



Georgia Chapter of the American Fisheries Society

2017 Annual Meeting

January 24 – 26, 2017
Statesboro, Georgia



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2017 GA-AFS Annual Meeting Program



Tuesday, January 24, 2017		
10:00 - 12:00	Registration	
12:30 - 12:45	Welcome/Opening Comments	Chris Harper
12:45 - 1:05	State of the State (Freshwater)	Matt Thomas
1:05 - 1:25	State of the State (Marine)	Patrick Geer
1:25 - 1:40	BREAK	
1:40 - 1:45	Session 1: Professional Presentations (State Program Information)	
1:45 - 2:00	Go Fish Education Center Happenings	Michael Fulghum
2:00 - 2:15	An Overview and Update of Georgia's State Fish Hatchery System	Scott Robinson
2:15 - 2:30	Georgia Scientific Collection Permits	Carolyn Belcher
2:30 - 2:45	Angler Recruitment, Retention and Reactivation (R3) and License Sales: Stories of Success	Jenifer Wisniewski
2:45 - 3:00	BREAK	
3:00 - 3:05	Session 2: Student Presentations	
3:05 - 3:20	Life History of the Creek Chub in an Urban Stream	Ashley Fredricks
3:20 - 3:35	Comparison of Green Sunfish and Redbreast Sunfish Population Characteristics in an Urban Stream	Jessica Coover
3:35 - 3:50	Spawning Behavior and Habitat Use of Shoal Bass in Two Non-navigable Chattahoochee River Tributaries	Amy Cottrell
3:50 - 4:05	Intersex in Blackbanded and Turquoise Darters in Athens, GA	Derek Pope
4:05 - 4:20	Metabolic Profiles of Wild Intersex Largemouth Bass: Toward Development of a Non-lethal Biomarker	Matthew Urich
4:20 - 4:35	BREAK	
4:35 - 4:40	Session 2: (continued)	
4:40 - 4:55	The Effects of Habitat Improvement Structures on the Condition and Abundance of Eastern Brook Trout in Streams of the Chattahoochee National Forest	Alex Kiser
4:55 - 5:10	Evaluation of Factors Influencing Spotted Bass Use of Introduced Structures in a Georgia Highland Reservoir	Ethan Barrett
5:10 - 5:25	Influences of Local and Regional Environmental Factors on Atlantic Coastal Plain Stream Fish Communities	Rebecca Scott
6:00 - 7:30	POSTER SESSION AND WELCOME SOCIAL	



Poster Session

--Professional--

Assessing Conservation Status of ESA Petitioned Fishes In the Face of Rapidly Approaching Deadlines	Zach Abouhamdan
Body Temperature, Cerebral Vasculature, and the Potential for Brain Warming in Cownose Rays (<i>Rhinoptera bonasus</i>)	Christine Bedore
Investigations of Georgia's Population of Sicklefin Redhorse <i>Moxostoma</i> sp.	Johnathan Davis

--Student--

Spatial and Seasonal Variation of Macroinvertebrate Biotic Indices of the Lower Ogeechee River Basin	Julien Buchbinder
Comparisons of Leaf-litter Processing and Macroinvertebrate Assemblages in Three Coastal Plain Rivers of Southeast Georgia	Byron Collins
Investigating the Role of Long Distance Dispersal in the Response of Stream Fishes to Urbanization	Andrea Davis
Evaluation of Duckweed <i>Wolffia</i> spp. Growth in Tilapia <i>Oreochromis</i> spp. Effluent	Matthew Durst-Scarlett
Regional and Tidal Phase Effects on Estuarine Fish Distributions Near Savannah, Georgia	Kalynn Fitzgerald
Habitat Preferences of the Hiwassee Crayfish <i>Cambarus hiwasseeensis</i> in a Headwater Stream	Samuel Flagg
Effects on <i>Campostoma oligolepis</i> Digestive Morphology and Gut Microbiota Across a Gradient of Urbanization	Hannah Grice
Who is Eating Crab Legs? Studies in Coastal Shark Diets	Ashlyn Henning
A Baseline Study of Fish Assemblages in a Pristine Georgia Estuary	Melissa Hewett
Comparing Three Types of Passive Samplers for the Assessment of Macroinvertebrates in Non-Wadeable Rivers	Kelsey Laymon
Diet of the Snail bullhead (<i>Ameiurus brunneus</i>) in the Lower Ogeechee River	Allison Lutz
Factors Affecting Tournament-Associated Mortality of Black Bass Species	Parker Moon
Comparison of Redbreast Sunfish Life Histories Across an Urban Gradient	Stefano Rosillo
Evaluating Elasmobranch Interactions in the Georgia Shrimp Fishery	Matt Scanlon
Comparison of Otoliths and Scales in the Age Estimation of Sunfishes	Jesse Sunga
The Fishy Side of Ecosystem Health: An Ecological Assessment of Fish Assemblage Composition and Diversity in the Satilla River Estuary	Jennie Wiggins



Wednesday, January 25, 2017

8:00 - 8:45	Fellowship of Christian Conservationists	
9:00 - 9:05	Session 3: Student Presentations	
9:05 - 9:20	Distribution and movement of Columbia River Redband Trout, <i>Oncorhynchus mykiss gairdneri</i> , in an Intermittent Southern Idaho Stream	Sarah Walsh
9:20 - 9:35	Are They Recovered Yet? Swimming Performance of Fish Following Anesthesia with Eugenol	Robert Bringolf
9:35 - 9:50	Evaluating Behavioral and Physiological Responses of Triploid Grass Carp Consuming Aquatic Vegetation Colonized by Toxic <i>Aetokthonos hydrillicola</i>	Austin Haney
9:50 - 10:05	Investigating Potential Risks of Utilizing Triploid Grass Carp (<i>Ctenopharyngodon idella</i>) for Hydrilla Management at VM Sites	Frank Braun
10:05 - 10:20	Occupancy Modeling of eDNA From an Endangered Darter in Turbid Rivers	Garret Strickland
10:20 - 10:35	BREAK	
10:35 - 10:40	Session 3: (continued)	
10:40 - 10:55	Atlantic and Shortnose Sturgeon Recruitment in the Savannah River, Georgia	Alexander Cummins
10:55 - 11:10	Over Winter Survival and Habitat Use of Gulf Sturgeon in the Apalachicola River, FL	Nathaniel Hancock
11:10 - 11:25	Using Cohort Age Analysis to Understand Spawning Patterns in Atlantic Sturgeon	Hudman Evans
11:25 - 11:40	The Status of Atlantic Sturgeon in the Satilla, St. Marys and St. Johns Rivers	Adam Fox
11:40 - 11:55	Temporal Trends in Abundance and Habitat Preferences of Deep Reef Fish off the Coast of South Carolina, U.S.A.	Sean Yeckley
11:55 - 1:30	LUNCH (On Your Own)	
1:30 - 1:35	Session 4: Professional Presentations (Marine)	
1:35 - 1:50	An Increase in Spotted Seatrout Minimum Length: A Proactive Approach	Ryan Harrell
1:50 - 2:05	Georgia's Trip Ticket Program: the Need, the Challenges, and the Big Picture	Julie Califf
2:05 - 2:20	The Emergence of Georgia's Cannonball Jellyfish Fishery: <i>Someone Actually Eats Those Things?</i>	Patrick Geer
2:20 - 2:35	The State of the Fleet: Georgia's Fishermen	Jennifer Sweeney Tookes
2:35 - 2:50	BREAK	



2:50 - 2:55	Session 4: (continued)	
2:55 - 3:10	A Collaborative Approach to Investigate Black Gill in Georgia and South Carolina's Commercial Shrimp Fishery	Bryan Fluech
3:10 - 3:25	Is Shrimp Black Gill Killing Shrimp?	Marc Frischer
3:25 - 3:40	Georgia's Coastal Telemetry Array	Chris Kalinowsky
3:40 - 3:55	A Blueprint for Oyster Aquaculture in Georgia	Mark Risse
3:55 - 4:15	BREAK	
4:15 - 5:00	GA-AFS Business Meeting	
6:00 - 8:00	BANQUET AND ANNUAL RAFFLE	

Thursday, January 26, 2017		
9:00 - 9:05	Session 5: Professional Presentations (Freshwater)	
9:05 - 9:20	Daily Age Estimation Reveals Extreme Growth of Young-of-Year Alligator Gar in the Wild	Peter Sakaris
9:20 - 9:35	Precision and Accuracy of Age Estimates Obtained from Anal Fin Spines, Dorsal Fin Spines, and Sagittal Otoliths for Known-Age Largemouth Bass	Tim Bonvechio
9:35 - 9:50	Rearing Temperature Produces Both Short-term and Long-term Energetic Impacts in Lake Sturgeon (<i>Acipenser fulvescens</i>)	Janet Genz
9:50 - 10:05	Using Cryopreservation of Robust Redhorse and Sicklefin Redhorse Sperm as a Conservation Tool for Restoration	Jaclyn Zelko
10:05 - 10:20	BREAK	
10:20 - 10:25	Session 5: continued	
10:25 - 10:40	A Comparison of Fish Communities in Savannah River Oxbow Lakes	Jason Moak
10:40 - 10:55	Effect of Flow Variation on Hatch-date Distributions and Daily Incremental Growth of Juvenile Black Bass in Two Southeastern USA Rivers	Steve Sammons
10:55 - 11:10	Analysis of Glutathione Redox State as Indicator of Environmental Stress in Ogeechee River Redbreast Sunfish (<i>Lepomis auritus</i>)	Johanne Lewis
11:10 - 11:25	Use of Partial Lifecycle Tests to Determine Effects of Nitrate and an Estrogen on Fatmucket (<i>Lampsilis siliquoidea</i>)	Robert Bringolf
11:25 - 11:35	CLOSING COMMENTS	
ADJOURN		



ORAL PRESENTATION ABSTRACTS

PROFESSIONAL

Go Fish Education Center Happenings

Michael Fulghum, GADNR, Wildlife Resources Division, Go Fish Georgia Education Center, Perry, GA

The Go Fish Education Center is the centerpiece of the Go Fish Initiative, which is designed to promote boating and fishing tourism throughout the state. The center's attractions include 200,000 gallons of freshwater aquariums, a fish hatchery which produces 9 different species of fish, interactive fishing and hunting simulators, and a stocked fishing pond. The Go Fish Education Center has become an education destination for central Georgia. Thousands of children from public and private schools, homeschools, day cares, day camps, and various non-profit organizations visit the center each year. Each field trip program contains curriculum that supports classroom learning and is based on the Georgia Performance Standards, however, we also offer tailored programs at the request of the teacher. In addition to educating Georgia's youth, the center also sees an average of 20,000 public visitors per year. Over the past six years the center has grown to accommodate events and meetings as well. The Go Fish Education Center is a hidden gem in central Georgia.



