2016 Annual Meeting

Joint Meeting of the Georgia and Alabama Chapters
of the American Fisheries Society

February 9 -11
Columbus, Georgia

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2016 GA and AL-AFS Annual Meeting
Program

Tuesday, February 9, 2016		
9:30-12:00	Registration	
12:30-12:45	Welcome/Opening Comments	Bryant Bowen
12:45-1:05	State of the State (GA-Freshwater Fisheries)	John Biagi
1:05-1:25	State of the State (AL-Freshwater Fisheries)	Nick Nichols
1:25-1:45	State of the State (GA-Marine Fisheries)	Pat Geer
1:45-2:05	State of the State (AL-Marine Fisheries)	Kevin Ansen
2:05-2:25	**BREAK**	
2:25-5:55	**Session 1: Marine Fisheries and Sturgeon Ecology and Management**	
2:30-2:45	Gear selectivity in surveys of shark nurseries using hand-retrieved longlines and gill nets	Carpenter*
2:45-3:00	Assessing Southern Flounder, *Paralichthys lethostigma*, Populations in the Northern Gulf Of Mexico	Stanfill*
3:00-3:15	Seasonal Movements and Annual Mortality Rates of Tripletail Lobotes surinamensis in the Southeast	Cummins*
3:15-3:30	Use of portable ultrasonography to detect pregnancy and fecundity in bonnetheads (Sphyrna tiburo)	Belcher
3:30-3:45	The state of sturgeon in Georgia: an overview of sturgeon research and sturgeon populations in the Peach State	Peterson
3:45-4:00	Spawning migrations of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Altamaha River, Georgia	Stowe*
4:00-4:15	Juvenile Atlantic Sturgeon Seasonal Movements and Outmigration in Four Georgia Rivers	Fox*
4:15-4:35	**BREAK**	
4:40-4:55	Atlantic and Shortnose Sturgeon recruitment in the Savannah River, Georgia	Cummins*
4:55-5:10	Using Side-Scan Sonar to Assess the Atlantic Sturgeon Spawning Run in the Altamaha River	Stowe*
5:10-5:25	A New Population of Atlantic Sturgeon in the Satilla River, GA	Fox*
5:25-5:40	Experimental Passage of Adult Gulf Sturgeon on the Apalachicola River	Peterson

5:40-5:55	Calcium regulation during early ontogeny in *Acipenser fulvescens*	Genz
5:55-6:15	**BREAK (transition to business meetings)**	
6:15-7:00	GA and AL AFS Chapter Business Meetings	
7:00-8:00	Poster Session	
7:00-9:00	Welcome Social	

*Student presentation

2016 GA and AL-AFS Annual Meeting
Program

Wednesday, February 10, 2016		
7:30-2:00	Registration	
8:00-11:45	**Session 2: Student Session**	
8:05-8:20	Growth and Mortality of Largemouth and Spotted Bass in Three Georgia Reservoirs	Perry*
8:20-8:35	Estimation of Stock-Specific Productivity to Assess Trade-offs in Mixed Stock Pacific Salmon Fisheries	Staton*
8:35-8:50	Do residential ponds serve as sources of competitors to the fish assemblages of local streams?	Sunga*
8:50-9:05	Disentangling exogenous drivers of Alewife population dynamics in Lake Michigan	Vidal*
9:05-9:20	Downstream Changes in Periphyton Communities from Gaps in Riparian Forest Cover	Davis*
9:20-9:35	Optimizing a Standard Sampling Program for Non-wadeable Rivers in Alabama to Estimate Species Abundance and Richness of Fish Communities	Dattilo*
9:35-9:50	Fish Community and Health Assessment in a Blackwater System in SE Georgia	Kuhn*
9:50-10:10	**BREAK**	
10:15-10:30	Endemic Black Bass Habitat Use and Availability at Multiple Scales in Middle Chattahoochee River Tributaries	Katechis*
10:30-10:45	Is Nitrate a Potentiator of Estrogens in Fish?: a Multi-Tiered Approach	Parr Moore*
10:45-11:00	Investigation of Environmental and Biochemical Factors Associated with Intersex in Freshwater Fish	Urich*
11:00-11:15	Effects of Hydrologic Change on Stream Fish Assemblages in Alabama	Stiles*
11:15-11:30	Freshwater Mussel Larval Metamorphosis Response to Elevated Cortisol in Host Fishes	Nelson*
11:30-11:45	Economic Value of Recreational Fishing on Reservoir and Tailrace Sections of Millers Ferry Reservoir, Alabama	Gratz*
11:45-1:00	**Lunch (on your own)**	
1:00-3:35	**Session 3**	

