Georgia Chapter of the American Fisheries Society

2019 Annual Meeting

February 5 – 7, 2019
Veterans Memorial Park
Cordele, GA

2019 GA-AFS Annual Meeting Program

Tuesday, February 5, 2019		
10:00 – 4:00	Registration	
1:00 – 1:10	Welcome/Opening Comments	Carolyn Belcher
1:10 - 1:30	State of the State (Freshwater)	Matt Thomas
1:30 - 1:50	State of the State (Marine)	Carolyn Belcher
SESSION 1: STUDENT PRESENTATIONS		
1:55 – 2:10	Effects of Hydrogen Peroxide Treatment on Hatching Success on Walleye Eggs Infected with *Saprolegnia* spp.	Guy Eroh
2:10 – 2:25	Effects of a Novel Cyanotoxin on Swimming Performance of Largemouth Bass	Alex Pelletier
2:25 – 2:40	Thermal and Low Oxygen Tolerance of a Southern Population of Striped Bass (*Morone saxatilis*)	Daniel Lleras
BREAK		
3:00 – 3:15	Growth rates of juvenile Atlantic Sturgeon in the Altamaha River Georgia	Catlyn Chapman
3:15 – 3:30	Overwinter Habitat Use and the Influence of Flow on Recruitment of Juvenile Gulf Sturgeon in the Apalachicola River, FL	Nathaniel Hancock
3:30 – 3:45	Dorsal scute development in *Acipenser fulvescens* in different environmental calcium concentrations	Rachael Hicks
3:45 – 4:00	Using Side-scan Sonar to Quantify the Spawning Runs of Atlantic Sturgeon in the Altamaha River System, Georgia	Cortney Bunch
4:15 – 5:15	**BUSINESS MEETING**	
5:15 – 7:00	**DINNER ON YOUR OWN**	

Tuesday (continued), February 5, 2019

POSTER PRESENTATIONS AND SOCIAL

7:00 – 10:00 Social including poster presentations

7:00 – 8:00 Poster Presentations

	Comparing otoliths and scales to age Bartram's Bass—A Savannah River endemic	Jon Blalock
	The Molecular Evolution of the DNA Methyltransferase Gene Family in Fishes	Karen Bobier
	Patterns of Imperilment within Georgia's Rare Fishes	Caroline Cox
	The Southern Appalachian Snorkeling Trail: Preserving Water Quality in Appalachian Communities by Promoting Native Fishes	Caroline Cox
	Analysis of ontogenetic shifts in diet habits of the invasive blue catfish from the Altamaha River, GA	Derrick Frondarina
	"Growth of Nile Tilapia Fingerlings Fed Organic Diets Containing Yeast and Soybean Meal as Replacements for Fish Meal	Gary Hall
	Population assessment of brown trout and rainbow trout along a regulated section of the Chattahoochee River	Ariel Nunez
	Reach- and microhabitat-scale habitat selection in Coastal Plain fishes	Hayley Robinson
	Using Photo-identification to Assess Wintering Populations of White Sharks in Mossel Bay, South Africa	Mischa Schultz
	Spatial Variation in Fish Communities within the Hiwassee River Watershed	Hannah Walker

2019 GA-AFS Annual Meeting Program

Wednesday, February 6, 2019		
7:45 – 8:30	Fellowship of Christian Conservationists	
8:00 – 4:00	Registration	
SESSION 2: STUDENT PRESENTATIONS		
8:50 – 9:05	Movement Patterns During the Spawning Season of Sicklefin Redhorse in Brasstown Creek, Georgia	Caroline Cox
9:05 – 9:20	Estimation of population parameters of Sicklefin Redhorse (*Moxostoma* sp.) in Brasstown Creek, Georgia	Angela Hsiung
9:20 – 9:35	Assessing supply and demand of trout in north Georgia under current and projected thermal regimes	Jenna Haag
9:35 – 9:50	Regional effects of land use on growth of brown bullhead catfish in the Chesapeake Bay Watershed	Taylor Harof
BREAK		
10:10 – 10:25	The Movement of Redbreast Sunfish and Green Sunfish in Fragmented Habitats	Savannah Wells
10:25 – 10:40	Using instream stationary antennas to monitor the movements of warm water fishes	William Commins
10:40 – 10:55	Efficacy of Biofouling Mitigation Methods for Floating Cage Production of Southeastern Triploid Eastern Oysters *Crassostrea virginica*	Shannon Kirk
10:55 - 11:10	A Cautionary Tail: Attempting to Estimate Survival of Gag Grouper (*Mycteroperca microlepis*) in the Gulf of Mexico Using Acoustic Telemetry	Gina Alvarez
11:10 -11:25	Improving Bathymetric Estimates Using Kalman Filtering and Distance Analysis	Wesley Gerrin
LUNCH (Catered)		

Wednesday (continued), February 6, 2019		
SESSION 3: GEORGIA'S RIVERKEEPERS (SYMPOSIA)		
1:05 – 1:20	Coal ash In Georgia— what is it, where it is and why it's in the water	Jen Hilburn
1:20 – 1:35	Protecting the Chattahoochee with water quality monitoring	Jason Ulseth
1:35 – 1:50	Restoring the "trust" in environmental trust funds	Jesse Demonbreun-Chapman
BREAK		
2:10 – 2:25	Georgia instream flow policy: a brief history and consequences	Gordon Rogers
2:25 – 2:40	An overview of research collaborations between Ogeechee Riverkeeper and other organizations	Damon Mullis
2:40 – 2:55	Improving Relationships Between Fisheries Managers and Nonprofit Leaders	Anna Laws
BREAK		
3:15 – 3:30	Habitat restoration in the Satilla River estuary by closing obsolete navigation cuts	Laura Early
3:30 – 3:45	Cutoff bend restoration on the Savannah River	Tonya Bonitatibus
3:45 – 4:00	Daily GA-EPD sewage spills report: how that happened, what's in them, and what to do about them	John Quarterman
4:00 – 4:30	PANEL DISCUSSION - RIVERKEEPERS	
6:00 - 8:00	**AWARDS BANQUET AND ANNUAL RAFFLE**	

2019 GA-AFS Annual Meeting Program

Thursday, January 25, 2018		
SESSION 4: PROFESSIONAL TALKS		
9:05 – 9:20	Georgia's intertidal oyster and artificial reefs: an aerial perspective on spatial and geomorphological change	Cameron Brinton
9:20 – 9:35	Modeling distribution of endemic Bartram's Bass, congeners, and hybrids in the Savannah River basin	Brandon Peoples
9:35 – 9:50	Behavioral variation across sexes in an isolated Shoal Bass population	Amy Cottrell
9:50 – 10:05	Shoal Bass Conservation – Watershed Protection through the ACF Threats Assessment: An Innovative Decision Making Support Tool	Vance Crain
BREAK		
10:25 – 10:40	Using Specialized Anglers to Assess a Trophy Florida Bass Fishery in Calling Panther Lake, Mississippi	Tim Bonvechio
10:40 – 10:55	Current Trends for Trophy Bass Management	Greg Grimes
10:55 – 11:10	Reservoir Habitat Enhancement in Georgia	Scott Robinson
11:10 – 11:20	**CLOSING COMMENTS**	
ADJOURN		

ORAL PRESENTATION ABSTRACTS

SESSION 1: STUDENTS

Effects of hydrogen peroxide treatment on hatching success on Walleye eggs infected with *Saprolegnia* spp.