An Overview and Update of Georgia's State Fish Hatchery System

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Chris Harper, Georgia Department of Natural Resources, 110 Hatchery Drive, Richmond Hill, Georgia 31324. Phone 912-459-1164

The Georgia Department of Natural Resources State Fish Hatchery system consists of seven warm water hatcheries and three trout hatcheries. These facilities produce and stock more than ten million fish in public waters each year to improve existing fishing opportunities and create new opportunities, manage fish populations, and provide fish for species conservation and restoration purposes. Six facilities are primarily open pond aquaculture systems, while the trout hatcheries are primarily flow-through raceway systems and the Go Fish Center is a recirculating system hatchery. Eight of the ten hatcheries are more than fifty years old and only one is less than forty years old. Two have recently been renovated and seven are candidates for varying levels of renovation. The primary species produced are Rainbow Trout, Brown Trout, Striped Bass, Hybrid White x Striped Bass, Walleye, Largemouth Bass, Bluegill, Redear Sunfish, Channel Catfish, Lake Sturgeon, American Shad, and Shoal Bass. In addition to fish production and stocking, the hatcheries provide significant educational and outreach services and opportunities. Dozens of school tours, kids fishing events, and field trips are hosted on the hatcheries each year. This presentation will provide an overview and update of hatchery operations and production, renovation activities and plans, and outreach and education activities.



Georgia's Scientific Collection Permits: New Spins on an Old Process

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Wayne Hubbard, GADNR Law Enforcement Division, 2070 US Hwy 278 S.E., Social Circle, GA 30025

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Spud Woodward, One Conservation Way, Brunswick, GA 31520

As outlined in O.C.G.A 27-2-12, scientific collection permits are issued to individuals to allow for lawful collection of wildlife for scientific purposes. Although a general application review occurs at the State level, meeting the requirements of the state issued scientific collection permit may not be enough to be consistent with federal regulations. If a project is federally funded, the funding agency is required under Section 7 of the Endangered Species Act (ESA) to consult with the US Fish and Wildlife Service or the National Marine Fisheries Service to ensure activities do not impact any listed species or critical habitat. For projects funded by other sources additional consultation may be needed to ensure compliance with ESA and the National Environmental Policy Act (NEPA). In marine environs, additional consultations may also be needed for interactions with marine mammals, and federally managed species of particular concern. Many times, letters of authorization (LOAs) or Exempted Fishing Permits (EFPs) are written to address interactions with those species. The purpose of this presentation is to discuss the current process for issuing permits and to provide suggestions for improving the process.



Angler Recruitment, Retention and Reactivation (R3) and License Sales: Stories of Success

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The Recreational Boating and Fishing Foundation (RBFF) has introduced a 60 in 60 initiative to achieve the mark of 60 million licensed anglers in 60 months, nationwide. At present, there are approximately 124 million people in the U.S. who participate in angling, while only 45 million hold a fishing license. Georgia and RBFF have been integral partners in the development and testing of strategies to increase angler recruitment, retention and reactivation, with the Georgia Department of Natural Resources (GADNR) focusing its efforts on angler retention. The tools and strategies evaluated range from auto-renew to simplified license packages to targeted communications and others. This presentation covers results of studies that have shown these communications strategies to be effective and measures return on investment (actual \$\$\$) relative to the effort put forth. Strategies and results are being developed in to media kits for use by other state agencies and stake holders help achieve RBFF's nationwide 60 in 60 goal.



ORAL PRESENTATION ABSTRACTS

SESSION 2: STUDENTS

Life History of the Creek Chub in an Urban Stream

Ashley E. Fredricks, Georgia Gwinnett College, School of Science and Technology, Lawrenceville, GA 30043; E-mail: afredricks@ggc.edu

Peter C. Sakaris, Georgia Gwinnett College, School of Science and Technology, Lawrenceville, GA 30043

The creek chub is a highly resilient fish species that commonly occurs at high densities in urban systems; however, limited information exists regarding their life history characteristics. Our goal was to assess the population characteristics of the creek chub from an urban tributary of the Chattahoochee River. In Fall 2014 and Fall 2016, 76 creek chubs were collected from Rottenwood Creek for age and growth analyses. Creek chubs were weighed (g) and measured (mm TL), and lapillar otoliths were extracted from each fish. Otolith sections were read by two experienced readers, and any disagreements in age were reconciled by a concert read. For any disagreements that were not resolved, the second lapillus was processed. In Fall 2016, we also conducted standardized sampling of the creek chub population along two transects in Rottenwood Creek. All sampled fish were weighed and measured. Population densities were 2.1 creek chubs per 10 m of habitat along transect 1 and 11.0 creek chubs per 10 m along transect 2. Catch-Per-Unit-of-Effort was 1.5 creek chubs per shocking minute along transect 1 and 5.0 creek chubs per minute along transect 2. During Fall 2016 sampling, creek chub total lengths ranged from 39 to 129 mm TL, with a strong recruitment class of age-0 fish present in the population. Creek chubs did not exhibit great longevity (max age = 4 years), with an annual survival rate of approximately 43%. Creek chubs grew to mean lengths of 90, 109, and 131 mm at ages 1, 2, and 3, respectively. Maximum total length in the age and growth sample was 140 mm TL. We hope that this study will provide insight on the life history adaptations of the creek chub in urban environments. Future research will explore potential growth differences between sexes, as well as age at maturity and fecundity.



Comparison of Green Sunfish and Redbreast Sunfish Population Characteristics in an Urban Stream

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Peter C. Sakaris, Georgia Gwinnett College, School of Science and Technology, Lawrenceville, GA 30043

We aimed to compare the population characteristics of redbreast sunfish and green sunfish in an urban tributary of the Yellow River, near Georgia Gwinnett College. Standardized electrofisher sampling of the sunfish assemblage was conducted seasonally. All sunfishes were weighed (g) and measured (mm TL), and subsamples of fish were collected for age and growth analyses. Otoliths were removed from fish collected from the field, and final age assignments were conducted. In Spring 2016, redbreast sunfish lengths ranged from 26 to 163 mm TL, while green sunfish lengths ranged from 36 to 157 mm TL. Both redbreast sunfish and green sunfish showed a strong recruitment class in Spring 2016. In Summer 2016, redbreast sunfish lengths ranged from 43 to 158 mm TL, while green sunfish lengths ranged from 43 to 142 mm TL. In Fall 2016, redbreast sunfish ranged from 31 to 161 mm TL, while green sunfish ranged from 48 to 106 mm TL. A strong redbreast sunfish recruitment class was detected in Fall 2016, but very few age-0 green sunfish were observed in the Fall sample. In all three seasons, redbreast had a greater proportion of longer fish compared to green sunfish, and redbreast sunfish dominated the sunfish assemblage (52-73%), with significantly fewer green sunfish (12-40%) collected. Ages of redbreast ranged from 0 to 7 years, while green sunfish ages ranged from 1 to 7 years. However, redbreast sunfish exhibited slightly greater longevity, with a greater proportion of 6-yr olds in the sample. Redbreast sunfish grew significantly faster than green sunfish. Mean lengths at ages 3 and 4 were 107 and 128 mm TL for redbreast sunfish and 98 and 102 mm TL for green sunfish. Survival was very similar between the species (annual survival: 55 – 57%). Future analyses will include seasonal survival and condition comparisons.



Spawning behavior and Habitat use of Shoal Bass in two non-navigable Chattahoochee River tributaries

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Steve Sammons, School of Fisheries, Aquaculture, and Aquatic Sciences, 203 Swingle Hall, Auburn University, AL 38849

Officially described as a species in 1999, little is known about Shoal Bass biology. Their native range is limited to the Appalachicola-Chattahoochee-Flint River system, and native populations are threatened due to land-use changes, dam implementation, and introduced species. Dams prevent upstream passage and completion of their migratory spawning life stage. Introduced Spotted Bass compete with Shoal Bass for habitat resources. As habitat specialists, rocky shoal substrate used for spawning as well as maintaining the larval nursery is crucial, yet it's a relatively understudied component.

This study occurs within Flat Shoals Creek and Mulberry Creek, two tributaries of the Chattahoochee River in Georgia, where viable, native populations remain. We're using radio telemetry to determine movement patterns and document spawning and nesting behavior for two consecutive years. 20 individuals from each creek are tagged, and tributaries are tracked every two weeks. 15 additional males will be tagged in Flat Shoals Creek and will be tracked every 3-5 days to document nest selection and associated habitat variables. Abundance, daily growth, and hatch-date frequency will be investigated by collecting 50 age-0 fish each July. We hope to use the results to implement effective conservation and management practices as part of the Native Black Bass Initiative (NBBI).



Intersex in Blackbanded and Turquoise Darters in Athens, GA

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Robert Bringolf, Warnell School of Forest and Natural Resources, Athens, GA 30606

Intersex in fish is a research topic that has received increasing amounts of attention in the recent years. It is believed to be caused by endocrine disrupting compounds in waterways (Bahamonde et al. 2013). Many of these endocrine disrupting compounds are natural or synthetic forms of estrogenic chemicals that can cause exposed males to develop female characteristic, such as the production of eggs in their testes in severe cases. The objective for this study is to evaluate the effects of an upgraded waste water treatment facility (WWTF) in Athens, Ga on darter species. In previous studies on darters, populations below WWTF have been found to have upwards to 85% of males contained testicular oocytes. In addition to determining the effects of the WWTF on darter populations, work was also done on analyzing distributions of the oocytes inside of the gonads. Little work has been done in seeing if there is a tendency for the oocytes to fall in a specific area, or if they are randomly distributed across the gonads. Using Arcgis, histological slides were digitized with testicular oocytes measured out to the nearest feature. In doing so we developed a new technique for analyzing testicular oocytes and indicated a slight relationship for oocytes to be located closer to the perimeter than to the midline of the gonad.



Metabolic Profiles of Wild Intersex Largemouth Bass: Toward Development of a Non-lethal Biomarker

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Intersex among freshwater teleost fish has been increasingly reported in rivers and impoundments across the US and around the world. Factors associated with development of testicular oocytes in phenotypic males are most commonly linked to endocrine disruption via exposure to environmental estrogens. Reduced sperm fertility and motility reported in intersex fish provide evidence for association with population level effects, yet very little is known about alterations of physiological pathways in intersex fish. Current methods to positively identify intersex fish are lethal, requiring sacrifice of large numbers of wild fish; however, recent advances in technology allow for the simultaneous examination of hundreds of endogenous metabolites in body tissues, including some that can be collected non-lethally (e.g. blood, mucus). Identification of unique metabolic profiles in intersex fish may aid in identification of key cellular pathways and lead to development of biomarkers in intersex fish. We investigated metabolic profiles of 39 phenotypic male largemouth bass with testicular oocyte counts ranging from 0 – 164 (per longitudinal histological section) from an impoundment in the Piedmont region of Georgia. The relative abundance of several metabolites from the liver, gonad, mucus, and blood plasma was significantly ($p < 0.05$) correlated with the number of oocytes detected in testicular tissues, lending insight to the mechanisms of intersex induction in these fish, and showing promise for the development of a non-lethal biomarker approach. Development of non-lethal biomarkers could greatly enhance our ability to sample larger numbers of wild fish and allow for repeated sampling of individuals, increasing our understanding of biochemical mechanisms, spatial and temporal trends, causative factors and adverse effects of the condition on an individual and population level.



