex that includes the federally endangered Vermilion Darter (*Etheostoma chermocki*) and Warrior Darter (*E. bellator*). Unique lineages of this species complex are restricted to tributaries flowing over carbonate rocks in the Black Warrior River. In contrast to the *N. chlorobranchius* case-study, here river incision is progressively exposing more carbonate rock, driving dispersal-mediated allopatric speciation. Our two case-studies suggest that in the bedrock-dominated rivers found throughout much of the Appalachian Mountains, steady erosion through different rock types can drive the diversification of freshwater fish.

Keywords: speciation; geomorphology; Vermillion Darter; Warrior Darter; Greenfin Darter

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Stream restoration produces transitory, not permanent, changes to fish assemblages at Georgia compensatory mitigation sites

Edward Stowe[1], Kelly Petersen[2], Eric Walther[1], Shishir Rao[1], Seth Wenger[1] and Mary Freeman[3]

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Presentation Type: Student Oral
8:56 Thursday 17 November

Evidence that stream restoration projects lead to recovery of ecosystem attributes is

inconsistent, partly as a result of insufficient monitoring data. However, streams in the United States restored for compensatory mitigation must be monitored by practitioners for several years following restoration, which provides an opportunity to examine restoration efficacy broadly. In this study, we used data and monitoring reports submitted to federal regulators by stream mitigation consultants to examine whether in-stream restoration activities led to changes in fish community attributes at 23 compensatory mitigation sites representing 53 sampling reaches in Georgia, USA, over seven years of post-restoration monitoring. Modeling results indicated that species richness and abundance of fishes generally increased in the first years after restoration before decreasing to baseline levels by the seventh year. This pattern was consistent for models considering sensitive fish taxa, as well as at sites across a range of agricultural and forested land cover percentages. However, the effect of restoration on species richness was dampened in larger streams and at more urbanized locations. A community trajectory analysis corroborated the findings that fish community change was transitory at most sites. Remote estimation of canopy cover change at restoration sites suggested that the hump- shaped response may be driven by increased light availability during the immediate post-restoration period, followed by subsequent re-shading of stream channels. Our analysis indicates that reach-level manipulation of streams should not be expected to induce long-term changes in fish communities, and that publicly-available monitoring reports may be leveraged to address questions of stream restoration efficacy.

Keywords: stream restoration; fish populations; public data

Conservation genetics and environmental DNA of the Bridled Darter

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Presentation Type: Student Oral
1:43 Thursday 17 November

The Bridled Darter is a small, ray-finned fish native to the Mobile Basin in the Upper Coosa River watershed throughout Georgia and Tennessee. Prior to 2021, the Bridled Darter was thought to be one species. But recent genetic and morphological studies have now split the fishes into two distinct species, the Etowah Bridled Darter, *Percina freemanorum*, endemic to the Etowah River System in Georgia, and the Bridled Darter, *Percina kusha*, endemic to the Conasauga River System in Georgia and Tennessee. Recent range decline and declines in population sizes have raised concern to list them as threatened species to undergo protection from further decline. A full population genetic study is being conducted to understand the current genetic variability within and

between the two Bridled Darter species. This is done through collection of fin clip tissues from all known Bridled Darter populations, totaling eight sample sites. The DNA extracted from these tissues is being used to generate a molecular phylogeny. Environmental DNA (eDNA) is also being used to detect Bridled Darters at sites where their presence is below detectable limits by snorkeling or seining methods. The sites for eDNA include all known and historical Bridled Darter populations. The outcome of this study is to fully understand the population status of Bridled Darters to be able to properly manage the remaining populations and the recovery of the extirpated populations.