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Fungal infections of walleye eggs have been implicated in instances of poor hatching success experienced by the Georgia Department of Natural Resources. In the spring of 2018, this issue was investigated to evaluate the effectiveness of various hydrogen peroxide treatment regimens on fungal (*Saprolegnia* spp.) growth on incubating walleye eggs and resulting hatching success. Three hydrogen peroxide concentrations (100 ppm, 250 ppm or 500 ppm) and two exposure frequencies (once or twice daily) were tested. There were three replicates of each treatment combination and each was assigned randomly to individual hatching units. In addition, there were three control units that did not receive hydrogen peroxide. The number of eyed eggs and hatched fry were enumerated and used to calculate the percent hatch and percent eyed+ (hatched + eyed eggs). Results of analysis of variance showed that treatment concentration significantly affected hatching success of the eggs (p = 0.000089) and that treatment frequency (p = 0.26) and the interaction between the two factors (p = 0.48) did not. Hatching success of walleye eggs among various treatment concentrations ranged from 0.03 to 26.48%; the percent of eggs to reach the eyed stage ranged from 0.05 to 56.19%. The mean hatching success of the 100 ppm treatments (26.48% ± 4.52) were significantly higher than all other treatments (0 ppm = 6.46% ± 3.04, 250 ppm = 6.24% ± 1.05, 500 ppm = 0.03% ± 0.01). Results of the eyed+ success were similar (0 ppm = 11.82% ± 6.70, 100 ppm = 56.19% ± 8.04, 250 ppm = 9.74% ± 2.28, 500 ppm = 0.05% ± 0.03). None of the other treatment concentrations differed significantly from one another (all $p > 0.05$). This information will be useful to GADNR's walleyes stocking program and help to improve fishing opportunities for walleye anglers in the state.

Effects of a novel Cyanotoxin on swimming performance of Largemouth Bass

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The recently-described cyanobacteria *Aetokthonos hydrillicola* (*Ah*) produces a formally undescribed neurotoxin known as *Ah* toxin. This toxin was recently linked to the neurological condition in birds called vacuolar myelinopathy (VM). Birds, amphibians, reptiles and fish develop VM by consuming *Ah*-colonized hydrilla (*Hydrilla verticillata*), or through food chain transfer by consuming herbivorous prey that consume hydrilla/Ah. Symptoms of VM include motor impairment, seizures, and death. Because many fishes in *Ah*-contaminated reservoirs use hydrilla beds as a habitat sanctuary and as foraging grounds, we suspect that game fish may also be exposed to *Ah* toxin. However, the effects of *Ah* toxin in wild fishes remain mostly unknown. We investigate 1) whether *Ah* toxin can bioaccumulate in largemouth bass (*Micropterus salmoides*) through trophic transfer from prey fish, and 2) whether largemouth bass exhibit clinical signs of motor impairment when exposed to *Ah* toxin. We fed *Ah*/hydrilla material to an omnivorous fish (tilapia, *Oreochromis* sp.) for five days, after which time we fed the exposed tilapia to largemouth bass for up to fourteen days. We then evaluated burst swimming performance for largemouth bass fed control tilapia ('clean' hydrilla diet) and treatment tilapia (*Ah*/hydrilla diet) in a Brett-type swim chamber. These results will provide valuable information about the risk for trophic transfer of *Ah* toxin and effects on motor function in game fish.

Thermal and low oxygen tolerance of a southern population of Striped Bass (*Morone saxatilis*)

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Climate change projections estimate a 2-3°C increase in water temperatures by the end of the century. The amount of habitat with suitable temperature and oxygen concentration for aquatic organisms will also be reduced. Striped bass (*Morone saxatilis)* inhabiting the rivers in Southeastern Georgia make an interesting study system as they do not participate in summer coastal migrations typical of their northern conspecifics. Instead, fish in this southern population remain in freshwater environments that experience warming and decreases in dissolved oxygen. The present study aims to determine the thermal and low oxygen tolerance of juvenile striped bass collected from southeast Georgia through the measurement of aerobic metabolic scope (AMS) and critical oxygen tension (Pcrit), respectively. Fish will be acclimated to one of four experimental temperatures (20, 25, 30, and 33°C), representing the range of temperatures typical of the natural environment in the summer as well as the anticipated increase in temperature due to climate change (33°C). Additionally, tissue samples (plasma, liver and muscle) will be analyzed for glucose, glycogen, and lactate levels to assess the metabolic state of the fish. Preliminary observations indicate fish acclimated to 30 and 33°C have reduced performance (lower AMS) and low oxygen tolerance (higher Pcrit value). The findings of this study will determine the ability of southern populations of striped bass to tolerate the challenge of an increasingly warming environment and will provide valuable information for government agencies to guide location selection for future stocking efforts.

Growth rates of juvenile Atlantic Sturgeon in the Altamaha River, Georgia

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Over the last century, Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus)* have suffered major population declines as a result of human activities, especially the construction of dams and unsustainable fisheries. As a result, the species was listed as endangered in 2012. Much of what is known about Atlantic Sturgeon comes from northern populations, but the species is known to demonstrate a latitudinal variation in many life history traits. Compared to populations in northern river systems, southern Atlantic Sturgeon are thought to have faster growth rates, earlier age at maturity, and a shorter lifespan. However, these differences have not been well-quantified, and this knowledge gap is problematic because many southern populations do not appear to be recovering as well as some northern populations. The objective of this study was to determine growth rates of river-resident juvenile Atlantic Sturgeon in the Altamaha River. From 2004-2018, we captured sturgeon using anchored gill and trammel nets. All captured sturgeon were measured and tagged. Fish ages were estimated based on length, and only fish with >1 week between initial capture and recapture were included in our analysis. Growth rate was calculated based on change in fork length and days between measurements. We determined within-summer growth rates for age-1 river-resident juvenile sturgeon, as well as growth rates between the summers of age-1 and age-2. A better understanding of juvenile growth can help inform management actions to help protect juveniles of this endangered species.

Overwinter habitat use and the influence of flow on recruitment of juvenile Gulf Sturgeon in the Apalachicola River, FL

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The Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) is currently listed as federally threatened because of chronic overfishing and habitat degradation that occurred during the 20th century. Although the adult life history of Gulf Sturgeon has been well studied, little information is available regarding juvenile life stages. The objectives of this study were to estimate annual recruitment and to quantify overwinter survival and habitat use of age-1 Gulf Sturgeon in the Apalachicola River, Fl. During the spring and summer of 2014-2017 we acoustically tagged 58 age-1 juveniles (≥10 per year). Using a passive acoustic receiver array deployed throughout the lower estuary and bay, we monitored seasonal movements and survival of the tagged fish. Linear regression flow modeling was used to evaluate the relationship between discharge (cfs), high flow duration (number of days during that have flow above the 75th percentile during a set time period) and recruitment. Annual mark-recapture estimates of juvenile cohorts indicated consistent but low mean recruitment of 69 (st.dev. 70) age-1 juveniles per year during the study. Based on acoustic detections and recaptures of tagged juveniles, we estimated a mean overwinter survival of 80% (st.dev. 8). Because survival was high, our results suggest that population recovery is currently limited by low levels of recruitment to age-1. Our model indicated strong positive relationships between high flow duration in July, August, September, and summer (R^2=0.983, 0.983, 0.983, 0.979 respectively). Discharge also had a strong positive relationship with recruitment in July and August (R^2=0.941, 0.931). This study is the first to examine the relationship between an environmental parameter and yearly estimated recruitment of Gulf Sturgeon. Future studies will add further years of recruitment estimates to the model and will factor in further environmental parameters.

Dorsal scute development in *Acipenser fulvescens* in different environmental calcium concentrations

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Janet Genz, Biology Departmnet, University of West Georgia.

Calcium (Ca^{2+}) is an important element in growth and development of vertebrate species. In fish, the relationship between environmental concentration and internal availability are closely linked, and thus environmental conditions are predicted to have substantial effects on early life stages and growth. Environmental Ca^{2+} limitation could therefore limit healthy growth and reduce development of predatory defenses. This study examined whether different environmental Ca^{2+} levels affect the growth and development of the dorsal scutes and body size in the lake sturgeon, *Acipenser fulvescens*. Predicted effects include: 1) *A. fulvescens* in water with higher Ca^{2+} levels will develop scutes before *A. fulvescens* in water with lower levels of Ca^{2+}, 2) The rate of overall growth will stabilize to body size earlier in water with higher Ca^{2+} compared to lower Ca^{2+}, and 3) *A. fulvescens* in higher Ca^{2+} water will have larger scutes relative to body size than *A. fulvescens* found in lower levels of Ca^{2+}. We reared sturgeon in two recirculating tank systems containing water from two sources varying in ionic composition: the Warm Springs National Fish Hatchery, and the Coosa River. Each water type maintained stable pH and temperature throughout the experiment, and the environmental concentrations of Ca^{2+}, Na^{+}, Mg^{2+}, and K^{+} were quantified for collected water samples. These same ions will also be quantified by ICP-OES in the tissue and scutes of *A. fulvescens*, sampled weekly during the first ten weeks of development post-hatch. Initial results indicate that scutes do contain high levels of Ca^{2+} and the growth rate is slower in water with lower Ca^{2+} levels. Understanding environmental impacts on growth rate and development of defensive structures is important to re-establishing a self-recruiting *A. fulvescens* population in Georgia waterways.