The Effects of Habitat Improvement Structures on the Condition and Abundance of Eastern Brook Trout in Streams of the Chattahoochee National Forest

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Starting in 2009 habitat improvement structures were added to 11 north Georgia brook trout (*Salvelinus fontinalis*) streams in the Chattahoochee National Forest to see if trout abundance and condition could be improved. Brook trout populations and habitat were assessed prior to construction of structures, and reassessed yearly for 5 years post construction. Structures were modeled after Seehorn structures for restoring small headwater streams. A minimum of 8 structures were placed in a 100 meter treatment area, and a 100 meter buffer was left between 100 meter control areas up stream. A significant change in LWD was found in treatment sections post construction by 29.7 ± 3.74 , p-value $1.36e-12$. No significant change was found in pool volume. Treatment had a statistically significant, but biologically irrelevant effect on relative condition in adult brook trout -0.014 ± 0.01 , p-value $2e-16$. Adult total biomass increased overall sites $98g \pm 36$, p-value 0.012. Adult abundance was significantly higher in treatment areas by 3.9 ± 1.2 , p-value 0.0012. YOY abundance in treatment sites was also found to be significantly higher 3.06 ± 2 , p-value 0.0006, however this was largely driven by a few sites and maybe skewed. Over all creeks, structures showed to be beneficial for management. Although relative condition was not affected, the increase in mass and abundance shows positive results for future management actions.



Evaluation of Factors Influencing Spotted Bass Use of Introduced Structures in a Georgia Highland Reservoir

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Johnathan G. Davis, Young Harris College, 1 College Street, Young Harris, GA

As reservoirs age, habitat degradation occurs, resulting in reduced habitat to support reservoir fisheries. Chatuge Reservoir in western North Carolina and northern Georgia is 74 years old and experiencing significant habitat degradation. However, anglers purposely introduce various structures to improve available habitat and attract fish for angling. We tested the utility of various installed structures present in Chatuge Reservoir as suitable habitat for spotted bass and identified specific factors of these structures that best attract spotted bass. Using an underwater camera system, abundance of spotted bass from video recordings (SBAV) was quantified from 40 installed structures in Lake Chatuge from July – August 2016. We observed higher spotted bass abundance at structures with vegetation present, young of year present, increasing height, horizontal structural orientation and forage species absent. Structure orientation ($P=0.075$) and vegetation present ($P=0.094$) were significantly related to spotted bass abundance. Horizontal structures and structures with vegetation present contained approximately two more bass per structure on average. As surface water temperature increased ($P=0.079$) and distance to nearest bank increased ($P=0.049$) spotted bass counts were predicted to increase as well. Although structures may concentrate catchable size bass and increase angling susceptibility and fishing mortality, many sampled structures supported young-of-year bass, and thus, may improve young-of-year survival and recruitment. These findings provide guidance for biologists and anglers seeking to increase available habitat to support productive spotted bass fisheries in clear highland reservoirs similar to Chatuge Reservoir.



Influences of local and regional environmental factors on Atlantic coastal plain stream fish communities

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James H. Roberts, Department of Biological Sciences, PO Box 8042, Georgia Southern University, Statesboro, GA 30458

Atlantic coastal plain (ACP) streams are complex and unique ecosystems that support a diversity of fishes and other organisms, yet the environmental features that regulate fish assemblage structure are poorly understood in these systems. Based on limited previous studies, we hypothesized that (1) ACP fish assemblages would be more influenced by local than regional habitat conditions, (2) at the regional scale, historical biogeographic factors such as basin, physiography, and stream size would be more influential than contemporary factors such as anthropogenic land use, and (3) regardless of habitat conditions, fish assemblage variation would be greater among mainstem than headwater sites. We addressed these hypotheses using preliminary univariate and multivariate analyses of fish-assemblage, local-habitat, and land-use data collected in summer 2016 from paired sites (headwater vs. mainstem) in 13 wadeable ACP streams in the Ogeechee, Savannah, and Altamaha river basins. We captured over 4200 individual fish, of 49 different species. The four most commonly occurring and numerically abundant species were Redbreast, Pirate perch, Redfin pickerel, and Bluegill; these species made up 52% of all individuals collected. Richness varied among sites from 6 to 25 species, and appeared to be influenced by a combination of landscape (stream size, physiography, and land use), and local factors (large woody debris and dissolved oxygen). As hypothesized, headwater sites exhibited greater assemblage similarity than mainstem sites, regardless of basin boundaries. However, neither local nor landscape features predominantly drove assemblage variation, much of which was unexplained by measured variables. We discuss possible mechanisms for these patterns and avenues for further study.



ORAL PRESENTATION ABSTRACTS



SESSION 3: STUDENTS

Distribution and movement of Columbia River redband trout, *Oncorhynchus mykiss gairdneri*, in an intermittent southern Idaho stream

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The Columbia River redband trout (*Oncorhynchus mykiss gairdneri*) is native to the Columbia River Basin east of the Cascades. The genetic structure of many redband trout populations in this region has been negatively affected by introgression with hatchery stocks and by isolation due to migration barriers. The objective of our research was to describe trout distribution, movement patterns, and evaluate the potential effects of a road culvert on trout movement in Dry Creek, a tributary of the Boise River, characterized by seasonal fluctuations in temperature and flow. From 2012-2015, stream reaches throughout the watershed were surveyed for redband trout. Fish were collected via electrofishing, PIT-tagged, and fin clipped. Genetic analyses of 617 individual fin clips were carried out at the Idaho Department of Fish and Game (IDFG), Fish Genetics Laboratory in Eagle, Idaho. Each fish was genotyped at 186 single nucleotide polymorphisms (SNPs). Genetic analyses using the program Colony identified 40 trout families (defined as three or more full-siblings). Mean distance of trout within families was 1545-m, indicating significant dispersal of individual trout. Most families (75%) were located above the culvert while only five families were found entirely below the culvert. While no PIT tagged fish crossed the culvert, full siblings from five families were observed on opposite sides of the culvert. One family of young of year fish was found below the culvert—providing new evidence that lower reaches of Dry Creek are used for spawning. The continued monitoring of this population will assist efforts to design an effective watershed management plan.



Are they recovered yet? Swimming performance of fish following anesthesia with eugenol

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Fisheries professionals use anesthetics to immobilize fish, reduce stress during handling and hauling, and reduce risk of injury to the fish and handler. A variety of anesthetics have been used for nonfood fish but currently only two, MS-222 (tricaine methanesulfonate) and Aqui-S (eugenol), are FDA approved for fish that may be consumed by humans. Aqui-S is currently the only anesthetic approved for use with no withdrawal time prior to release for potential harvest by anglers. Following anesthesia, rapid recovery is desirable but 'recovery' is loosely defined and often refers only to restoration of equilibrium and tactile response. Fish that are released but have not fully recovered may have limited swimming performance and thus may be more susceptible to predation, competition and other challenges. Therefore, our objective was to assess swimming performance of fish following anesthesia with Aqui-S. We anesthetized seven individuals of each of three species, Largemouth Bass (*Micropterus salmoides*), Rainbow Trout (*Oncorhynchus mykiss*), and Nile Tilapia (*Oreochromis niloticus*), with the recommended dosage of AQUIS. Upon reaching stage three anesthesia (loss of equilibrium and unresponsive to tactile stimulus), the fish were placed in well-aerated clean water for recovery. Three minutes after all seven individuals regained equilibrium, the first individual was placed in a Brett-type swim tunnel to determine critical swimming speed (Ucrit). Each additional fish was tested in subsequent 10 minute intervals. Each species trial was replicated three times and mean Ucrit for each recovery time point was compared across the time intervals. Trout recovered rapidly and after 3 min Ucrit was not significantly different from anaesthetized controls. However, tilapia and Largemouth Bass generally required 40-60 minutes of recovery for Ucrit to reach levels similar to controls. These results indicate that following anesthesia, extended holding times may be necessary for full recovery of some fish species.



Evaluating Behavioral and Physiological Responses of Triploid Grass Carp Consuming Aquatic Vegetation Colonized by Toxic *Aetokthonos hydrillicola*

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Avian vacuolar myelinopathy (AVM) is a novel neurological disease that affects waterbirds, avian predators, amphibians, reptiles, and fish. AVM has been linked to a toxin-producing cyanobacterium, *Aetokthonos hydrillicola* (*Ah*), which grows on submerged aquatic vegetation. Triploid Grass Carp are stocked in reservoirs and ponds as biological controls of invasive aquatic vegetation such as *Hydrilla verticillata*. We investigated the possibility of sublethal effects and physiological behavioral changes in Grass Carp arising from consumption of hydrilla with toxic epiphytes. Our primary question was to determine what effect *Ah* consumption has on the swimming performance and behavioral response of Grass Carp. Grass Carp consuming *Ah* positive hydrilla declined significantly in swimming performance after 14 days of feeding. Furthermore, fish consuming the *Ah* positive hydrilla experienced impairment and mortality that was absent in the other two treatment groups (control pellet and *Ah* negative hydrilla). More research is needed to further evaluate risks of stocking Grass Carp into known-AVM lakes.



Investigating Potential Risks of Utilizing Triploid Grass Carp (*Ctenopharyngodon idella*) for Hydrilla Management at VM Sites

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Triploid Grass Carp (*Ctenopharyngodon idella*) are a common management tool for removal of invasive hydrilla (*Hydrilla verticillata*). Some hydrilla management sites have now been identified to contain a novel epiphytic cyanobacterium named *Aetokthonos hydrillicola*. The primary host for *Aetokthonos hydrillicola* is hydrilla. Toxins produced by this cyanobacterium have been found to be the cause of vacuolar myelinopathy (VM)—a neurologic disease caused by open spaces in myelinated areas of the central nervous system. The purpose of this study was to investigate potential risks of utilizing triploid grass carp for hydrilla management at VM sites. Triploid grass carp were fed toxic and non-toxic hydrilla material to determine if toxicity could be experimentally detected within fish tissue. Bodies and digestive tracts from fish that consumed hydrilla material were processed to extract any present toxic material. A 7-day static renewal bioassay was conducted using *Ceriodaphnia dubia* to quantify toxicity in each extract (body and digestive tract). Histology was also conducted on all individuals, and vacuoles were found in extreme abundance on the optical lobe of fish that consumed toxic hydrilla. A significant difference was found between digestive tract and body tissue toxicity, where digestive tract tissue was found to be significantly more toxic. Through this study, triploid grass carp were identified as a potential risk for bioaccumulation of *Aetokthonos hydrillicola* toxin at VM sites.



Occupancy modeling of eDNA from an endangered darter in turbid rivers

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Many imperiled freshwater organisms are difficult to detect, and potentially negatively affected, by traditional sampling techniques. The environmental DNA (eDNA) approach to aquatic species surveys promises low invasiveness and high detection rates, but the robustness of this technique to large stream-size, persistent turbidity, and a rich, closely-related fauna have been poorly investigated. We developed an eDNA monitoring protocol for endangered Roanoke logperch (*Percina rex*), a darter endemic to the darter-rich Roanoke, Dan, and Nottoway basins. Detection and occupancy rates of eDNA, and their sensitivity to biotic and abiotic covariates, were estimated in an occupancy model framework. Our quantitative PCR (qPCR) assay reliably amplified Roanoke logperch DNA, but not the DNA of co-occurring taxa, and water samples from four presumed-unoccupied rivers were always negative for eDNA. In contrast, Roanoke logperch eDNA was detected at 11 of 12 sites (in 53 of 96 water samples) in rivers presumed occupied by the species. These sites spanned a wide range of stream-sizes, physiographies, water chemistries, and turbidities (mean 8 NTU; range 1-16 NTU), but none of these factors appreciably influenced eDNA detection. Rather, based on occupancy models, eDNA detection and occupancy rates were strongly influenced by Roanoke logperch density at the site, estimated from previous electrofishing surveys. Our estimated detection probability per water sample ranged from 0.55 to 0.82 among sites. Based on these estimates and the collection of eight water samples per site, the false-negative probability (i.e., failing to detect Roanoke logperch when it occurs) was less than 0.003, an efficiency unrivaled by traditional sampling techniques. The reliability and ease of implementation of this technique should allow for rapid surveys of Roanoke logperch presence/absence, a prerequisite for informed management decisions. We therefore recommend eDNA as a useful tool to monitor the distribution of this and potentially other cryptic aquatic species.