Keywords: Bridled Darter

Molecular status assessment of the Smallmouth Bass complex in the Central Interior Highlands

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Presentation Type: Poster #30
6:00-8:30 Thursday 17 November

The Smallmouth Bass (*Micropterus dolomieu*) is one of the most popular freshwater sport fishes in North America. Recent phylogenomic analyses support a four-species complex within what was once considered *M. dolomieu*: the Neosho Bass (*M. velox*), the Little River Bass (*M. sp. cf. dolomieu*), the Ouachita Bass (*M. sp. cf. dolomieu*), and the Smallmouth Bass (*M. dolomieu*). To ascertain the conservation status of the three lineages endemic to the Central Interior Highlands, we investigated spatial patterns of introgression and population structure with microsatellites and SNPs. Within the range of the Neosho Bass, we uncovered high levels of introgression with Smallmouth Bass in the Illinois River basin near Lake Tenkiller, OK, which was stocked in the early 1990's. Within the Neosho Bass range, pockets of historical admixture with Smallmouth Bass exist that likely pre-date human stockings, which could complicate conservation planning. Within the ranges of the Little River Bass and Ouachita Bass, introgression between Little River Bass and Smallmouth Bass was widespread in the upper and lower Mountain Fork near Broken Bow Lake, OK. Otherwise, we found little evidence of invasion or hybridization with non-natives across the ranges of the Little River Bass and Ouachita Bass. Results can be used to guide management and conservation of these unique, endemic lineages of the Smallmouth Bass species complex, including

establishment of population-genetic management units and adopting protections for remaining non-introgressed populations.

Keywords: conservation genetics; fisheries management; hybridization

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Spiky heads, black bands, and gill rakers: a new guide to Kentucky's herbivorous minnows, the stonerollers (*Campostoma*)

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Presentation: Poster #34
6:00-8:30 Thursday 17 November

The stonerollers (Leuciscidae: *Campostoma*) are herbivorous minnows that are among the most common and widespread of Kentucky's minnows. Despite a surge in systematic studies of this group over the past 40 years, the distributions and diagnostic characters of Kentucky *Campostoma* species have remained unclear. Our goals here are to (1) describe the currently known geographic distributions of Kentucky *Campostoma*, and (2) present morphological characters useful in species identification. We found morphotypes representing three, possibly four, species in Kentucky occupying non-overlapping ranges: *C. anomalum* (Rafinesque), Central Stoneroller, widespread in northeastern and north-central Kentucky; *C. oligolepis* Hubbs and Greene, Largescale Stoneroller, in south-central to western Kentucky; *C. pullum* (Agassiz), Finescale Stoneroller, in extreme western Kentucky; and a form similar to *C. anomalum* in the upper Cumberland drainage. These species can be distinguished by a combination of breeding male tuberculation, anal fin pigmentation, scale counts, pharyngeal tooth formula, and number of gill rakers. The upper Cumberland form differs from "typical" *C. anomalum* in only rarely having a dark anal fin band, usually only 1-2 pairs of internasal tubercles (three pairs in "typical" *C. anomalum*), and more gill rakers and lateral-line scales.

Keywords: Stonerollers; *Campostoma*; Kentucky; distribution; variation

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Genetic contributions of hatchery-stocked Walleye to Douglas Reservoir

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Presentation Type: Poster #36
6:00-8:30 Thursday 17 November

Walleye (*Sander vitreus*) has been a popular sports fish for anglers in Tennessee for many years. However, some reservoir populations of Walleye are in decline and fail to naturally produce enough offspring to sustain fishery desires. To support reservoir populations, the Tennessee Wildlife Resources Agency (TWRA) has been stocking Tennessee reservoirs, oftentimes yearly, with hatchery-raised fish. Captive rearing programs for Walleye are costly, and the contribution of stocked fish to the existing population is not well known. The objective of this project is to determine the genetic contribution of hatchery-reared fish to reservoir populations of Walleye in Tennessee. We used genome-wide Single Nucleotide Polymorphisms (SNPs) to estimate the genetic contribution of hatchery-reared fish to the existing Walleye population at Douglas Lake, a popular fishing reservoir in Tennessee. We genotyped hatchery brood stock and the existing reservoir populations prior to stocking and two years after stocking was initiated. Results from this study will be used to assess population introgression of stocked fish and the effectiveness of TWRA stocking practices on improving Walleye populations.