Using side-scan sonar to quantify the spawning runs of Atlantic Sturgeon in the Altamaha River System, Georgia

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a large, benthic, anadromous fish that occurs in the waters off the east coast of North America. Many populations were nearly extirpated by commercial harvest and the construction of dams on spawning rivers; this resulted in the species being listed as federally endangered in 2012. The Altamaha River in Georgia hosts one of the most robust Atlantic Sturgeon populations within the South Atlantic Distinct Population Segment based on recruitment studies. Unfortunately, population estimates for the large, migratory adults are lacking because it is logistically challenging to sample them. The recent availability of cost-effective side-scan sonar technology offers a new method for estimating adult spawners during their upstream migrations. The primary objective of this study was to assess the run size of Atlantic Sturgeon in the Altamaha River. From September through November of 2017 we conducted side-scan sonar surveys throughout the entire 451 river km of navigable potential spawning habitat within the upper Altamaha River system, including the Oconee and Ocmulgee tributaries. We used an N-mixture model to estimate spawning run size; the model considered count data from a continuous survey of the whole system, and estimated detection probability based on repeated surveys of selected river reaches. We detected 85 apparent adult Atlantic Sturgeon, with an estimated detection probability of 0.518 (SE 0.06). Preliminary results from our N-mixture model yielded a total run estimate of 253 (95% confidence interval = 229–279) adults for the 2017 spawning season. Our results were similar to a previous study in 2004-2005, which used mark-recapture to estimate adult spawners, suggesting that the population of adult spawners has apparently remained stable over the past decade. Our study demonstrates that side-scan sonar can be successfully used to estimate localized populations of adult Atlantic Sturgeon.

ORAL PRESENTATION ABSTRACTS

SESSION 2: STUDENTS

Movement patterns during the spawning season of Sicklefin Redhorse in Brasstown Creek, Georgia.

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The sicklefin redhorse (SFR; *Moxostoma spp*.) is a species of special concern previously considered for federal protection under the Endangered Species Act. Once abundant, this species inhabited much of the Hiwassee and Little Tennessee River basins but today exists in < 20% of each occupied basin. In Georgia, it is only known from Brasstown Creek in the Hiwassee River system in Towns County. SFR spawn in fluvial habitats and migrate long distances upstream, beginning its upstream migration in March and arriving to spawning grounds by mid-April. Disruption of spawning behavior can negatively affect populations. Because this species displays fidelity to spawning sites, changes to the environment can affect SFR spawning success. Many aspects of the migration remain poorly understood including residence time in spawning grounds and sex-specific differences in migration patterns. Because of greater mortality rates for males estimated from an earlier study and previous field observations, we hypothesized that males would arrive earlier to and have a longer residence time in spawning grounds. Researchers monitored the creek over a four-month period (March through June) using passive integrated tag (PIT) antenna detection arrays, deployed at two sites approximately 4.6 river km apart, to assess the duration of the SFR migration. In mid-April, a modified fyke net captured additional SFR to insert passive integrated transponder (PIT) tags. A bank of 12-volt deep cycle batteries was replaced weekly to power the arrays, and arrays were checked for malfunctions. Data was download from arrays monthly. Spawning time duration will be based upon the first tag detection and last tag detection for individual SFR at the most downstream array. This research will aid biologists in better understanding SFR movement patterns within the spawning season.

Estimation of population parameters of Sicklefin Redhorse (*Moxostoma sp.*) in Brasstown Creek, Georgia

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Sicklefin Redhorse (*Moxostoma sp.*) is a freshwater species, in family Catostomidae, whose range is limited to the Hiwassee and Little Tennessee River systems in north Georgia and southwest North Carolina. While prior studies have documented migratory patterns and life history, a lack of population demographic data is limiting conservation efforts. However, a coordinated effort by members of the Sicklefin Redhorse Conservation Committee was initiated in 2016 to conduct a capture-mark-recapture study of the population in Brasstown Creek, GA. Fyke nets were used to capture fish moving upstream during their spawning migration (early April). Captured fish were implanted with Passive Integrated Transponder (PIT) tags as marks to identify individuals during subsequent recapture events. Sex, condition, and morphometric measurements were taken before fish were released. An antenna array installed in the river produced additional recapture records of tagged fish that passed by the antennae during the spawning and post-spawning seasons (March-June). A capture-mark-recapture history of marked individuals was compiled with year as capture occasion to be analyzed using an integrated modeling framework. The results will inform managers of estimates of survival, recruitment, abundance, and detection probability of the population. Similar methods could potentially be applied to other populations to provide managers with a better understanding of the status of the species.

Assessing supply and demand of trout in north Georgia under current and projected thermal regimes

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There is little debate that our climate is warming, and this change may affect the persistence of trout in the cool-water regions of Georgia. This warming could affect trout-based recreational opportunities and natural communities in the state. We partnered with GA Department of Natural Resources (GADNR) to evaluate how different warming scenarios might affect trout supply and demand. This information will be used to update GADNR's 18-year old Trout Management Plan. We used data from a 2017 survey of GA trout anglers (n=378) to assess demand for trout. Each angler's responses were counted only for the county in which they fished predominantly. Stocking records from 2017 were then intersected with the angler preference data to determine whether GADNR was meeting angler demands. We used stream water temperature data from 156 sites distributed throughout 38 counties in Georgia to assess the supply of native, naturalized, and stocked trout. We then used linear regression in a model selection framework to predict stream temperature based on air temperature and watershed geomorphology. Air temperature alone was most often the top model and we used estimates based three warming scenarios to forecast stream temperature through 2050. All three forecasts showed a reduction of available thermal habitat for trout. Model forecasts predicted a decline in available habitat of 33% to 70% for Brook Trout and a 30% to 68% for Brown Trout and Rainbow Trout. Suitable thermal habitat for all three species will be increasingly restricted to higher elevations during summer, where refuge from lethal temperatures is available. Our results will inform a revision of Georgia's trout management plan and can be used by fisheries managers to allocate limited resources to areas where trout are most likely to persist in the future and where anglers will be happiest with possible changes.

Regional effects of land use on growth of brown bullhead catfish in the Chesapeake Bay Watershed

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Limited information exists regarding the effects of human land use on the growth patterns of ictalurids. The main goal of this project was to assess the environmental impacts of urban and agricultural runoff on a broader regional scale. Specifically, we examined the effects of anthropogenic activities on brown bullhead catfish growth throughout the Chesapeake Bay Watershed. Brown bullheads *(Ameiurus nebulosus)* collected from nine waterbodies on the Western and Eastern shores of the Chesapeake Bay were weighed (g) and measured (mm Total Length), and lapillar otoliths were extracted from each fish. Otoliths were processed in the laboratory, and ages were estimated from otolith sections. Individual growth histories were computed using the Dahl-Lee method to back-calculate lengths at age. Von Bertalanffy growth models were calculated for each population, and growth was compared across populations. Potential associations between growth patterns and land-use were assessed. Growth models varied greatly by population throughout the Chesapeake Bay watershed. On the western shore of Chesapeake Bay where urbanization predominates as land cover, theoretical maximum lengths (L_∞) ranged from 280 to 349 mm TL (mean = 323 ± 10 mm TL) and growth coefficients (K's) ranged from 0.197 to 0.603 (mean = 0.442 ± 0.057). On the Eastern Shore of Chesapeake Bay where agriculture predominates as land cover, L_∞'s ranged from 299 to 380 mm TL (mean = 332 ± 25 mm TL) and *K*'s ranged from 0.187 to 0.395 (mean = 0.309 ± 0.063). The highest L_∞ (380 mm TL) and the lowest *K* (0.187) was discovered at a location with the highest level of agricultural land cover (Chester River). We suspect that eutrophication of waterbodies from agricultural runoff may result in a bottom-up effect that increases catfish productivity (i.e., higher L_∞'s), although other local features (e.g., fishing mortality, density-dependent growth, habitat, etc.) may also have a strong effect on catfish growth. Future work will involve more detailed analyses of land-use in each subwatershed to further explore relationships between land use and catfish growth. For example, differences in % urban development in western shore watersheds are apparent and may likely explain some of the additional variation observed in catfish growth.