Atlantic and Shortnose Sturgeon recruitment in the Savannah River, Georgia

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Atlantic and Shortnose Sturgeon were once abundant along the Atlantic Coast of North America; however, overfishing and habitat loss have resulted in major population declines and both species are now listed under the US Endangered Species Act. Quantified recruitment data are desperately needed to evaluate species recovery for many populations of both species, particularly in the Southeastern US. The objective of this study was to quantify annual recruitment of both Atlantic and Shortnose Sturgeon in the Savannah River, Georgia, by estimating annual abundances of age-1 juveniles over a 4-year period. During the summers of 2013–2016, we used entanglement gears to sample juveniles of both species throughout the Savannah River estuary. Ages of captured juveniles were determined using length-frequency histograms that were verified with fin ray cross sections from a subsample of the captured fish. Annual abundances were then estimated with Huggins closed-capture models in RMark. Our results showed that the Savannah River contained 528 age-1 Atlantic Sturgeon in 2013, 616 in 2014, 623 in 2015, and 924 in 2016. Over this same period we estimated annual cohorts of age-1 Shortnose Sturgeon to be 81 in 2013, 270 in 2014, 245 in 2015, and 28 in 2016. These findings suggest the Savannah River populations of both species are likely the 2nd largest within the Southern Atlantic. Future estimates of annual recruitment for both species will provide quantified information regarding population trends as well as helping to identify key environmental variables affecting recruitment in the Savannah River system.



Over Winter Survival and Habitat Use of Gulf Sturgeon in the Apalachicola River, FL

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The Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) is listed as threatened due to the impact of chronic overfishing and habitat degradation that occurred throughout the 20th century. Although recent studies have provided important information about critical habitats in natal rivers, marine habitat use in the Gulf of Mexico are poorly characterized. The objectives of this study were to define marine habitat use and to quantify overwinter survival of age-1 Gulf Sturgeon in the Apalachicola drainage. During the summers of 2014 and 2015, we captured and tagged 10 age-1 juveniles with sonic transmitters and monitored their seasonal movements using a passive acoustic receiver array deployed throughout the Apalachicola Bay and Estuary. These juveniles out-migrated to the Apalachicola Bay during September and November once water temperatures had dropped below 25°C. Acoustic detections of tagged fish obtained during their return migration in spring, combined with annual recaptures of tagged juveniles revealed that overwinter survival was 89 and 78% in each respective year. Telemetry data also revealed that a variety of migration routes were used by young juveniles, including the mainstem Apalachicola River, two tributaries, and the Intracoastal Waterway. These findings suggest that seasonal patterns of juvenile migration and overwinter habitat use are relatively consistent among years and likely mediated by seasonal changes in environmental conditions. Future studies are needed to better understand the critical linkages between overwinter habitat use and juvenile survival within the Apalachicola population.



Using Cohort Age Analysis to Understand Spawning Patterns in Atlantic Sturgeon

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is an anadromous fish that historically occurred along the Atlantic coast of North America from maritime Canada to northern Florida. The species experienced major population declines during the 20th century, resulting in its listing under the Endangered Species Act in 2012. Although assessment of annual spawning runs is essential to evaluating species recovery, the timing of spawning is still unknown for many populations. Recent telemetry studies suggest that dual spawning runs may occur in at least some rivers, and some researchers have suggested that bimodal length-frequency distributions in juvenile populations provide corroborating evidence of dual spawning. Unfortunately, age analyses of juveniles are largely lacking so interpretation of length-frequency data of juvenile cohorts is ambiguous. The objective of this study was to determine the length-at-age relationship of co-occurring juvenile cohorts of Atlantic Sturgeon within the South Atlantic distinct population segment. During the summers of 2015 and 2016, we sampled juvenile Atlantic sturgeon in the Ogeechee Georgia, where previous studies had documented a bimodal distribution in the juvenile population of Atlantic Sturgeon. Over the two summers of sampling, we captured a total of 126 juveniles within a total length range of 210 to 432 mm. Cross-sections of pectoral fin rays obtained from a random subsample of 44 juveniles were examined to estimate the age of each of individual based on the number of annuli present. Results indicated that all juveniles within the smallest mode of the length-frequency distribution (<325 mm TL) had zero annuli, while those >325 mm had a single, discernable growth ring. Comparisons of these data with similar length-frequency data from other South Atlantic rivers suggest that only one annual spawning run occurs within the South Atlantic DPS.



The Status of Atlantic Sturgeon in the Satilla, St. Marys and St. Johns Rivers

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is an anadromous species that historically occurred along the North American Atlantic coast from maritime Canada to the St. Johns River, Florida. The species has experienced major population declines due to overharvest and dam construction, and was listed under the Endangered Species act in 2012. Although several populations in the central and northern parts of the range appear to be stable or increase, the status of southern populations is much less certain. The objective of this study was to assess the status of the southernmost Atlantic Sturgeon populations in the Satilla, St. Marys and St. Johns Rivers. Our approach to this assessment was twofold: first, we sampled for river resident juvenile sturgeon (an indication of successful recruitment) in the estuary of each river, and second, we used an array of acoustic receivers to detect seasonal use of each estuary by Atlantic Sturgeon migrants from other river systems. Sampling with entanglement gears was conducted in the Satilla River in summer 2014-2016, the St. Marys in 2013-2016, and the St. Johns during the summers of 2014 and 2015. Our receivers array was active in all rivers from 2014-2016. Our results suggest that remnant Atlantic Sturgeon populations persist in the Satilla and St. Marys Rivers, but we could find no evidence of an extant population in the St. Johns River. The telemetry component of this study indicates that all three rivers are frequently visited by migrating Atlantic Sturgeon during the non-spawning periods.



Temporal trends in abundance and habitat preferences of deep reef fish off the coast of South Carolina, U.S.A.

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ROV and submersible video footage recorded in 1985, 2002, and 2010 from hard bottom habitat located NE of Charleston, SC in depths ranging from 175 – 300 m were reviewed to assess temporal trends in demersal fish abundance and bottom habitat preferences for key species. The main purpose of this long-term assessment of deep reef fish abundance and bottom habitat associations was to determine if deep reef fish populations have recovered since the development and implementation of the snapper/grouper fishery management plan (1983) and its various amendments. Snowy Grouper *Hyporthodus niveatus* preferred low relief hard bottom (< 1 m in vertical rise) where they were found at the highest density of 10 fish per 1000 m³. Blueline Tilefish *Caulolatilus microps* were found in the highest densities over mixed hard/soft bottom and low relief hard bottom. Yellowfin Bass *Anthias nicholsi* density increased above high relief habitat but decreased over low relief hard bottom. The major finding of the study was that Snowy Grouper and Blueline Tilefish were found in higher densities above low relief hard bottom areas than over high relief hard bottom. Snowy Grouper were observed to inhabit low relief hard bottom regions in significantly higher densities (10 fish/1000 m³) than over high relief hard bottom regions (3 fish/1000 m³) ($p = .0001$). Blueline Tilefish were found in the highest densities within low relief areas (5 fish/1000 m³) and mixed hard/soft bottom regions (4 fish/1000m³). Abundance of Snowy Grouper and Blueline Tilefish have both increased from 1985 to 2010 predominantly within low relief bottom regions where they have significantly lowered prey populations of Yellowfin Bass and restored a balanced deep reef ecosystem.



ORAL PRESENTATION ABSTRACTS

SESSION 4: PROFESSIONAL (Marine)

An increase in Spotted Seatrout minimum length: A proactive approach

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Spotted seatrout, *Cynoscion nebulosus*, is one of Georgia's most frequently harvested marine sportfish. The popularity of the species stems from its tenacious fight when hooked, superb quality as table fare, and accessibility to anglers fishing from shore and boat. However, this popularity makes the species vulnerable to overharvest. In 2012, the Finfish Advisory Panel (FAP) was created to advise GA DNR on saltwater finfish management. Membership includes a commercial fisherman, saltwater fishing guides and anglers from throughout the coastal area with representation from inland areas, as well. The FAP members met with DNR staff several times over three years learning about the biology, population trends, and management goals for spotted seatrout as well as other marine sportfish. During these discussions, DNR informed the FAP members of benefits of increasing the minimum size limit from 13 inches to 14 inches total length. These benefits include greater egg production in female trout, larger quality trout in the population, and more resiliency of the seatrout population to the effects of periodic environmental extremes such as abnormally cold winters. In 2015, a majority of the FAP members concurred with the DNR staff recommendation to increase the minimum size limit for spotted seatrout. At its October 2015 meeting, after considering public comment provided through two public hearings and email, the Board of Natural Resources unanimously approved the increase of the minimum-size regulation for spotted seatrout from 13 inches to 14 inches total length with an effective date of January 1, 2016.



Georgia's Trip Ticket Program: the Need, the Challenges, and the Big Picture

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One of the keys to successful fishery management is the availability of reliable landings data. Since 1989, Georgia has collected these data to support management of federal and state species in accordance with State laws and the Magnuson-Stevens Act. The types of data collected and methodology have evolved as coastal states, the federal government, and regional fishery management councils have implemented data integration strategies. As the availability and quality of data have improved, inconsistent regulations, conflicting authorities, lack of funding, and ever-changing technology have all placed unique pressures on the program.



The Emergence of Georgia's Cannonball Jellyfish Fishery: *Someone actually eats those things?*

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Jellyfish products are considered a delicacy in many Asian cultures and appear in numerous forms and dishes. The demand is such that it's become profitable for local shrimp trawlers to modify their nets to harvest cannonball jellyfish (*Stomolophus meleagris*) which are processed and shipped directly to Japan, China, and Korea. The development of this fishery in Georgia began in the late 1990's, proved successful as an experimental fishery during the 2000's, and was designated a bona fide state fishery in 2012. The growth of this fishery has not gone without some concerns along the way. Questions over bycatch, impacts related to trophic interactions with sea turtles, gear regulations, and processing effluent have all been discussed. However, with the cooperation of fishers, dealers, processors, and the Department of Natural Resources, this fishery has grown to be one of the State's top three in total landings, and provides additional opportunity and income for shrimp trawlers when that season is closed. At the same time, research and monitoring of cannonballs has and continues to be conducted to address concerns that have been raised in this unique and flourishing fishery.



The State of the Fleet: Georgia's Fishermen

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The commercial fishing fleet in Georgia is shrinking, and there are few novice fishermen entering the field. Ethnographic data from a Georgia Sea Grant-funded project (2014-2016) indicates that the human composition of the commercial fishing fleet in Georgia is fragmented and troubled. Their current socioeconomic stability is threatened by interrelated issues ranging from socioeconomic obstacles to boat maintenance to the combined problems of an unreliable workforce and the imminent “greying of the fleet.” This paper addresses the historical and economic issues that have led to the current state of the fleet, and the contemporary difficulties that commercial fishermen face in Georgia.