Keywords: Walleye; SNPs; hatchery; genetics; genome

The effect of water quality parameters on eDNA yields of the Bridled Darter (*Percina kusha*) and the Etowah Bridled Darter (*Percina freemanorum*)

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Presentation Type: Student Poster #20
6:00-8:30 Thursday 17 November

The Bridled Darter (*Percina kusha*) and recently described Etowah Bridled Darter (*Percina freemanorum*) are small, ray-finned fishes native to the Mobile Basin in the Upper Coosa River watershed throughout Georgia and Tennessee. These species have both experienced recent range decline and declines in population sizes which has raised concern to list them as threatened species to provide protection from further decline. In order to help determine the current conservation status of both species, molecular detection of species specific eDNA was used to define their current ranges. However, there are still many uncertainties regarding the accuracy of eDNA and its dynamics under natural conditions, and this study aims to shed some light on these uncertainties by determining the effects of various water quality parameters on eDNA yields for both Bridled Darter species. This was done through sampling for eDNA and taking various water quality measurements using a YSI probe at all known and historical

sites where Bridled Darters have been found. Comparisons of eDNA yield and different water quality parameters revealed that eDNA yield showed a positive correlation with total dissolved solids (R^2= 0.48) and conductivity (R^2= 0.35) suggesting that conditions with high levels of total dissolved solids and high conductivity are ideal for obtaining the highest concentrations of Bridled Darter eDNA. How eDNA yield relates to water quality parameters is still not fully understood among scientists. This data can help shed some light on ideal water quality parameters for the collection of eDNA for the Bridled Darter and Etowah Bridled Darter.

Keywords: Bridled Darter; eDNA; water quality; conservation

An update to the fishes of Mississippi checklist

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Presentation Type: Poster #26
6:00-8:30 Thursday 17 November

Following the turn of the 20th century, the development of two landmark publications have increased our knowledge of the diverse fish fauna found within Mississippi's waters (Cook, 1959; Ross, 2001). The novel works by Fannye A. Cook (1959) established a list of 145 native freshwater species including 2 introduced species across 21 families and an additional 39 saltwater fishes which invade freshwater from 22 families. Forty-two years later, Ross (2001) produced an update to the original publication on Mississippi fishes which listed 217 (14 introduced) freshwater species within 25 families. Today, Ross (2001) continues to serve as an essential resource on the identification of fishes found within Mississippi and as a source of biological information on each species. However, because of recent technological advancements in the field of taxonomy, and because of more than two decades worth of ichthyological studies on the occurrence of Mississippi fishes, an updated reference is needed. Herein we present an updated assessment of the status of ichthyofauna within the state of Mississippi and provide details on the taxonomic uncertainty of several fishes of future interest.

Keywords: distribution; collections; data

Searching for extinction debt in southeastern U.S. fish communities

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Presentation Type: Student Oral
10:56 Friday 18 November

Estimating the number of freshwater fish species expected to occur in a given watershed is a fundamental question of ecology yet has proven challenging to answer. Part of the challenge is that habitat modification, stream fragmentation and land use change likely reduce the number of species a watershed can support and are major causes of species extinctions. However, extinction is not always an immediate phenomenon– there often is a time lag between the extinction of a species and the perturbation that initiated the process. This delayed extinction is termed extinction debt, and can create opportunity for intervention if it is detected. The southeastern United States is a global hotspot for freshwater biodiversity, yet many of these freshwater fish populations are now vulnerable to local extinction. A first step in identifying extinction debt is to estimate current species richness across variously altered and fragmented watersheds. In this talk, we present a preliminary model for estimating current species richness from collection data, while accommodating different collection methods, survey effort, stations, and unseen species. We evaluate model performance using a simulated dataset and then apply it to empirical data from the upper Coosa River basin. We will then discuss approaches and data requirements for applying macroecological theory to streams to estimate potential extinction debt. The ability to detect watershed-level extinction debt could make it possible to avert species losses by identifying locations that are in need of urgent restoration or reconnection actions.