The movement of Redbreast Sunfish and Green Sunfish in fragmented habitats

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Human activities in urban watersheds have resulted in the fragmentation of local streams. We hypothesized that fragmentation has restricted the movement of sunfishes and has led to the isolation of subpopulations throughout the fragmented system. In Fall 2017, Spring 2018, and Fall 2018, we conducted backpack electrofishing at upstream and downstream locations in the highly fragmented Tree Creek and a section of Ivy Creek with little fragmentation. During each season, three rounds of sampling were conducted through the four locations on a rotational basis. During each trip, sunfish ≥ 80 mm TL were tagged in both cheeks with VI alpha tags. If fish were recaptured, tag numbers were read and recorded. A total of 99 redbreast sunfish and 108 green sunfish were tagged in Ivy Creek, with 28 redbreast sunfish and 30 green sunfish being recaptured. The majority of recaptured sunfish were found in their original transects (91.4%). However, while only one redbreast sunfish exhibited a long-distance movement between transects (3.6%), four green sunfish exhibited such a move (13.3%). A total of 255 redbreast sunfish and 81 green sunfish were tagged in Tree Creek, with 61 redbreast sunfish and 28 green sunfish being recaptured. The majority of recaptured sunfish were found in their original transects (94.4%). However, four redbreast sunfish exhibited long-distance movements between transects (6.6%), while only one green sunfish exhibited such a move (3.6%). In conclusion, redbreast sunfish and green sunfish exhibited limited dispersal, displaying great site fidelity. Limited evidence suggests that green sunfish are more likely to disperse greater distances in streams that are less fragmented, while redbreast sunfish are more likely to migrate in fragmented systems. We postulate that redbreast sunfish are more selective in habitat choice, and therefore are more likely to seek out more suitable habitats in degraded ecosystems.

Using instream stationary antennas to monitor the movements of warm water fishes

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Populations of riverine fishes can be divided into stationary (stayers) and mobile (movers) components. The importance of movement for many stream fishes is supported by reductions in fish diversity within watersheds where movement barriers have been introduced. In this study we investigate the variation in the proportions of stayers and movers in a stream fish community. This study took place between June 14, 2018 and August 2, 2018 in a 590-meter stream reach of Raccoon Creek in Paulding County, Georgia bisected by a box culvert. We used 12mm passive integrated transponder (PIT) tags and four instream stationary antennas to monitor six species of fish (221 individuals). Multiple detections of the same individual were grouped by day and considered to be a single daily detection event. There were 1365 daily detection events during the study and the percent of marked individuals detected by species ranged from 33% (*Campostoma oligolepis*) to 64% (*Micropterus coosae*). Larger fish were more frequently detected for four species (*C. oligolepis, M. coosae, Lepomis megalotis, L. auritus*), while two species had greater detection percentages for smaller fish (*Moxostoma duquesnei, Hypentelium etowanum*). We also examined the movement of 111 fish throughout a 320-meter reach of unimpeded stream (six riffle–pool sequences) above the culvert using three of the four instream stationary antennas. Within this reach, 58 upstream and 33 downstream movement events were detected. The proportion of movers in each population ranged from 14% (*M. duquesnei*) to 50% (*M. coosae*) and 28% of the tagged fishes within the reach made movements greater than 150- meters. The preliminary results from this study indicate that an array of instream stationary antennas can be used to examine the differential movements of PIT tagged fishes, and in turn potentially inform conservation and management decisions.

Efficacy of biofouling mitigation methods for floating cage production of southeastern triploid eastern oysters *Crassostrea virginica*

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Off-bottom oyster aquaculture has the potential to be a major economic contributor in the Southeastern United States. However, suitable conditions for optimum bivalve growth are congruent with many suspension-feeding invertebrates that can attach to gear, increasing the need for research of appropriate biofouling mitigation methods. This project assesses the efficacy of three aerial drying frequencies and a fouling-release coating on the control of biofouling on floating oyster cages (OysterGro®) in NC, SC, and GA. Triploid Eastern oyster (*Crassostrea virginica*) seed with an average shell height of 30.9 ± 4.2 mm were stocked at densities of 150 per bag. Cages and oysters were deployed at all locations in mid-October 2017. Fifty percent of cage pontoons and culture bags were treated with a water-based silicone release coating (Netminder®) in September 2017. Aerial drying treatments included drying frequency regimes of every one, two, and three weeks. Quarterly sampling included measurement of shell metrics (height, length, width) and photographic documentation of fouling. An initial subsample of 25 oysters per bag was collected in June 2018. Mortalities were bagged and retained for later shell height measurements. 15 of the 25 oysters were measured, cleaned, weighed, and discarded. The remaining 10 were frozen for further analysis of shell metrics, meat yield, condition, and fouling. Cages remained deployed and drying regimes continued through October 2018 to assess summer fouling. At that time, another 10 oysters per bag were frozen until analysis. Bags were photographed and weighed to determine final fouling intensity. Frozen oysters will be measured, cleaned, and fouling weighed to determine intensity. Meat yield and condition will be assessed. A final economic analysis of each fouling mitigation method in combination with growth and condition data will allow us to infer which regimen produces the highest yields at the lowest cost for growers.

A cautionary tail: attempting to estimate survival of Gag Grouper (*Mycteroperca microlepis*) in the Gulf of Mexico using acoustic telemetry

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The Gag Grouper (*Mycteroperca microlepis*) is an estuarine-dependent fish found in the Gulf of Mexico (GOM) and western Atlantic. Despite the importance of Gag Grouper (Gag) to the recreational and commercial fisheries, basic population dynamics of this species are not well understood. Moreover, recent fluctuations in annual recruitment of Gag have generated concern among managers about the sustainability of current fishing practices. Although there are numerous studies that focus on the survival of Gag as adults, little is known about the survival of juveniles, especially after out-migrating from estuarine nursery area to offshore reefs. Apalachicola Bay, FL is an important nursery ground for juvenile Gag in the northern GOM. Recruits from this area are thought to provide a major contribution to GOM fisheries. Our objective was to estimate survival of post-estuarine juvenile Gag (age 0-3) and describe their movement pattern as they transition from Apalachicola Bay to offshore reefs. In the fall of 2017, we deployed 20 acoustic receivers on natural and artificial reefs located up to 20 miles offshore from Apalachicola Bay, FL. Thirteen Gag were captured via hook-and-line sampling and tagged with surgically-implanted VemcoV7-4L acoustic transmitters. We intended to use telemetry detections as recaptures in a spatial mark-recapture analysis, but as of May 2018, only one Gag was detected. Based on these results, we conclude that our approach to this study was too limited, and that a much larger investment of receivers and transmitters would be required to achieve our objectives. We hope that by identifying the obstacles we faced in this study, future researchers will be better prepared to study Gag and other similar fishes in offshore environments.