A Collaborative Approach to Investigate Black Gill in Georgia and South Carolina's Commercial Shrimp Fishery

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Despite declines in catch and effort to the industry in recent decades, shrimp remains Georgia's largest commercial fishery and is vital to the state's coastal economy. In 2013, Georgia's shrimp fishery was declared a fishery disaster by the Department of Commerce in part due to the presence of black gill, a ciliate-caused parasitic infection. Researchers at the University of Georgia's Skidaway Institute of Oceanography (SKIO) have been investigating the causes and effects of black gill on local shrimp populations. While it is known that a ciliate causes black gill, the identity of the shrimp black gill ciliate remains unclear. Identifying the ciliate is critical for the understanding of its life cycle and ecological properties. Lab studies have shown black gill can impact a shrimp's endurance making it more vulnerable to predators, and incidents of direct mortality have been observed. With funding from Georgia Sea Grant and the Georgia Department of the Natural Resources (DNR), SKIO with the South Carolina DNR are currently working to quantify mortality rates of infected shrimp and pool data from long term data sets to investigate the relationship between black gill presence and various environmental factors. These efforts improve the ability to forecast how shrimp populations respond to black gill outbreaks. Strong partnerships between stakeholders have been key to this ongoing initiative. Researchers, marine extension faculty, managers, and shrimpers are working collaboratively to gather data on where, when and how frequently black gill occurs, possible causes, and whether anything can be done to prevent or manage it. A number of outreach events and communication resources have also been developed to build trust among stakeholders and improve understanding of black gill and its impacts. This presentation will highlight the outcomes of these collaborative partnerships and ongoing efforts to address black gill in the region.



Is Shrimp Black Gill Killing Shrimp?

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Penaeid shrimp including *Litopenaeus setiferus* (white shrimp), *Farfantepenaeus aztecus* (brown shrimp), and *Farfantepenaeus duorarum* (pink shrimp) support one of the most valuable commercial fisheries in the US Southeast Atlantic. However, since the late 1990's the fishery, especially in coastal Georgia and South Carolina, has experienced a significant decline. A contributing factor to this decline has been hypothesized to be due to a severe outbreak of shrimp black gill caused by a ciliate. DNA sequence-based analysis of the shrimp Black Gill (sBG) ciliates's small subunit rRNA gene suggests that it is closely related to the apostome ciliate *Hyalophysa chattoni*. *H. chattoni* is common in many crustaceans but has never been reported to be pathogenic or cause mortality. However, morphological characteristics of the ciliate observed by electron microscopy are inconsistent with this identification and suggest that the sBG ciliate is likely an undescribed pathogenic species. Laboratory studies confirm that sBG can negatively impact respiratory capacity, physical endurance and possibly cause mortality. Elevated water temperatures are hypothesized to be an important trigger of black gill symptoms and can be responsible for mortality events. Initial exploration of Georgia's fisheries-dependent shrimp landings suggest that sBG may have contributed to the recent decrease in landings, but this association is not confirmed by fishery independent data or available landings data in South Carolina. However, it is difficult to separate the effects of sBG from the many other environmental and economic factors that influence the fishery. The contribution of shrimp black gill to the decline of Georgia's shrimp fishery remains unresolved but appears to likely have played a role.



Georgia's Coastal Telemetry Array

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Georgia's Coastal Telemetry Array is a series of individual receivers that continuously listen for coded ultrasonic transmitters attached to or implanted in marine animals. In its current configuration there are three series of eight receiver arrays placed off the St. Simons shipping channel. These arrays offer tracking coverage from approximately one to fifteen miles offshore. Established in 2013 the array is funded as a three-year collaboration with SCDNR to better describe the movements of Atlantic Sturgeon in coastal waters but has proven valuable for many other species. Data from the receivers are downloaded quarterly and all detection data are shared with cooperating researchers. Regional consortiums of telemetry users have developed along the US Atlantic Coast to help facilitate data exchange and communication among researchers. The Florida Atlantic Coast Telemetry (FACT) group is one such example. Current FACT members have agreed to share tag and receiver information following a written data sharing and code of ethics policy that governs the exchange of those data. By agreeing to follow those written policies, members gain access to expanded coverage in order to track highly mobile animals and/or animals tagged in regions beyond their own array coverage.



A Blueprint for Oyster Aquaculture in Georgia

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Georgia is launching a new industry in aquaculture, cultivating oysters for the lucrative half-shell market. Nationally, consumer demand for high-quality, raw-bar-grade oysters is rising. At the same time, the regions traditionally sourcing this product have experienced a decline in supply, resulting in an increase in price and profit margin. This has created a prime opportunity for Georgia to enter the aquaculture market. The University of Georgia, Georgia Department of Natural Resources and Georgia Department of Agriculture are partnering to expand the Georgia aquaculture industry, with the goal of gaining enough growers to sustain a private, commercial oyster hatchery. By working together and leveraging resources, this partnership seeks to follow the example of Virginia, who has shown what state investment in the single oyster market can produce. In just 10 years, Virginia expanded their oyster harvest value from \$196,125 in 2004 to \$27.96 million in 2014. We have developed a blueprint for Georgia Oyster Aquaculture that outlines critical needs to grow the industry from its current state of 10 permitted growers to 50 in the next 5 years. Using both state and federal investment, the University of Georgia Oyster Hatchery opened in 2015 at the UGA Shellfish Research Laboratory on Skidaway Island, Georgia. At full capacity, the hatchery will produce 15 million oyster spat with an estimated harvest value of \$3- 5.25 million. Additional investment in oyster research, training for shellfish growers, resource management and consumer safety is needed to sustain continued growth and realize the goals and actions outlined in this collaborative Blueprint for Georgia Oyster Aquaculture.



ORAL PRESENTATION ABSTRACTS

Session 5: PROFESSIONAL (Freshwater)

Daily age estimation reveals extreme growth of young-of-year Alligator Gar in the wild

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Growth of young-of-year (YOY) Alligator Gar in culture facilities has been reported to be exceptionally fast exceeding 5 mm per day. We collected YOY produced during an extensive flood pulse on the middle Trinity River and Choke Canyon Reservoir (Frio River, TX) and estimated their daily age using sagittal otoliths to confirm if growth rates were similar in the wild. Otoliths were embedded in a clear epoxy resin and then mounted with crystal bond to microscope slides, positioned perpendicular to the plane of the slide. Otoliths were incrementally ground with wet 600-grit sandpaper and routinely viewed with a compound microscope (under 100 × and 400 × magnification) until the core and daily increments were visible in a transverse plane. Otoliths were then inverted and ground incrementally on the other side until a thin section (< 0.1-mm thick) was obtained. All otolith sections were polished with 1500-grit sandpaper until otolith cores and rings were clearly visible for age estimation. All otolith sections were read and interpreted using an image analysis system at 400 × magnification. Daily increments were counted from the inner core to the outer edge of each otolith section. Each otolith section was read three times, with the mean of the three counts for each otolith being the estimated age. Daily ages of alligator gar ranged from 7 to 115 days post-hatch. Strong relationships between total length (mm) and daily age were observed for the Trinity ($r^2 = 0.67$, $P < 0.01$) and Choke Canyon Reservoir ($r^2 = 0.81$, $P < 0.01$) populations. Wild YOY Alligator Gar grew at even faster rates than in captivity and fish exceeded 400 mm within two months and 750 mm in four months. Future analyses will explore how the flow regime influences the spawning and hatching of alligator gar in Texas floodplain rivers.



Precision and Accuracy of Age Estimates Obtained from Anal Fin Spines, Dorsal Fin Spines, and Sagittal Otoliths for Known-Age Largemouth Bass

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Sagittal otoliths are the preferred ageing structure for black basses *Micropterus* spp. in North America due to the accuracy and precision demonstrated in several studies. Typically, fisheries managers are hesitant to use lethal ageing techniques (e.g., otoliths) on rare, trophy-size fish or in small impoundments where population abundance is low. Therefore, we sought to evaluate the precision and accuracy of two non-lethal ageing structures (i.e., anal fin spines, dorsal fin spines) and sagittal otoliths from known-age Largemouth Bass *M. salmoides* ($n = 87$) collected from Ocmulgee Public Fishing Area, Georgia. Sagittal otoliths exhibited the highest concordance with true ages of all structures evaluated. Similarly, age estimates obtained from sagittal otoliths were the most precise ageing structure as evidenced by a low CV (0.0) and high between-reader agreement (100%). Relatively high agreement between readers for anal fin spines (84%) and dorsal fin spines (81%) suggested the structures were relatively precise. However, age estimates from anal fin spines and dorsal fin spines exhibited low concordance with true ages. Despite being a lethal ageing technique, sagittal otoliths will likely remain the standard for ageing Largemouth Bass and other similar black bass species.

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**Rearing temperature produces both short-term and long-term energetic impacts in lake sturgeon
(*Acipenser fulvescens*)**

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Hatchery rearing and stocking are essential to restoration of endemic populations of lake sturgeon in Georgia. However, uncertainty regarding optimal environmental conditions can limit survival both in the hatchery and post-stocking. This study examined the dietary and energy physiology of lake sturgeon reared at three ambient temperatures ($15.2 \pm 0.1^\circ\text{C}$, $18.2 \pm 0.1^\circ\text{C}$, and $21.2 \pm 0.2^\circ\text{C}$). Fish from each treatment were sampled weekly for six weeks following the transition to exogenous feeding (37-79 dph). The remaining fish were then transferred to a common temperature of 20°C and reared to 10.1 ± 0.5 g, to investigate possible long-term effects on growth rate and metabolic processes. Standard metabolic rate (SMR) was determined via intermittent-flow respirometry at the three experimental rearing temperatures for each group. Diet incorporation efficiency in the early life stages is a primary factor known to impact the physiological condition of stocked juvenile lake sturgeon, and thus survival rates to spawning size in the river system. Therefore, in addition to physical growth parameters, sampled fish were subsequently analyzed by absorption spectrometry for whole-body lipid (triglyceride) and protein content. Wet weight and total length did not differ between exposure temperatures during the initial 6 weeks, but condition factor differed between rearing temperatures, and sturgeon reared at 15°C exhibited significantly higher survival. Nutritional composition results suggest the prioritization of lean muscle production in all treatments, while overall lipid content did not differ based on rearing temperature. As expected, SMR increased with temperature in all treatment groups. However, fish reared at 18°C exhibited less variability in SMR between exposure temperatures. Thus, it appears that rearing temperature influences physiological tolerance to temperature change in juvenile lake sturgeon, and that rearing temperature plays a role in balancing the energy trade-off between growth and condition of lake sturgeon during early life.