Keywords: Bayesian modeling; conservation; extinction; macroecology; restoration

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Effects of instream barriers on population connectivity of the Kentucky Arrow Darter (Percidae)

River A. Watson[1], Alexis V. Culley[1], Catherine G. Haase [1], Matthew R. Thomas[2], Stephanie L. Brandt[2], Michael A. Floyd[3], and Rebecca E. Blanton[1]

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Presentation Type: Student Oral
10:30 Thursday 17 November

Anthropogenic habitat alteration and fragmentation are leading causes of freshwater fish imperilment globally. Both contribute to increased population isolation, which leads to declines in genetic diversity from inbreeding and genetic drift. The Kentucky Arrow Darter, *Etheostoma sagitta spilotum* (KAD), is a federally threatened darter restricted to headwater streams of the Kentucky River system, where mining and other factors have contributed to extirpation from 45% of its historic localities. A previous range-wide study of KAD found populations located in proximity to one another within the Daniel Boone National Forest (DBNF) had higher levels of genetic fixation than expected under an isolation-by-distance model and that recent, human-mediated habitat fragmentation had contributed to population isolation. We further explore the impact of instream anthropogenic factors including conductivity levels and culvert presence and type on population isolation within the DBNF using resistance surfaces. We sampled 221 individuals from 14 sites within the DBNF and genotyped them at eleven microsatellite loci to describe genetic diversity and population structure. Four culverts located on sampled streams were measured for SARP's Aquatic Organism Passage (AOP) score, and conductivity levels were measured at all sampling sites and in corridors between sites. AOP scores, conductivity levels, % forest cover, stream size, and distance between sites were used to model the effects of these different landscape elements on gene flow and genetic diversity. Model results will be presented and discussed. Overall this work will provide a novel, fine scale view of the barriers causing declines in connectivity among and genetic diversity within populations of highly imperiled fish.

Keywords: conservation genetics; landscape genetics; microsatellites; barriers

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Simple methods for analyzing fish count time series data.

Seth Wenger

University of Georgia, Athens
Presentation Type: Lightning Talk
3:50 Thursday 17 November

No Abstract

Keywords: abundance; modeling

Population dynamics of the Western Blacknose Dace (*Rhinichthys obtusus*) in Alabama

Courtney A. Weyand and Jonathan W. Armbruster

Auburn University, Department of Biological Sciences, AL
Presentation Type: Student Poster #18
6:00-8:30 Thursday 17 November

Within Alabama, the Western Blacknose Dace, *Rhinichthys obtusus* is found within the

Black Warrior, Coosa, and Tennessee Rivers. In 2004, this species was hypothesized as extirpated from the Black Warrior system based on infrequent and singleton collections. However, more recently, multiple populations have been observed within the Sipsey and Locust Fork Rivers of the Black Warrior River drainage (Mobile Basin), both of which are in close proximity to the Tennessee divide. Additionally, several other Tennessee endemic species have been observed within the Bankhead National Forest (Black Warrior River), outside of their presumed range. It is thought that faunal transfer between the Black Warrior and Tennessee River drainages could be associated via stream capture, subterranean movements, or human transfer (bait bucket introduction). Given the recent findings of *R. obtusus* within the Black Warrior River, this suggests that the species is still occupying the drainage, but to what extent and source of entry are unknowns. Using restriction site associated DNA sequencing (RADseq), the goals of this study were to identify the source population(s) of *R. obtusus* within the Black Warrior, and to determine if gene flow is occurring between the drainages. Results will be used to determine if populations are the product of a more recent or historical event, provide a better understanding of the species natural prevalence in the region, and perhaps determine the source of other Tennessee endemics within the drainage.

Keywords: RADseq; genomics; stream capture; riffle dace

Underwater photography and its use in social media outreach

Derek Wheaton and Shannon Murphy

Conservation Fisheries, Inc., Knoxville, TN
Presentation Type: Poster #37
6:00-8:30 Thursday 17 November

In an ever-changing information landscape, those working in conservation need to adapt their science communication efforts in order to perform effective outreach. As field biologists, every time we step outdoors, we have new opportunities to document the work we do and the fauna we work with. Combining in-situ wildlife photography, documentation of field activities, and human interactions with the animals, we demonstrate the utility of social media to educate the public about both common and imperiled fish species, and to make conservation science seem more interactive, approachable, and relevant to the average citizen.