ORAL PRESENTATION ABSTRACTS

SESSION 3: RIVERKEEPER SYMPOSIUM

Coal ash In Georgia— what is it, where it is and why it's in the water

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Coal Ash is the by-product of burning coal to create electricity. Historically in Georgia it has been wet-stored in unlined ponds next to power plants, which are next to rivers and/or lakes. Over the last 20 years it has been recognized through investigations, testing and research as well as legal decisions that coal ash, containing a variety of heavy metals including arsenic, thallium, and cobalt, stored in unlined ponds are leaking both into surface water and groundwater. In 2015, the EPA created new regulations for storing coal ash, requiring utilities to "close" coal ash ponds and only store coal, dried in lined facilities (or alternatives such as recycling the ash). Since then, there has been testing, planning, action, legislative measures all around the current coal ash ponds and the moving and storing of coal ash. This presentation will be a quick review of where we in are in Georgia with the desire to have initial conversations of potential impacts to and sampling of fish in our lakes & rivers.

Data to Action: Protecting the Chattahoochee With Water Quality Monitoring

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Although the health of the Chattahoochee River has improved in recent decades, more than 1,000 miles of waterways within the Chattahoochee watershed still do not meet water-quality standards, putting people and wildlife that come in contact with it at risk. Meanwhile, government agencies—typically underfunded and understaffed—are often unable to conduct the monitoring necessary to protect water quality and public health. In response, Chattahoochee Riverkeeper has pioneered several water quality monitoring programs aimed at finding and stopping sewer spills, monitoring bacteria for recreational river users, testing nutrient levels in reservoirs, tracking low dissolved oxygen levels in the river, and using new technology to monitor water quality in real-time. Each year, we collect thousands of samples from the river, its reservoirs and tributaries. In this session we will discuss our core water quality monitoring programs and how we use them to protect the Chattahoochee River for people and wildlife.

Georgia instream flow policy: a brief history and consequences

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During the last century senior fisheries biologists working for GA DNR recommended changes to Georgia's instream flow policy after witnessing marked hydrologic changes in Georgia rivers and streams. The Georgia DNR Board set an 'interim' instream flow policy that has now stretched for about two decades. While based upon robust science, the function of the policy allows for flows to be depleted to 7Q10 levels due to the fact that permit applicants are allowed to choose from a 'menu' of management options as opposed to the permitting agency (GAEPD) giving shrift to actual instream flow needs. Further, additional ad hoc policies have been proposed around Tri-State (ACF) litigation. And, rainfall climate has changed over time, rendering metrics such as 7Q10 into results even more damaging than if rainfall inputs had remained steady. The net effect of policy implementation and practice has been substantial dewatering of streams and rivers in many cases. Examples from around Georgia will be shared.

Restoring the "Trust" in environmental trust funds

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Since the creation of the Solid and Hazardous Waste Trust Funds in the mid-90s, Georgia's General Assembly has directed more than 40% of these funds (over $200 million) away from their intended purposes and into the General Fund. Georgia's constitution must be amended to allow the General Assembly to dedicate these funds, put a stop to bait-and-switch budgets, and restore the "Trust" in Trust Funds.

An overview of research collaborations between Ogeechee Riverkeeper and other organizations

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The Ogeechee River is a coastal plain river with unique fish and wildlife. The watershed is home to over 500,000 people and covers portions of 22 counties. Planted pine forest, coastal sands and clays, and wetlands are major features of the landscape. Environmental concerns include impacts to fish, wildlife, public health, wetlands, tidal marshes, river water quantity and water quality from activities such as titanium and zirconium sand mining, forestry practices, paper mills, solid and hazardous waste disposal sites, residential and industrial development, and invasions by exotic animals and plants. The mission of the Ogeechee Riverkeeper (ORK) is to protect, preserve, and improve the water quality in the Ogeechee River basin. In an effort to fulfill this mission ORK has collaborated with many public and private organizations on a variety of research projects. These projects include water quality and microplastic monitoring, land-use mapping, assessing long-term ecological change by replicating a historical project, septic system mapping, as well as many others. This presentation will highlight many of our successful partnerships, highlight the many benefits of collaborating with non-profits, and suggest areas of collaboration for the future.

Improving Relationships Between Fisheries Managers and Nonprofit Leaders

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Wildlife managers and nonprofit leaders often fail to communicate effectively with one another. This lack of dialogue leads to a poor understanding of the basic processes that govern our respective day to day work activities. Using her own experiences as both a fisheries manager and a nonprofit worker, the St Marys Riverkeeper will outline ways in which we can improve our working relationships, and thereby better achieve organizational objectives.

Habitat restoration in the Satilla River estuary by closing obsolete navigation cuts

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Clay Montague, 245 Deerwood Creek Estates, Waverly, GA 31565-2301

Satilla Riverkeeper and Georgia Department of Natural Resources have been working with the US Army Corps of Engineers (USACE) to restore habitat and access by closing two obsolete navigation cuts and an old creek channel. Based on the best available science of species habitat requirements and on a modern field-calibrated hydrodynamic modeling, these closures are expected to return a natural salinity gradient to the tidal creeks and halt a shoaling issue that has restricted access for recreational fishermen and aquatic species. This project has involved years of coordinated planning and research from a consortium that includes the local community, a local fishing club, university scientists, citizen volunteers, state saltwater fishery managers, environmental nonprofits, the Georgia legislature, and the USACE. The project is innovative both by recognizing that certain obsolete navigation cuts caused reversible habitat damage and by engineering a method to stop that damage.

Cutoff bend restoration on the Savannah River

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Once an important transportation corridor, today the Savannah River is a source for municipal and industrial users, a vehicle for waste disposal, and a force for power generation. It supplies water to Savannah River Site where nuclear material is processed; two electricity-generating nuclear reactors at Plant Vogtle, and dozens of chemical plants and other facilities that discharge waste, "boasting" the third-highest number of toxic releases from its 48 municipal and industrial outfalls. In the Savannah Harbor, the nation's fourth-largest seaport for oceangoing container ships, the river is currently being dredged from 43 to 47 feet. After several decades of this use and abuse, dissolved oxygen levels have become a concern because of large amounts of industrial waste as well as the harbor deepening. In response the Army Corps of Engineers and other partners to undertake one of the largest river restoration projects in U.S. history: to restore the oxbows which were straightened for barge traffic, adding an estimated 40-45 miles of flow—extra assimilative capacity for the overburdened river. Assimilative capacity refers to the river's ability to naturally flush and filter contaminants, a capacity that increases when more water is available. Swamps and wetlands serve as the liver and kidneys of a river system. While the old adage "the solution to pollution is dilution," doesn't always apply, an increase in flow for the Savannah River would be a huge step in the right direction, reducing its heavy toxic burden. A long-term yet critical project and expected to be the largest river restoration in US history, the reintroduction of natural river bends will offer enormous benefits to the Savannah River. We are part of a consortium who recognize the importance of this project and are working towards allowing the river to heal itself.

Daily GA-EPD Sewage Spills Report: how that happened, what's in them, and what to do about them

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Sewage spills damage fishing, swimming, boating, and drinking water. It has been difficult even to find out who spilled what where, since permitted wastewater facilities are only required to tell the press for spills over 10,000 gallons. Thirty-one organizations throughout Georgia and Florida asked the Georgia Environmental Protection Division (GA-EPD) to post sewage spill reports online the same day received, like Florida and Alabama already did. GA-EPD already started posting reports, December 20, 2018. Room for improvement: signup for email alert, and 30-day map, like Florida. These reports make it much easier to who spilled, how much, and where. Suwannee Riverkeeper John S. Quarterman, with WWALS Watershed Coalition, has automated daily differences, highlighting new spills and updates on old ones. Many cities blame rain for spills from the same locations. Maybe it's not the rain that's excessive. Maybe their infrastructure is inadequate, and they should fix it. How do we get GA-EPD to fine offenders? How do we get spillers to fix their infrastructure? How do we know how far spills went downstream, or underground into wells? How do we get spillers to do water quality testing or fund others doing it?