Using Cryopreservation of Robust Redhorse and Sicklefin Redhorse Sperm as a Conservation Tool for Restoration

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The Warm Springs Fish Technology Center has developed cryopreservation protocols for several species, which can be used for spawning populations, transport of semen over long distances, long-term storage in the event of catastrophes, and preservation of genetic materials. Robust redhorse is a large, long-lived sucker species historically found in river basins of Georgia, South and North Carolina, and was thought to be extinct until rediscovery in 1991. A cryopreservation protocol was developed for robust redhorse in 2005. The FTC currently maintains a cryopreserved sperm repository of 55 males from the Savannah River and 51 males from the Oconee River. Efforts are currently underway to include males from the Pee Dee River in North Carolina. The sicklefin redhorse was not recognized as a distinct species until 1992 and is relatively rare throughout its known range. It is found primarily in the Hiwassee and Little Tennessee rivers in Georgia and North Carolina. The Service is working with partners to propagate and reintroduce the species into its historic range. Efforts to develop a cryopreservation protocol have been undertaken in the past two years. The current protocol uses an extender (modified Hanks' balanced salt solution at 300 mOsmol/kg) at a ratio of 1:2 (v:v; sperm:extender). Extended sperm are mixed with cryoprotectants (10% methanol) and equilibrated for 12 minutes. Cryopreserved sperm are stored in liquid nitrogen. Sperm has been frozen from 106 males collected from Little Tennessee and Tuckasegee rivers, NC and Brasstown Creek, GA in 2014-2016. Also in 2015, a fertilization trial was initiated and results of that work are pending. Additional research was conducted on sperm to refine cryopreservation protocols for this species. The development of a successful protocol for sicklefin redhorse sperm cryopreservation will allow the establishment of a sperm repository for future restoration efforts.



A Comparison of Fish Communities in Savannah River Oxbow Lakes

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The Savannah River has been altered by humans for thousands of years. Within the last century, these alterations have aimed to provide flood control and commercial navigation. The construction of large hydroelectric dams and storage reservoirs in the upper drainage basin have resulted in significant changes to the hydrograph. Navigation cuts that straightened the river to make it shorter effectively doubled the number of oxbow lakes in the middle and lower basin. Many of these oxbows are still physically connected to the river to varying degrees depending on river discharge, while some are completely disconnected at all but flood flows. Some of these oxbow habitats may be important to species of fish and mussels. Efforts to revise management plans for upstream reservoir releases, especially during droughts, have resulted in questions about how those releases affect the oxbow habitats and their aquatic communities. We examined four oxbow lakes on Tuckahoe Wildlife Management Area in Screven County, GA. Two of the oxbows, Possum Eddy and Conyers lakes, were disconnected from the main river at all but flood flows. The other two lakes, Miller and Whirligig, were connected to the river at all flows. We sampled the fish community using boat electrofishing and gill nets between July 2015 and August 2016. We collected a total of 3,287 fish representing 15 families, 25 genera, and 39 species. Electrofishing catch per unit effort ranged from 56 to 600 fish/hr. Gill net catches ranged from 15 to 36 fish/set, and 5.6 to 33.7 kg/set. We found no significant differences in CPUE between lakes or across seasons. Bluegill and warmouth were the most abundant species sampled, while common carp and bowfin composed the largest percent of sample biomass.



Effect of Flow Variation on Hatch-date Distributions and Daily Incremental Growth of Juvenile Black Bass in Two Southeastern USA Rivers

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We examined the effects of flow variation on juvenile dynamics of fluvial specialist and habitat generalist species of black bass (*Micropterus* spp.; Centrarchidae) in two southeastern USA rivers, one unregulated and one regulated by a hydropower dam. Successful hatching in both rivers generally occurred when water levels became low and stable; however, hatching distributions were more consistent among years between species and reaches in the unregulated river compared to the regulated river. Black bass hatching distributions were usually unimodal, with little evidence of spawning disruption, except for the generalist species in the reach of the regulated river with the highest flow variation. Daily growth of black bass in the unregulated river was inversely correlated to flow variation in 3 of 4 comparisons, mostly driven by the generalist species, which experienced reduced growth when exposed to higher variation. In contrast, black bass growth in the regulated river was inversely related to flow variation in only one reach. Results from this study have demonstrated that variable flows resulting from either natural or anthropogenic sources have less of an impact on early-life dynamics of black bass than has been reported for other, less adaptable species.



Analysis of glutathione redox state as indicator of environmental stress in Ogeechee River Redbreast sunfish (*Lepomis auritus*)

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In the spring of 2011 a major fish kill occurred on the Ogeechee River. Tissue samples from fish collected after this event had elevated levels of *Flavobacterium columnare*, the causative agent of Columnaris disease. *F. columnare* is a common bacterium in freshwater environments, however, transmission rates of *F. columnare* and mortality due to Columnaris disease have been shown to be positively correlated with water temperature and inversely related with water quality. As part of a collaborative effort to establish the effect of natural and anthropogenic loadings to the Ogeechee River, Redbreast sunfish (*Lepomis auritus*) have been sampled from six sites on a quarterly basis since June 2014 and tissues analyzed for glutathione redox state. Glutathione (GSH) is an important antioxidant found in all cells that functions to prevent damage from reactive oxygen species (free radicals). In the cell, glutathione exists in both the reduced (GSH) and oxidized (GSSG) state, with GSSG typically maintained at 1-10% of the total glutathione. When there is an increase in the amount of free radicals in the cell's environment (common causes are increases in temperature, rapid fluctuations in oxygen and exposure to chemicals in the environment), GSH functions to convert the free radical to water and in the process it becomes oxidized, forming GSSG. If organisms are exposed to excessive amounts of free radicals, levels of GSSG increase significantly, with a coinciding decrease in GSH. As such, the ratio of GSH:GSSG (referred to as the glutathione redox state) is frequently used to evaluate the presence and extent of oxidative stress in biological systems. Preliminary results from this study suggest a significant temperature effect on glutathione redox state, but no effect due to collection site along the river.



Use of partial lifecycle tests to determine effects of nitrate and an estrogen on fatmucket (*Lampsilis siliquoidea*)

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Water quality and contaminants have been frequently identified as critical stressors for freshwater mussels, many species of which are highly imperiled throughout North America and the world. Nutrient pollution, specifically nitrate, is one of the most prevalent causes of water quality degradation globally, with increasing anthropogenic input from agricultural and domestic runoff, municipal wastewater, and industrial waste. Nitrate pollution often co-occurs with known endocrine disrupting compounds such as hormones, pointing to the need to understand how these compounds may be interacting to affect wildlife. The potential effects of nitrate and hormones on freshwater mussels are largely unknown, particularly during the parasitic stage of the freshwater mussel lifecycle during which metamorphosis from larvae to juvenile occurs on host fish. Therefore, we investigated the effects of nitrate singly and in combination with a model estrogen on freshwater mussel glochidia viability, attachment success on host fish, and metamorphosis success. In the first experiment we exposed released Fatmucket (*Lampsilis siliquoidea*) glochidia for 24 hours to environmentally relevant nitrate concentrations (0, 50, 250 mg/L NO₃) alone and in mixture with an environmentally relevant concentration of ethynylestradiol (EE2; 5 ng/L) before inoculation on their primary host, Largemouth Bass (*Micropterus salmoides*). Nitrate exposure altered glochidia attachment, metamorphosis success, and the number of juveniles produced, while EE2 had no measurable effects. In a separate experiment, we exposed brooding female Fatmucket to a range of nitrate concentrations (0, 50, 100, 150, 200, 250 mg/L) for 25 days and monitored the same suite of endpoints to determine the effects of nitrate when glochidia are exposed in the marsupial gills. Results of these studies are important for improving understanding of the hazards of these common contaminants to freshwater mussels at the critical stages of brooding and metamorphosis and to better define the role of water quality in assessing habitat suitability for mussel conservation efforts.



POSTER ABSTRACTS

Professional (alphabetical order)

Assessing Conservation Status of ESA Petitioned Fishes In the Face of Rapidly Approaching Deadlines

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Bridled Darter (*Percina kusha*), Holiday Darter (*Etheostoma brevirostrum*), Trispot Darter (*Etheostoma trisella*) and Frecklebelly Madtom (*Noturus munitus*) are petitioned for listing under the U.S. Endangered Species Act, with listing determinations (i.e., 12 month findings) due in 2017 for the darters and in 2020 for the madtom. The decision of whether or not to list these species has important social, economic, and conservation implications and therefore must be made upon the best available biological information. Working with a team of agency and academic biologists, we are compiling information on the distribution, population status, and threats to each species across their range. We surveyed populations of Bridled Darter and Holiday Darter in Georgia during 2016 to generate updated occurrence records. We have also reviewed over 3000 records from museums, agencies, and online databases and identified about 1600 unique collections with the information that is needed for the status assessment (e.g, collection date and locality). Records were processed by a GIS algorithm to create conservation status assessment maps for each species. These maps categorize HUC 10 watersheds by the most recent occurrence of a species and help identify areas where populations may be declining or where additional surveys are needed. We are also attempting to create additional status assessment maps based upon individual stream reaches, which will help identify patterns occurring within watersheds. Threats to populations will be assessed using 2011 National Land Cover Data at the stream reach and watershed scale as well as expert opinion collected during the 2015 update of our State Wildlife Action Plan. Our assessment is based primarily on the compilation of existing data sets rather than the completion of new studies, which is important given funding constraints and rapidly approaching deadlines.





Body Temperature, Cerebral Vasculature, and the Potential for Brain Warming in Cownose Rays (*Rhinoptera bonasus*)

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The visual system of the cownose ray (*Rhinoptera bonasus*) demonstrates temperature sensitivity similar to that of cranially endothermic billfishes. Although physiological mechanisms that support cranial endothermy have not been identified in batoids, previous authors have described a pre-cerebral rete in some species of derived Myliobatids. The function of the pre-cerebral rete has been suggested to play a role in cranial thermoregulation. Upon gross and histological examination, we confirmed that *R. bonasus* brains possessed an extensive vascular network, extending anteriorly to perfuse the olfactory structures, ventrally to the saccus vasculosus, and posteriorly to the thyroid gland. However, the network was composed of branching arteries that did not directly contact one another as is typical of countercurrent heat exchanging retia, which conduct heat between arterial and venous blood. Field-based temperature measurements from freshly landed rays were inconclusive and raise speculation that the pre-cerebral rete contributes to brain temperature regulation. Though temperatures across the body were elevated 1-3°C above ambient, these measurements are lower than those typically reported for regionally endothermic fishes. Elevated temperatures from cownose rays may reflect either the production of heat by the swimming musculature during capture or the retention of that heat for thermoregulation. Ongoing field temperature measurement data will be supplemented by controlled thermal manipulation experiments in the laboratory. Future work will model the extent to which *R. bonasus* may produce or retain heat, as well as investigate the potential for elevated body temperatures to contribute to brain warming.



Investigations of Georgia's Population of Sicklefin Redhorse *Moxostoma* sp.

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The Sicklefin Redhorse (SFR) *Moxostoma* sp. is a rare catostomid in the upper Tennessee River watershed of western North Carolina and north Georgia whose only Georgia population exists in Brasstown Creek, Georgia. Little data was available on the population until recent investigations that began in 2013. This study presents data on age, growth, mortality, sex ratios, and spawning period. To date, 128 SFR (83 males and 28 females) have been collected during spring spawning migrations via seining ($n = 72$) and a modified fyke net technique ($n = 56$). SFR were implanted with PIT tags for tracking, survival rate calculation and population estimation. SFR have a mean total length of 489.5 mm (range- 401 – 596 mm) with males (mean TL = 480.5 mm) being significantly smaller (mean TL = 520.1 mm) than females. Using pectoral fin ray sections, SFR were estimated to live more than 20 years and have a relatively slow growth rate ($L_{\infty} = 60.02$; $k = 0.12$; $t_0 = -0.54$) compared to sympatric redhorses. The youngest migrating SFR was estimated to be 7 years old. Estimated mortality (Z) of the population was 0.303 (95% CI = 0.186 – 0.419). Sex ratio of migrating SFR was 1.4:1 (males:females) and was calculated from Fyke net sampling as seining preferentially sampled males (11:1). Although spawning migrations were initially thought to occur mostly from mid-April to the end of May, migrating SFR were observed as early as 28 March. Visual surveys of SFR throughout Brasstown Creek detected a clustered distribution with SFR most abundant in sections with intact riparian zones dominated by mature, woody hardwoods. Future research will focus on continued PIT tagging and recapturing SFR to evaluate population metrics such as mortality, recruitment and abundance by establishing capture histories of recaptured individuals.