Keywords: photography; conservation; outreach; memes; social media,

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Dam good opportunities: making the most of increasing interest in dam removals

Kit Wheeler[1], Luke Etchison[2], and Keith Gibbs[3]

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[2]North Carolina Wildlife Resources Commission

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Presentation Type: Oral
8:43 Thursday 17 November

Dams are perhaps the most obvious source of fragmentation in riverine habitats, and they are known to restrict or eliminate access to migratory corridors used by fishes to complete critical transitions among spawning, feeding, and refuge habitats. However, momentum appears to be building for dam removals in the form of federal and state legislation allocating funding to projects focused on the removal of outdated, minimally beneficial, or unnecessary dams. Given these unique circumstances, we wish to emphasize the tremendous research opportunity offered by dam removals to freshwater biologists and resource managers interested in the conservation and restoration of fluvial habitats and biota. In the context of migratory fishes in the Southeastern US, there are multiple pathways by which the effects of dam removal could manifest. There is the potential to restore migrations of a diverse group of fishes, including but not limited to sturgeons, suckers, herrings, shads, paddlefish, and eels. If dam removal expands the habitats available to migratory fishes like these, there is also the potential for delivery of substantial resource subsidies to previously inaccessible habitats. Furthermore, restoring fish migrations may facilitate the recovery of freshwater mussel populations that suffered declines or extirpations upstream of previously existing dams. Finally, dam removals have the potential to produce changes in fish community structure and available habitat, both of which are important considerations in fisheries management and conservation. By highlighting some potential ecological outcomes of dam removal, sharing information about available resources, and identifying best practices for research design, we hope to promote collection and analysis of critical data that can guide effective conservation and management of migratory fishes.

Keywords: dams; migratory fishes

Population genomics research on freshwater fishes is needed to understand freshwater mussels

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Presentation Type: Lightning Talk
2:40 Friday 18 November

No Abstract.

Keywords: population genomics; molecular ecology; RADseq; landscape genetics; parasite-host interactions

Aquatic connectivity gone wrong... the Tennessee-Tombigbee Waterway: a bidirectional pathway for invasive species

James D. Williams

Florida Museum of Natural History, Gainesville
Presentation Type: Lightning Talk
3:00 Thursday 17 November

Construction of the Tennessee-Tombigbee Waterway in northeast Mississippi and west Alabama resulted in a permanent aquatic connection across the divide between Yellow Creek (Tennessee River drainage) and Mackeys Creek (Tombigbee River drainage) at Bay Springs Lock. Initial construction started in 1971 and was completed in 1985. This 234-mile-long navigation project, with a series of 10 locks and dams, provides a total lift of ~340 feet. There are two groups of fishes present, foreign invasives and native invasives. On the Tennessee River (Mississippi basin) side, there are five foreign invasive species— three carps (Silver, Bighead, and Black), Round Goby (*Neogobius melanostomus*), and Northern Snakehead (*Channa argus*)—that are not currently established in the Tombigbee River drainage. One large Silver Carp (*Hypophthalmichthys molitrix*) has been found (deceased) in the Tombigbee River drainage just below Bay Springs Lock. Native fishes, whether endemic to the Tennessee River drainage or Tombigbee River drainage, may become invasive outside their native ranges. There are ~120 species native to the lower Tennessee River drainage and ~125 species native to the Tombigbee River drainage. Possible outcomes resulting from mixing of these two evolutionarily distinct faunas include hybridization, competitive displacement, and alteration of predator/prey relationships. There have been almost no studies to determine to what extent native fishes have crossed the divide. In addition to fishes, there are numerous other aquatic species, including invertebrates, amphibians, reptiles, and plants, in the respective drainages that may become invasive.