ORAL PRESENTATION ABSTRACTS

SESSION 3: PROFESSIONAL

Improving bathymetric estimates using Kalman filtering and distance analysis

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Bathymetric profiles based on user-generated sonar data can be useful for a variety of management applications, including volume estimation, aquatic plant management, recreational maps, etc. We present two methods of post-collection data processing and compare results generated using these methods as covariates in a thin-plate spline interpolation model to products generated using the same interpolation of raw sonar data without covariates. Distance analysis helps to improve shallow-water estimates by introducing the assumption that as distance from the shore increases, so does depth. Kalman filtering uses a series of measurements—which potentially contains noise and inaccuracies—and produces a series of estimates that tend to be more accurate than estimates that are based on a single measurement. This is done by producing estimates of a variable, along with its uncertainties, then updating them using the weighted average of the first estimate and the next estimate, with higher weight given to the estimate with the highest certainty. Comparison of the two methods using leave-one-out cross-validation showed that adding both a distance raster and Kalman filter estimates as covariates to the thin-plate spline model provided the best bathymetric estimates.

Georgia's intertidal oyster and artificial reefs: an aerial perspective on spatial and geomorphological changes

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The Georgia Department of Natural Resources, Coastal Resources Division, Habitat Restoration and Enhancement Unit (HREU) administers the enhancement of artificial reefs and the restoration of oyster reefs for recreationally and ecologically important finfish and shellfish. In the last five years the HREU has completed fourteen offshore, ten inshore, and eight oyster reef projects. The growth of these reefs increases valuable ecological services, but also increases the amount of monitoring time required by staff to maintain an effective adaptive-management plan. The stability and productivity of reefs in the intertidal zone need to be regularly assessed due to the turbulent nature of Georgia's estuarine systems. With the growing availability and data quality obtainable from unmanned aerial systems (UAS), this platform provides a viable option to reduce field effort while maintaining or enhancing the monitoring data obtained by traditional methods for certain metrics. In particular, advances in photogrammetry make it possible to generate three-dimensional point clouds for measuring biological and geological processes such as the vertical and lateral growth of oyster reefs, enhancement of adjacent habitats in relation of restored reefs, sedimentation, and erosion, without the expense of a LIDAR sensor.

Modeling distribution of endemic Bartram's Bass, congeners, and hybrids in the Savannah River basin

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Bartram's Bass *Micropterus sp. cf cataractae* is an undescribed species of Shoal Bass endemic to the Savannah River basin of South Carolina and Georgia. Bartram's Bass is threatened by habitat alteration and hybridization with invasive Alabama bass (*M. henshalli*) and other co-occurring congeners that may be better adapted for lentic or otherwise altered riverine habitats. In this study, we used generalized linear mixed models and conditional inference trees (CITs) to identify determinants of presence of three bass species and hybrids in Savannah River tributaries. From March to November of 2017 and 2018, individuals were collected from 160 sites across the upper Savannah River basin. Sites represented a gradient of key abiotic variables—watershed- and riparian-scale land use types, ecoregions, stream gradient, and elevation. Genetic analysis of 241 individuals from 50 sites revealed Bartram's Bass were present at 33 sites, and hybrids were present at 21 sites. GLMMs revealed forested land cover at the watershed scale was the most important predictor of Bartram's Bass presence (p=0.0236), and this variable interacted significantly with distance to reservoir. Pure Bartram's Bass inhabited sites with greater forested watershed cover, but only if the site was an appreciable distance from a reservoir with a larger watershed and moderate gradient. Pure Bartram's Bass were collected at sites near reservoirs, but only if stream gradient was high enough to produce shoal habitats. Sites closer to reservoirs with moderate gradients were more likely to contain Largemouth Bass or Alabama Bass. These results reflect the tradeoff between local habitat and dispersal for facilitating spread and hybridization of invasive fishes.

Behavioral variation across sexes in an isolated Shoal Bass population

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Behavioral differences between sexes are well known in Smallmouth and Largemouth Bass but are generally understudied in other black bass species. Males provide parental care to offspring, which likely leads to seasonal differences in habitat use and movement. Understanding behavioral variation across sexes in other *Micropterus* spp. will provide critical information to biologists on how to manage potamodromous sportfishes. We used radio telemetry to track movements of Shoal Bass in Flat Shoals Creek every week for 18 months. 18 sexually immature individuals were tagged early winter. An additional 20 males were tagged in spring and sex was verified. During spring of 2016 and 2017, fish moved into rocky shoal complexes that were used as a spawning and rearing site. The two tagged groups (mixed-sex and known males) exhibited varied seasonal movement rates and navigated the shoals differently (timing, length of stay). Males tended to enter the shoals earlier than the mixed-sex group and remained for a longer duration, which suggests nest guarding behavior. Results may have implications for proper management via seasonal harvest restrictions and identification of critical habitat for both sexes.

Shoal Bass conservation – watershed protection through the ACF threats assessment: an innovative decision making support tool

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Aquatic systems are continually impacted by hydrologic alterations primarily caused by changes in environmental conditions and land use. These changes are putting more and more pressure on our aquatic systems while economic resources to restore and enhance them become more limited. One species, the Shoal Bass, has seen a loss of habitat, fragmentation of native range and even localized expatriation. To address these impacts, the Southeast Aquatic Resources Partnership (SARP) has partnered with the National Fish and Wildlife Foundation (NFWF), Georgia Department of Natural Resources (GADNR), Georgia Power and others to improve aquatic habitat in the Apalachicola-Chattahoochee-Flint River Basin (ACF). To identify and prioritize aquatic threats SARP developed the ACF threats assessment. This range-wide assessment and mapping tool is used to help regional staff identify restoration projects and critical habitat areas in greatest need of protection. It uses multiple data layers, including species occurrences, habitat niche modeling results, barrier inventories, land cover, and water withdrawals to identify threats to aquatic resources. These threats are then weighted by experts based on the level of risk believed to be driving habitat degradation in each sub-watershed. The ACF threats assessment and the science behind it provides a platform for promoting conservation practices, particularly agricultural improvements to water quality and quantity. SARP and its partners are now implementing this tool across the landscape for a host of restoration projects, allowing effective allocation of limited dollars and ensuring the greatest benefit for Shoal Bass and the overall aquatic resource.

Using specialized anglers to assess a trophy bass fishery in Calling Panther Lake, Mississippi

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Trophy largemouth bass Micropterus salmoides angling is increasing in popularity across North America, more specifically in the Southern United States where conditions are favorable for growing large fish. As a result, state agencies have been tasked with examining existing trophy bass fisheries. Traditional standardized sampling gear, such as electrofishing and creel surveys, often prove ineffective at obtaining adequate sample sizes needed to assess the valuable trophy fisheries within a particular system. In this study, we assessed the trophy bass population in the newly impounded 163-ha Calling Panther Lake, Mississippi, using a non-traditional specialized angling technique and compared the results with data collected by more traditional techniques of creel surveys and electrofishing. The specialized angling technique utilized a select few, highly skilled and devoted anglers that targeted only the largest bass in a population. The specialized angling technique collected nearly 8 and 24 times more trophy bass (< 3.6 kg or < 56 cm TL) than creel surveys and electrofishing, respectfully. As a result, this was the only method that reliably collected enough trophy sized fish to estimate a population size in Calling Panther Lake. The specialized angling data revealed through our population model an estimate of 150 (CI's 118-206) trophy bass (≥ 3.6 kg) were present in the lake at the end of 2011, which is equivalent to a density of 1 trophy (≥ 3.6 kg) bass per 1.09 ha-1 (95% CI, 0.79 – 1.38). The use of data collected by specialized anglers provided vital information for the trophy segment of this bass population which is difficult for fisheries managers to obtain with traditional techniques. Thus, fisheries managers should consider all forms of sampling gears, including the utilization of specialized anglers when evaluating trophy fish populations.

Current Trends for Trophy Bass Management

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Private water management for top end bass growth is an ever changing environment. We have continued to tweak tactics with results being outstanding bass growth rates. Included techniques: nutrient management, water quality monitoring, forage stocking options, habitat design, harvest regulations, bass genetic manipulation, and initial stocking densities.