POSTER ABSTRACTS

STUDENTS (alphabetical order)

Spatial and Seasonal Variation of Macroinvertebrate Biotic Indices of the Lower Ogeechee River Basin

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The Ogeechee is a blackwater river whose catchment is situated almost entirely in the Coastal Plain ecoregion of southeastern Georgia. Over the river's course, its catchment experiences changes in land use, from agricultural to urban, as well as ecological changes from its Piedmont headwaters through its floodplain to the estuary at its mouth. Additionally, ecological communities within the river are subject to large seasonal physicochemical and hydrological shifts, including winter and spring flooding, that drive the life histories of the organisms in the river channel. Using macroinvertebrate community data collected from an ongoing study, we assessed seasonal and spatial differences in the community composition of the river using biotic indices. Benthic macroinvertebrates were sampled on a quarterly basis from summer 2014 until spring 2015 at 6 main channel locations along a longitudinal gradient on the Lower Ogeechee River Basin. We used community composition data to generate biotic indices for each sampling event at each site. Spatially there were few consistent trends for overall richness and tolerance metrics, with the two most downstream sites being slightly less taxonomically diverse and harboring fewer sensitive taxa, thus leading to lower scores in the GA Multimetric Index. Furthermore, little to no seasonal change was observed for many of the metrics with the exception of the Simpson Index and the Shannon Wiener function which yielded lower diversity scores in the winter and spring. Continuous monitoring data from multiple, consecutive years, combined with additional analyses of community structure and composition, should improve our understanding of the Ogeechee River's overall health, condition and potential for natural fluctuations. This information is ultimately needed to aid in the future management of the system.





Comparisons of leaf-litter processing and macroinvertebrate assemblages in three Coastal Plain rivers of Southeast Georgia

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We compared leaf-litter processing and the concomitant macroinvertebrate assemblages in main-channel habitats of three Coastal Plain rivers in Southeast Georgia: Altamaha, Ogeechee, and Savannah. From mid-September to mid-November (= fall) and from mid-March to mid-May 2015 (= spring), a total of 192 packs of water oak (*Quercus nigra*) leaves were retrieved at two-week intervals over an eight-week period. Six study sites (two per basin) were chosen to assess the effects of flow regime, particularly the magnitude of discharge, on leaf-litter breakdown and assemblage structure. During the fall study period, a distinct discharge gradient was observed (average $Q = 150.8, 75.3,$ and $8.2 \text{ m}^3/\text{s}$ for the Savannah, Altamaha, and Ogeechee, respectively). Despite differences in discharge, each basin exhibited similar processing coefficients (average $k = -0.013$). A distinct gradient was also observed in spring (average $Q = 499.3, 235.2,$ and $72.4 \text{ m}^3/\text{s}$ for the Altamaha, Savannah, and Ogeechee, respectively). Processing coefficients remained similar among basins and to those observed in the fall (average $k = -0.013, -0.011,$ and -0.009 for the Ogeechee, Altamaha, and Savannah, respectively). Fall assemblages were similar among basins based on abundance (PERMANOVA, $p = 0.085$) and biomass (PERMANOVA, $p = 0.133$). Midges in the subfamilies Orthoclaadiinae and Tanypodinae were the most abundant taxa in the Ogeechee and Savannah (17 and 13%, respectively). Oligochaetes comprised 31% of the Altamaha's total abundance. Spring assemblages were also similar among basins based on abundance (PERMANOVA, $p = 0.077$) and biomass (PERMANOVA, $p = .074$). Midges in the subfamily Orthoclaadiinae were the most abundant taxon in all assemblages comprising 56, 32, and 22% of total abundance in the Ogeechee, Altamaha, and Savannah, respectively. These results suggest that discharge is not a determining factor in leaf-litter processing rates and reinforce the usefulness of the ecoregion concept in delineating macroinvertebrate distributions in these systems.



Investigating the Role of Long Distance Dispersal in the Response of Stream Fishes to Urbanization

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We are conducting a mark-recapture study in the metro Atlanta area to investigate the role urbanization plays in long distance dispersal of stream fishes. Our two stream sites represent a heavily impacted urban watershed (impervious surface cover ~ 30%) and a mildly impacted rural watershed (impervious surface cover ~6%). Species of interest, *Camptostoma oligolepis* (n=130 rural site, 137 urban site) and *Lepomis auritis* (n=152 rural site, 89 urban site), were marked with 12mm HPT PIT tags (Biomark, Idaho) with monthly resampling conducted using a portable antenna. Resampling began in September 2016 and will continue until February 2017. Movement data will be fitted to a dispersal curve in order to determine the proportion of each population displaying long distance dispersal. Comparing intraspecies movement between rural and urban stream site will allow us to determine if fishes utilize long distance dispersal as a means of locating suitable habitat in streams affected by urbanization. Including a generalist species, *L. auritis*, and a specialist, *C. oligolepis*, will further allow us to analyze the degree to which fishes may need to employ long distance dispersal based upon their habitat needs. We anticipate a higher proportion of long distance dispersal in urban stream sites for both species with a greater degree of difference between the proportion of long distance dispersal in urban and rural stream sites for *C. oligolepis*.



Evaluation of Duckweed *Wolffia* spp. Growth in Tilapia *Oreochromis* spp. Effluent

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The focus of this study is to evaluate the effect of water quality on the growth of *Wolffia* spp. cultured in tilapia effluent. Water quality parameters, which include ammonia, oxygen, salinity and temperature, will be compared against a control group of water (zero salinity, ambient temperature, and non-aerated, well water). It is hypothesized that low salinity, high temperature, high ammonia and aerated water will increase the *Wolffia* spp. growth rate.



Regional and tidal phase effects on estuarine fish distributions near Savannah, Georgia

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Estuaries are areas of high variability from factors such as tidal flushing, trophic interactions, and nutrient and energy fluctuations. Tidal flushing impacts the distribution of estuarine biology in which planktonic organisms are flushed with the ebbing and flooding tides, affecting their overall patchiness and their availability to predators. A dual sampling method was used to characterize the abundance and distribution of biology within two different confluences in the Savannah River Estuary system. Analysis determined that tides did not significantly impact the overall abundance of biology ($p=0.481$, $p=0.564$). The study locations had a significant effect on the total abundance of organisms and composition of nekton at trawl and total depth ($p=0.002$, $p=0.008$). From this study, a dual sampling method yielded a good representative sample of organism abundance within a region.



Habitat Preferences of the Hiwassee Crayfish *Cambarus hiwasseeensis* in a Headwater Stream

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The Hiwassee crayfish *Cambarus hiwasseeensis* (CH) is a relatively rare crayfish species endemic to the Hiwassee River watershed in north Georgia and western North Carolina. A lack of information exists on this species, and no studies have been conducted on the habitat preferences of CH. This study defined the specific habitat preferences of CH in Corn Creek, a small second order stream. From August to November 2016, 146 1-m² quadrants were randomly sampled from an 800-m stream reach. Twenty-one habitat parameters were defined for each 1-m² quadrat. Logistic regression models were used to define the probability of CH presence for various habitat parameters, and a multivariate model selection procedure was used to identify important habitat parameters. CH presence was more frequent in substrates dominated by boulders and pool habitats. Significant variables from univariate models that predicted CH presence included bank stability ($P = 0.002$; AIC = 171.2), depth ($P = 0.003$; AIC = 162.7), embeddedness ($P = 0.18$; AIC = 174.0), and percent gravel ($P = 0.046$; AIC = 177.0), large boulder ($P = 0.043$; AIC = 177.2), sand ($P = 0.036$; AIC = 176.5) and silt substrates ($P = 0.015$; AIC = 174.6). The most significant predictors of CH presence from multivariate models included bank stability, depth, and percent sand and cobble substrates. Probabilities of CH presence increased with increasing bank stability and stream depths, and decreased with increasing percentages of cobble and sand substrates. Thus, CH preferentially utilizes deeper pool habitats in Corn Creek that contain larger, coarse substrates. However, the stream is experiencing substantial bank erosion and instability in some sections due to poor streamside management practices that are contributing sand and silt to stream pools, which may negatively influence the CH presence in this stream.



Effects on *Campostoma oligolepis* digestive morphology and gut microbiota across a gradient of urbanization

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Campostoma oligolepis, the Largescale Stoneroller, is a species of minnow native to North Georgia. Our study investigated the impacts of urbanization on gut microbiota community composition and gut length in *C. oligolepis* from watersheds within the Etowah River drainage basin with varying levels of impervious surface coverage (ISC). Individuals were collected from four sample sites in the summer of 2016 between late July and early September, and then again in the fall between mid-October and mid-November. The gut length to total length ratio was calculated for each individual to allow for fair comparison of gut lengths between individuals of varying ages and sizes. Additionally, gut microbiota communities from summer individuals were identified using 16S metagenomic sequencing on an Ion Torrent platform. We found that summer individuals from watersheds with lower ISC had significantly longer gut lengths than individuals from more urbanized watersheds. These findings were consistent with previous findings from a 2013 study conducted out of the same watersheds. However, no significant difference in relative gut length was found between the fall individuals from different sites.



Who is Eating Crab Legs? Studies in Coastal Shark Diets

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The Satilla River Estuary (SRE) was cut in the early 1900s and one cut, Noyes Cut, was created to transport commercial lumber more efficiently. The Cut has not been maintained and it's possible that it has disrupted water flow and wildlife populations. As one of the main predators found here, sharks may provide evidence to help address this concern. We expect to find differences in shark population makeup as well as in stomach contents among 4 sampling sites. Using gill nets, 50 sharks were caught between June 2014 and August 2016. Of those, 9 had their stomachs dissected, preserved in 95% Ethanol, and contents visually separated by taxon to determine diet. The most species rich site was Noyes Cut with 5 shark species, compared to Parsons Creek where only one species, the bonnethead, was observed. All stomachs from sharks caught at Parsons Creek were given a fullness rating of 3, while Noyes Cut sharks showed variable stomach fullness from 0-3. Upon examination of stomach contents, the most common taxon found was crustaceans. When comparing stomach contents to invertebrate and fish assemblage data, Parsons Creek and Piney Bluff had the greatest number of these prey species, while Noyes Cut and Todd Creek had the lowest. When salinity was examined, values at Piney Bluff and Parsons Creek were higher than those at Noyes Cut and Todd Creek for a majority of months. The differences in shark abundances could indicate that these differences in water quality and prey distribution make certain species prefer specific sites for hunting. It comes to no surprise that sharks, active predators, are following their prey species. However, due to limited number of dissections, definitive statements regarding shark diet cannot be made. The SRE shark population seems healthy indicating that Noyes Cut's effect is either positive or negligible.