Keywords: invasive fishes; Tennessee-Tombigbee Waterway; Alabama; Mississippi

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Evidence supporting the formal recognition and description of a new species of Spottail Darter endemic to the Clarks River drainage in Kentucky and Tennessee

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Presentation Type: Student Oral
2:22 Thursday 17 November

Etheostoma cf. *oophylax,* the Clarks Darter, was discovered in 2011 and has been the subject of population genetic studies. However, the identified yet undescribed species has not received formal description. *Etheostoma* cf. *oophylax* was recognized as *Etheostoma oophylax* based on morphological characters. Subsequent to the description of *E. oophylax*, molecular phylogenetic analyses consistently resolved specimens from the Clarks River drainage and *E. chienense* as sister species, which together formed a sister clade to all other sampled populations of *E. oophylax*. Our analyses of morphological trait data, mitochondrial DNA (mtDNA), and genomic sampling using double digest restriction-site associated DNA (ddRAD) sequencing support the distinctiveness of *E.* cf. *oophylax*. Morphologically, *E.* cf. *oophylax*, differs from *E. oophylax* in the modal number of dorsal fin rays (12 versus 11), anal fin rays (8 versus 7), and in the average number of scale rows around the caudal peduncle (21.8 versus 20.37). *Etheostoma* cf. *oophylax* does not share mtDNA haplotypes with *E. oophylax* or *E. chienense*. Phylogenomic analysis of an average of 28,448 ddRAD loci per sampled specimen resolves *E.* cf. *oophylax* and *E. chienense* as sister species, and assessment of genomic divergence supports the hypothesis that each of these two species represents a distinct and independently evolving lineage. In addition, we report a range extension of *E. oophylax* in the Obion River drainage, a direct tributary of the Mississippi River.
Keywords: species delimitation, Percidae

Impact of road crossing barriers on karst headwater endemic species in northwest Arkansas

Anthony Zenga, Susan Colvin, Seth Drake, and Parker Brannon

Arkansas Tech University, Russellville
Presentation Type: Lightning Talk
3:45 Thursday 17 November

No Abstract.
Keywords: barriers; darters; crayfish

Movement of endemic Bartram's Bass and invasive Alabama Bass in Eastatoee Creek, South Carolina

Tyler Zumwalt[1], Brandon K. Peoples[1], Troy M. Farmer[1], Mark C. Scott[2], Daniel Farrae[2], Kevin Kubach[2], Katherine Silliman[2], and Tanya Darden[2]

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Presentation Type: Student Oral
11:48 Friday 18 November

Hybridization between endemic Bartram's Bass and nonnative Alabama Bass has threatened Bartram's Bass persistence. However, the manner at which Alabama Bass alleles are spreading is unknown. Therefore, our objective was to quantify the movement of Bartram's Bass, Alabama Bass, and Hybrid Bass. We radio-tagged 10 Bartram's Bass, 12 Alabama Bass, and 5 Hybrid Bass in May of 2021, then tracked individuals from May-September of 2021. We used mixed effect models to quantify mean movement rates (meters/week) and changes in location (rkm) among each species, with account for temperature and discharge as fixed interaction effects. Bartram's Bass moved the least (170 m/week; 0-390 95% CI), followed by Alabama Bass (489 m/week; 237-740 95% CI), while Hybrid Bass moved the most (763 m/week; 400-1125 95% CI). Bartram's Bass were also located significantly further upstream than nonnative bass ($F_{2,22} = 172.103$; $p < 0.001$). Furthermore, the movement rate of Alabama Bass increased in response to discharge ($\beta = 0.17 \pm 0.11$, $p < 0.01$), while movement rate of Hybrid Bass decreased in response to temperature ($\beta = -0.29 \pm 0.08$, $p < 0.01$). The movement rate of Bartram's Bass increased in response to discharge ($\beta = 0.03 \pm 0.01$, $p = 0.01$), yet their location shifted upstream in response to temperature ($\beta = 0.10 \pm 0.05$, $p = 0.02$). These results suggest temperature and discharge affect each species differently and substantially affect the manner at which nonnative alleles are spread. However, existing physical barriers and habitat differences may confound invasion potential, while simultaneously limiting Bartram's Bass dispersal. Therefore, actions to prevent further nonnative allele spreading should consider these barriers, as well as the impacts of temperature and discharge on overall invasion potential.

Keywords: native fish; Black Bass; endemic species; bass conservation; fish management