Reservoir Habitat Enhancement in Georgia

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Similar to many other waterbodies in the southeastern United States, Georgia reservoirs are experiencing fish habitat degradation and declines due to reservoir aging and shoreline development. Examples of these issues include erosion, sedimentation, and decomposition and loss of aquatic and shoreline vegetation. Georgia Department of Natural Resources – Wildlife Resources Division (Georgia DNR) has been proactive in establishing and conducting several notable reservoir fisheries habitat enhancement projects. These projects include multiple Reservoir Fisheries Habitat Partnership sponsored vegetation projects, constructing and operating an aquatic vegetation greenhouse, establishing aquatic vegetation in multiple reservoirs throughout the state, conducting aquatic vegetation surveys and installing and improving fish habitats near popular angler use areas, such as fishing piers and bank angling access areas. Georgia DNR also worked with controlling authorities such as Georgia Power Company to enhance fish habitat through reservoir operation and maintenance activities.

POSTER ABSTRACTS

STUDENTS (alphabetical order)

Comparing otoliths and scales to age Bartram's Bass—A Savannah River endemic

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Bartram's Bass Micropterus sp. cf. cataractae is an undescribed species of fluvial black bass, endemic to the Savannah River Basin of South Carolina and Georgia. In the spring/summer of 2017 and 2018, 622 individuals were collected from 53 sites. Otoliths and scales were extracted from each individual, and length and weight were recorded. A subsample of 48 individuals was used to conduct the otolith and scale age comparison. Obvious other Micropterus species and hybrids (based on morphology) were excluded from the study; genetic results are pending. Age estimations were made by two observers to minimize bias, and were confirmed by a third observer in cases of discrepancy. Estimated ages ranged between 2 and 10 years. Individuals weights ranged from 10 to 519 grams (mean = 110.6 g), and lengths ranged from 101 to 374 mm (mean = 180.2 mm). Mean lengths-at-age will be reported for both scales and otoliths. Scales showed 76.7% congruency with otoliths and had only small age discrepancies. With current results, scales are a reliable source for aging within the majority of the tributaries sampled and can provide a non-lethal method for aging this endemic species.

The Molecular evolution of the DNA methyltransferase gene family in fishes

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Zebrafish, cichlids, sticklebacks, and other fishes are important models for human health, development, species radiations, parallel evolution, and other areas of research. Fishes account for more than 50% of vertebrate diversity with more than 32,000 species and represent over 300 million years of evolutionary divergence. Despite the majority of vertebrate species being members of the paraphyletic group known as fishes, DNA methylation has been understudied in fishes compared to other taxa. We need to be able to take information we learn from model species and apply it to other, sometimes distantly related species. This may be especially important for food production, as fishes grown in hatcheries have differences in their methylomes compared to wild fish that contribute to the disparity in phenotypes between wild and farmed fishes. In order to be able to utilize these differences in methylation to increase aquaculture output, we need to understand how the genes that control the application of DNA methylation function. In this study, I analyzed the genomes of 232 vertebrate species ranging across taxa from jawless fishes to mammals. With this dataset, I have identified DNA methyltransferase (Dnmt) genes in each species, characterized functional domains within the methylation genes, and identified retained duplicated copies of Dnmt 3 that show evidence of sequence divergence suggesting subfunctionalization of gene copies.

Patterns of Imperilment within Georgia's Rare Fishes

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The southeastern United states is a hotspot for biodiversity of native fishes. Georgia ranks third in the U.S. in native fish species richness. This area has a high rate of imperilment caused by human-induced degradation of stream habitats. Degraded habitats favor a few species, and studies have suggested that certain taxa are more susceptible to imperilment than others based upon life history traits or habitat preference. This study investigated the relationship between imperilment and family, substrate preference, stream size, and flow preference to determine if there are patterns of imperilment within rare fishes of Georgia. Data was collected from fish status assessment maps of rare fishes constructed by the Georgia Department of Natural Resources Nongame Section based upon fish detections over a >20-year sampling period. Imperilment was classified into five categories based on the number of years since the species was last observed in a watershed, and a weighted imperilment score was developed for each species based upon the ratio of historically-occupied watersheds and currently-occupied watersheds. This study found a significant difference in imperilment score among family ($p = 0.013$), flow ($p = 0.002$), and substrate ($p = 0.011$). Results suggest that imperilment risk is similar among each category except that Fundulidae and Cyprinidae differ from each other, slow and moderate flow differ from swift flow, and vegetation differs from large substrate. Based upon our study, taxa that are more susceptible to imperilment include those fishes that prefer slower flows, which may be susceptible to stream alterations that create homogenized stream habitats that eliminate pools and increase sedimentation. This data may help predict losses of fish diversity, guide recovery efforts, and identify fishes that are indicators of ecological health.

The Southern Appalachian Snorkeling Trail: preserving water quality in Appalachian communities by promoting native fishes

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Students in Young Harris College's Ichthyology course, as part of the Appalachian Teaching Project, collaborated with the Hiwassee River Watershed Coalition to address the issue of sustainable water quality in Appalachian communities by developing the Southern Appalachian Snorkeling Trail. The project linked fish biodiversity to the water quality of local streams, through the recreational and experiential learning activity of snorkeling. The project was designed to encourage the intersection of fisheries science, environmental sustainability and ecotourism in the region. The central focus of the first year of this project was to create the snorkeling trail. To accomplish this, students conducted field research and used findings to develop informational materials including a guidebook that contains maps, directions, site descriptions, and fish descriptions. The guidebook reviews eight sites spread across five watersheds in northeast Georgia and southwest North Carolina, each of which contains a unique assemblage of fishes. Sites were chosen based upon public access, safety considerations, and water clarity. These materials will be made available to the public, both online and through community partners, to promote the snorkeling experience and highlight the need for preserving and protecting water quality in southern Appalachian streams. The project hopes to increase appreciation for the waters of Appalachia as a unique natural and cultural asset while providing economic opportunity. Future research will seek to add additional sites for the snorkeling trail and create interdisciplinary opportunities that enhance community engagement with the project.

Analysis of ontogenetic shifts in diet habits of the invasive blue catfish from the Altamaha River, GA

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We investigated the ontogenetic shifts in food habits of the non-native blue catfish, *Ictalurus furcatus*, in the Altamaha River, Georgia, and assessed the potential impact of the blue catfish on native fauna in the system. The blue catfish was first documented in the Altamaha River in early 2000's, and this species has expanded and become increasingly invasive over time. Biologists from GADNR collected 195 blue catfish from the Altamaha River in summer 2017, and stomach samples from these fish were delivered to the research laboratory at Georgia Gwinnett College. All stomachs were dissected, and any gut contents were identified, enumerated, and weighed for diet analyses. Changes in diet composition with size were explored, with particular focus on potential shifts to piscivory at larger sizes. Overall, 175 of the 195 stomach samples contained diet contents. The Asiatic clam (64%, frequency of occurrence), vegetation/detritus (40%), and fish and fish parts (16%) were the most dominate prey items observed in the stomachs of blue catfish. Of the six whole fish that were identified, four were likely centrachids, one was an ictalurid, and one was an eel-like fish (possible anguillid). Bivalves other than Asiatic clam were observed in 14 stomach samples. Asiatic clams dominated the diets of blue catfish in the 324-464 mm TL size range (82%), while occurring at much lower frequencies in small (≤ 323 mm TL, 30%) and large (465-970 mm TL, 24%) blue catfish. Blue catfish became increasingly piscivorous with size, with fish (or fish parts) occurring in 3.3% of stomachs from small blue catfish, 10% of stomachs from medium-sized catfish, and 35% of stomachs from large catfish. Insects or insect parts were observed most frequently in the stomachs of small blue catfish (20%). Although the Asiatic clam was the most dominant prey item, the blue catfish proved to be an opportunistic predator that feeds on a wide variety of prey. As predicted, blue catfish exhibited increased piscivory with size, and therefore may negatively affect the native fish assemblage through predation. This study should further inform fisheries management on the diet preferences of the latest invasive species to inhabit the Altamaha River.