A Baseline Study of Fish Assemblages in a Pristine Georgia Estuary

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St Catherine's Island is one of Georgia's uninhabited barrier islands, and is used strictly for research and conservation purposes. It is approximately seven miles from the mainland, and eighteen miles from the Altamaha River. Due to its location, the surrounding estuary has seen negligible anthropogenic impacts throughout its history. Brunsen Creek, on the southern end of the island, is isolated and considered to be a pristine marine ecosystem. This study is a continuation of an initial 2014 study to collect baseline monthly ichthyofaunal data via trawling. Data presented here contains summary information collected through August 2016. Information collected during this period will provide baseline data for fish assemblage comparisons within the surrounding Georgia estuarine ecosystem. Statistical relationships between Brunsen Creek fish assemblages and environmental factors, such as temperature and salinity, were not established. However, consistent relationships were observed in natural migration and reproduction patterns of key fishes that have also been noted in other studies. Temporal trends among the targeted species in this study reflect a well-established natural pattern along the Georgia coast. Following these trends will provide a baseline of expected life history events, and a reference for further research within southeastern estuaries.



Comparing Three Types of Passive Samplers for the Assessment of Macroinvertebrates in Non-Wadeable Rivers

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Passive samplers provide an alternative method for assessing macroinvertebrate communities in large streams where traditional sampling techniques may not be feasible or effective. This study was conducted to determine the effectiveness and potential biases of three passive samplers using the GA multi-metric index (MMI) as a standardized tool to compare assemblages colonizing the different devices. Nine replicates each of mesh bags filled with leaves (leaf packs), and masonite boards (Hester-Dendy samplers), and eight replicates of mesh bags filled with woody debris (snag bags), were deployed during the fall of 2014 at three sites on the Savannah River (N=26) and three sites on the Ogeechee River (N=26). After 30 days, samplers were retrieved and macroinvertebrate assemblages were assessed for differences in: Richness (EPT Taxa, Diptera Taxa), Composition (%EPT, %Trichoptera), Tolerance (Hilsenhoff Biotic Index), Functional Feeding Group Structure (Predator Taxa), and Habit (Clinger Taxa). Differences in macroinvertebrate assemblages collected were minimal between the samplers, with each substrate-type scoring similarly in most metrics. However, there were slight differences in scores for one of the Richness metrics (Diptera taxa). Furthermore, the GA MMI had similarly high scores for all samplers at both river basins. Our study suggests that all three devices provide efficient means for sampling macroinvertebrates in large Coastal Plain rivers.



Diet of the Snail bullhead (*Ameiurus brunneus*) in the Lower Ogeechee River

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The Snail Bullhead (*Ameiurus brunneus*) is a small ictalurid species with a maximum length of 243 mm SL. Little is published about its biology; however, it is known that adults are nocturnal and omnivorous. The goal of this study was to examine the diet of snail bullheads as adults. The only two studies, to our knowledge, to describe diet are by McLane in 1955 and Jordan and Brayton in 1878. They are reported to feed on larval trichopterans, chironomids, snails and small fish. Forty specimens were collected from the Lower Ogeechee River Basin during the summer and fall of 2016 by boat electrofishing. Fish were sacrificed, stomachs removed and prey items were identified to the lowest practical taxonomic unit (usually family). The most numerous prey items consumed were Viviparidae snails followed by crayfish, Chironominae, Tanypodinae and fish (Cyprinidae or un-identifiable fish remains). Plant material was found in nearly (~80%) every stomach, however many of those stomachs had caddisflies as well so some of the material could have been from caddisfly cases. This study adds more information about the diet of this relatively understudied species.



Factors Affecting Tournament-Associated Mortality of Black Bass Species

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Black bass caught in competitive tournaments often suffer mortality as a result of stressors from angling, captivity and weigh-in, and tournament mortality can account for a relatively high portion of total mortality of a bass population on fisheries with heavy tournament pressure. The objective of this study was to determine significant factors influencing initial, delayed and total mortality of Black Bass during competitive fishing tournaments held within the United States. Competitive tournaments ($n = 63$) were sampled in 6 states and Puerto Rico. To collect data, we searched through numerous fisheries journals and collected data on 27 different variables of tournaments potentially related to initial, delayed, or total mortality. Surface water temperature was significantly related to initial ($P = 0.076$), delayed ($P = 0.051$) and total ($P < 0.001$) mortality. Additionally, angler hours ($P = 0.014$), state in which the tournament was held ($P < 0.001$) and tournament year ($P = 0.002$) were significantly related to delayed mortality. Mortality rates were highest in southern states and increased with tournament length. Based on our results, tournaments conducted when average water temperature is greater than 25°C can cause excessive mortality and may pose a risk to sustainable management of black bass fisheries. Strategies and regulations that lower tournament-related mortality rates during warm summer months in southern U.S. fisheries and promote black bass welfare during competitive tournaments should be considered.



Comparison of redbreast sunfish life histories across an urban gradient

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Human activities in urban watersheds can have detrimental impacts on local stream fauna. Therefore, our main goal was to compare the age structure, body growth, condition, and survival of redbreast sunfish across three tributaries of the Chattahoochee River that range from low to high urban impact (Nickajack, Sope, and Rottenwood creeks). For age and growth analyses, redbreast sunfish populations were sampled by backpack electrofishing in Fall 2014. Fish were weighed (g), measured (mm TL), and processed in the laboratory. Sagittal otoliths were extracted from each fish. In Fall 2016, standardized sampling was conducted for each population. Backpack electrofishing was conducted along 3-4 transects in each creek. All fish were weighed and measured on site and released. In Fall 2016, Catch-Per-Unit-of-Effort was statistically similar across all creeks, indicating that abundance did vary by system. Fish density (# fish/10 m of habitat) was 4.0 (\pm 0.9), 2.0 (\pm 0.2), and 3.0 (\pm 0.5) in the Nickajack, Sope, and Rottenwood Creeks, respectively. Although density was highest in Nickajack, differences were not statistically significant. Fish sizes ranged from 47-196 mm TL in Nickajack Creek, 48-154 mm TL in Sope Creek, and 23-159 mm TL in Rottenwood Creek. A greater proportion of longer fish was observed in Nickajack Creek. Fish condition was similar across all creeks for small-bodied redbreast sunfish (\leq 100 mm TL); however, condition was significantly lower in Nickajack Creek for large-bodied fish ($>$ 100 mm TL). Fish growth was significantly faster in Nickajack and Sope than in Rottenwood Creek. Mean lengths at age-2 were 134 mm, 126 mm, and 108 mm in Sope, Nickajack, and Rottenwood creeks, respectively. Future work will include standardized sampling in the spring, additional aging of fish to compute complete growth models and annual survival, as well as additional life history characteristics.



Evaluating elasmobranch interactions in the Georgia shrimp fishery

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Abstract:

The Georgia shrimp fishery has seen a dramatic decrease in profit and productivity since the 1980's due to a number of ecological and political factors. An additional, yet undocumented, pressure on this fishery is the interaction between foraging sharks with trawl gear. Fishermen report that sharks frequently bite nets in an attempt to prey on netted fish, resulting in large holes in the mesh or entanglement of the animal in the gear. Further elasmobranch interactions with trawl gear occur as bycatch; shrimp trawls represent nearly 100% of elasmobranch commercial bycatch in Georgia state waters, the species composition of which is largely unstudied. Shark interactions with nets were detailed through fishery-dependent observations on commercial shrimp boats in Georgia (n= 5 vessels). Number of damaged sites, location of damage on the net, estimated repair time, and tow/environmental variables (turbidity, temperature, depth, tow time, and tides) were recorded for 37 trawling events between May-November 2016. 95% of sharks seen foraging near trawl gear were either *Carcharhinus limbatus* or *Carcharhinus brevipinna*. Sharks bit an average of 2.4 holes (± 0.4 SE) in the nets for every trawl. A trend was observed of gear damage and shark sightings decreasing as water temperature decreased. Elasmobranch bycatch composition was also recorded for each trawl day (species, number of individuals, catch location, and standard morphometrics). Of twelve total species caught, three species in particular accounted for 77.6% of all elasmobranch bycatch (n=37 trawls): *Rhizoprionodon terraenovae* (CPUE = 2.05 individuals per trawl hour ± 0.38 SE), *Gymnura micrura* (CPUE =1.32 ± 0.37), and *Dasyatis americana* (CPUE =0.8 ± 0.23). Because the fishery has decreased in size and effort over the last two decades and the use of TEDs increase selectivity of nets, it is unknown if bycatch in shrimp trawls are drastically decreasing stock sizes in elasmobranch species.



Comparison of Otoliths and Scales in the Age Estimation of Sunfishes

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Various fish structures, such as scales, spines, and otoliths, have been used to estimate the ages of freshwater fishes. However, comparisons of aging structures for sunfishes have been limited. Previous studies have indicated that otoliths are more accurate and precise in estimating age compared to scales, but otolith extraction is a lethal method. Therefore, our goal was to compare otoliths and scales in estimating age, growth, and survival of redbreast sunfish and green sunfish in an urban stream. In addition, the timing of annuli formation may differ between aging structures and between fishes. Therefore, we also conducted Marginal Increment Analysis to compare timing of annuli formation between structures and species. Backpack electrofishing was conducted on a monthly basis to collect approximately 10 individuals of each species from a tributary of the Yellow River. All fish were weighed (g) and measured (mm TL), and sagittal otoliths and scales were removed from each fish. Scales and otolith sections were aged by two experienced readers, and any disagreements in age were reconciled by a concert read. For any disagreements that were not resolved during concert reads, an independent third reader resolved any conflicts. Scale and otolith ages were not strongly correlated for redbreast sunfish ($r^2 = 0.39$), but the relationship was statistically significant ($P < 0.01$). Scales generally overestimated the otolith-based ages of younger fish, while underestimating the otolith-based ages of older fish. However, survival and growth estimates using otolith and scale-based age data were very similar for the redbreast sunfish. Marginal Increment Analysis for the age-1 group indicated that annulus formation in redbreast sunfish otoliths occurred in late spring into early summer. Marginal Increment Analysis failed for redbreast sunfish scales, likely due to difficulties during reading and interpretation and a small sample size. Future analyses will be conducted for the green sunfish.



The Fishy Side of Ecosystem Health: An Ecological Assessment of Fish Assemblage Composition and Diversity in the Satilla River Estuary

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Healthy estuaries protect productive coastlines and support diverse ecosystems. They act as migratory routes and nursery areas, as well as feeding and/or breeding sites in support of abundant fish assemblages. The purpose of this study was to continue analyses of the Satilla River Estuary's (SRE) biological integrity by using the Shannon-Weaver Diversity and Estuarine Fish Assemblage indices to reflect system health. The following four sites in the Dover Bluff area of the SRE were sampled monthly from July 2015 to August 2016: Todd Creek (reference), Parsons Creek, Piney Bluff Node, and Noyes Cut (human-made). Fishes were collected by otter trawl, experimental gill nets, minnow traps, and eel pots. Water quality was measured using a multi-probe water-quality sonde. We hypothesized that Piney Bluff Node would be the least diverse due to the continued fluctuations in salinity patterns that were observed in past studies. A total of 49 fish species were collected among the four sites, with Noyes Cut and Parsons Creek having the greatest species richness. There were ten common species found among all four sites, 40% of which were the same species found in 2015. The closing of Noyes Cut should restore historically referenced water flows, and therefore, equitably redistribute the local fish populations into the surrounding waterways. Ultimately, by increasing the diversity in these other sites, positive benefits should result for recreational and commercial fishers within the Dover Bluff area.