Growth of Nile Tilapia fingerlings fed organic diets containing yeast and soybean meal as replacements for fish meal

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The global fish meal (FM) output has remained constant for the past 20 years (6 to 7 million metric tons per year). However, demand has dramatically increased because of FM inclusion in all animal production as a high-quality protein source. Soybean meal (SBM) is the most widely used plant-protein ingredient for replacing various sources of FM in aquatic animal diets. However, the use of SBM as the sole protein source has often resulted in reduced fish growth, Consumers' desire for organically-grown seafood continues to increase. Tilapia are the second most farmed fish species in the world and their natural herbaceous feeding habits make them a prime candidate for the rapidly developing market of organic agriculture/aquaculture. An experiment was conducted to evaluate the use of organic soybean meal (SBM) and organic yeast (OY) as complete replacements for FM in the diets of Nile tilapia (Oreochromis niloticus) fingerlings. One commercial marine-based feed was used as a reference diet along with three formulated diets containing organic SBM and different levels of OY (15, 30, 45 %). Nile tilapia fingerlings (mean weight 1.56 ± 0.79 g) were randomly distributed into 12 five-gallon glass aquaria, 10 fish per aquaria and were fed their respective diet for a period of 25 days. Fish fed the control diet containing <10% FM and fish fed a diet containing 45% OY and 55% SBM with amino acid supplementation showed no significant differences ($p > 0.05$) in final weight, weight gain, and specific growth rate (SGR). These results indicate, an organic diet which replaces FM in the proportion (45/55) of SBM and OY along with limiting amino acid supplements (methionine and lysine) may be commercially feasible and further investigation into the increased use of these two ingredients in aquaculture diets for this species is warranted.

Population assessment of brown trout and rainbow trout along a regulated section of the Chattahoochee River

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Historically, the hypolimnial release of cold water downstream of hydroelectric facilities has permitted the introduction and establishment of coldwater nonnative fisheries, such as rainbow trout and brown trout below dams. Since the 1960's, brown trout and rainbow trout were routinely stocked below Buford Dam on the Chattahoochee River. Stocking of brown trout was terminated in 2006, as brown trout were naturally reproducing at high rates and sustaining viable populations below the dam. We hypothesized that brown trout are more highly adapted to the altered flow regime in the regulated river, and, therefore, exhibit better condition, higher GSI's (gonadal somatic indices) and faster growth than stocked rainbow trout. We also hypothesized that trout growth and condition would improve as distance from the dam increased. Brown trout and rainbow trout were collected by angling along the environmental gradient, from approximately 0.38 to 15.76 river miles downstream of Buford Dam. All trout were weighed (g) and measured (mm TL) for condition analyses, and gonads from mature fish were weighed to compute GSI. Rainbow trout ranged from 201 to 350 mm TL, while brown trout ranged from 171 to 340 mm TL. No significant differences in relative weight of brown trout and rainbow trout were discovered along the environmental gradient or by season (summer vs. fall). However, rainbow trout exhibited a significantly higher mean relative weight (mean *Wr* = 97.7) than brown trout (mean *Wr* = 88.4). Female rainbow and brown trout exhibited spikes in GSI in early September and early October, revealing two distinct spawning episodes. In contrast, males of both species exhibited a spike in GSI in early September, and sustained GSI's through early October. Male rainbow trout exhibited significantly higher GSI's than male brown trout, but a significant difference was not observed for females. Based on our results, we hypothesize that stocked rainbow trout may be well-provisioned and artificially selected for enhanced body condition and reproductive investment. Allocation of energy may differ between species, with brown trout allocating more energy to growth or other functions. Future age and growth analyses of both species will test this hypothesis.

Reach- and microhabitat-scale habitat selection in coastal plain fishes

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Studying the habitat use of Coastal Plain fishes enables us to develop a deeper understanding of how fishes thrive in this highly variable environment. Based on previous research in our lab, Coastal Plain fishes seem to sort into two groups: (1) species with a preference for stream reaches that exhibit a fluvial character through the summer, which often are benthic insectivores (hereafter "F" species) and (2) species that prefer sites with a nonfluvial character, which often are laterally-compressed sunfishes ("NF" species). For this study, we took a deeper look at eight species, representing the F-NF gradient, and asked which environmental variables (e.g., water quality, stream size, floodplain connectivity) most influence reach-scale occupancy. At occupied sites, we further examined the fine-scaled habitat use of these species, asking whether F and NF species differed in their specialization on particular microhabitat configurations [depth, velocity, substrate, large woody debris (LWD)]. Habitat availability and use data came from electrofishing and habitat surveys of 25 sites sampled in summer 2016 and 12 sites sampled in 2018. At the reach scale, F species consistently selected sites with higher dissolved oxygen, pH, and conductivity, whereas NF species tended to show the opposite pattern. Neither group showed consistent selectivity for stream-size, physical-habitat, or land-use variables. At the microhabitat scale, F species generally specialized on coarser substrate but showed no consistent preference for particular LWD or velocity configurations. In contrast, NF species consistently specialized on low-velocity and high-LWD microhabitat configurations, but showed no substrate selectivity. These findings suggest that habitat selection of Coastal Plain fishes is scale-dependent, and potentially dependent on morphology, feeding strategy, and water-quality tolerance. In future studies, we plan to assess how well these apparent habitat associations transfer over space and time.

Using photo-identification to assess wintering populations of White Sharks in Mossel Bay, South Africa

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Dorsal fin photo-identification has been used in mark-recapture studies of marine mammals to identify unique individuals in a population for monitoring populations and residency patterns. Few studies have assessed the efficacy of dorsal fin photo-identification in other aquatic species. I compared accuracy and efficiency of manual identification with dorsal fin recognition software packages DARWIN and FinFindR, developed for marine mammals, for white shark fin identification. This is the first study to use the FinFindR software to match fin ID's for white sharks. During winter of 2018, I collected dorsal fin images at a white shark aggregation site near Seal Island in Mossel Bay, South Africa. Sharks were attracted to the boat using sardine chum and tuna heads. I took high resolution photos of dorsal fins of all individuals and obvious pigmentation, scarring, and notches on the dorsal, caudal, anal, pelvic, and pectoral fins. I assessed photo quality, based on focus and contrast, before photos were entered into the software recognition programs. To reduce false positive matching errors, images with a low-quality score are not used in the identification process. DARWIN and FinFindR were ranked by the number of correct identifications made on the systems first suggested match and the time taken to match a set of fins. Information and fin images were stored in a modified version of a cetacean identification-database FinBase. The techniques we design for data storage, using a combination of the best recognition software and FinBase, will be used to monitor the wintering population and residency patterns of white sharks in Mossel Bay. Our results will identify an accurate and efficient photo-identification storage method for use by shark researchers as a prioritized method of identification.

Spatial variation in fish communities within the Hiwassee River watershed

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Human-induced disturbances, such as addition of infrastructure, deforestation, flow modification, and pollution can negatively impact fish biodiversity within watersheds. Thus, changes in fish communities and assemblages can serve as a bioindicator of water quality deterioration and habitat degradation. In addition, community comparisons of subwatersheds within basins can be indicative of historical impacts. We investigated whether changes have occurred within a 15-year period in the Hiwassee River Watershed (HRW) temporally as well as whether communities differ spatially in subwatersheds within the basin. Using fish community data provided by the North Carolina Department of Environmental Quality, we analyzed eight different subwatersheds in the HRW across three sampling periods (2004, 2009, and 2014) using community metrics such as richness, evenness, Shannons diversity index (SDI) and ecological distance. Significant differences among means between years and subwatersheds were detected using analysis of variance with a posthoc Tukeys test and Kruskal-Wallis, respectively, using BiodiversityR in R 3.5.1. Similarity among sites was determined using principle components analysis and constructing a dendrogram from an ecological distance matrix. Fish communities were not significantly different ($P = 0.64$) temporally. However, there were significant differences among two of the eight subwatersheds, Little Brasstown Creek and Shooting Creek, in mean evenness ($P = 0.005$) and SDI ($P < 0.001$). Based upon available water quality data and land use measurements, differences among communities may be related to poor water quality resulting from activities such as unsustainable methods of agriculture and livestock operation, deforestation, flow modification and septic system leakage. Thus, human-induced disturbances such as these can reduce overall fish biodiversity in the HRW if stream best management practices are not observed.