1:05-1:20	Use of pectoral fin rays to age sicklefin redhorse Moxostoma sp. and effect of stream discharge on annual growth	Serrano*
1:20-1:35	Using Cryopreservation of Robust Redhorse and Sicklefin Redhorse Sperm as a Conservation Tool for Restoration	Zelko
1:35-1:50	Taxonomic diversity of blood flukes (Digenea: Schistosomatoidea) infecting Alabama turtles	Roberts*
1:50-2:05	Comparison of Induced Mutations in Ticam 1 Gene in Different Tissues of Channel Catfish *Ictalurus Punctatus*	Elaswad*
2:05-2:20	Age, growth, and mortality of the White Catfish, *Ictalurus catus*, in the tidal St. Mary's River	Sakaris
2:20-2:35	Evaluation of Management Alternatives for Gulf Striped Bass	Aspinwall*
2:35-2:50	Incremental stocking and monitoring of triploid grass carp to manage hydrilla and reduce the risk of Avian Vacuolar Myelinopathy at J. Strom Thurmond Reservoir	Brandon*
2:50-3:05	Influences of Different Types and Rates of Mechanical Aeration on Water Temperature and Evaporation Rate in Aquaculture Ponds	Abdelrahman*
3:05-3:20	Update on Programmatic Activities of the Watershed Protection Branch of the Georgia Environmental Protection Division	Hendrickx
3:20-3:35	Instream flows in Alabama: informing decisions regarding water allocation with science-based assessment	Irwin
3:35-3:55	**BREAK**	
3:55-6:05	**Session 4: Dam Removal Session**	
3:55-4:00	Introduction	Hess
4:00-4:15	Can we redeem the dammed?	Freeman
4:15-4:30	River Restoration through Dam Removal: National and Regional Perspectives	Emanuel
4:30-4:45	The Southeast Aquatic Connectivity Program: Building Capacity for Dam Removal in the Southeast	Hoenke
4:45-5:00	A Brief Overview of the Columbus, Georgia Dam Removal Project	Turner
5:00-5:15	Movement of Transported Alabama Shad in the Alabama River, AL.	Kern*
5:15-5:30	Effects of Dam Removal & Habitat Restoration on Migratory Fishes of Green Bay with Emphasis on Northern Pike (*Esox Lucius*)	Cottrell*

5:30-5:45	Potential for White Dam Removal	Vining
5:45-6:00	Response of Fish Assemblages to Removal of Two Mainstem Dams on the Chattahoochee River Between Phenix City, Alabama, and Columbus, Georgia	Sammons
6:00-6:05	Closing Comments	Hess
7:00-9:00	**Banquet and Awards Ceremony**	

*Student presentation

2016 GA and AL-AFS Annual Meeting
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Thursday, February 11, 2016		
7:30-9:00	Registration	
8:00-12:15	**Session 5**	
8:05-8:20	Distribution and Community Structure of Fish Species in Large Tributary Streams of the Middle Chattahoochee River, Georgia and Alabama	Belkoski
8:20-8:35	Evaluation of Mean Rank Shift for Discerning Changes in Reservoir Fish Assemblages	Jennings
8:35-8:50	Will the Increasing Alkalinity of Surface Waters Affect Fisheries Management Decisions?	Boyd
8:50-9:05	Abiotic competition between Alabama native and non-native aquatic species	Meade
9:05-9:20	Distribution of the introduced island apple snail (*Pomacea maculata*) in the lower ACF	Ruehl
9:20-9:35	Invasive crayfishes of the lower ACF basin	Keller
9:35-9:50	A Comparison of Benthic Macroinvertebrates Colonizing leaf, Wood, and Artificial Substrates in Two Southeastern Coastal Plain Rivers	Mullis
9:50-10:10	**BREAK**	
10:15-10:25	Midwest Lakes Presentation	Slipke
10:25-10:40	Watering our Mussels: Can Water Augmentation Benefit Freshwater Mussels?	Wisniewski
10:40-10:55	Revision of Georgia's State Wildlife Action Plan and Implications for Aquatic Species Conservation	Albanese
10:55-11:10	Longevity and Habitat Use of the Imperiled Okaloosa Darter	Holt
11:10-11:25	Black Bass SNPs: An Update	Peatman
11:25-11:40	Evaluation of Stocking All Female Largemouth Bass in Alabama Ponds	Maceina
11:40-11:55	Development of a Range Wide Shoal Bass Management Plan	Robinson
11:55-12:10	Shoal Bass Standardized Sampling along the upper Flint River	Baker
12:10-12:15	Closing Comments	Bowen
12:15-1:00	**RAFFLE & SILENT AUCTION**	
1:00	MEETING ADJOURN	

Poster Presentations

Growth and Mortality of Largemouth Bass in Georgia Waters: Implications for Research and Management	Bonvechio
Age, growth, and condition of sunfishes in an urban stream	Coover*
Effect of elevated temperature on the metabolic physiology of non-native Alabama Asiatic clam, *Corbicula fluminea*	Gregory*
Consumer community structure along a ~200-km stretch of the Ogeechee River	Lutz*
Comparison of age and growth of redhorses in Brasstown Creek, Georgia.	Newman*
Environmental DNA Monitoring for Blue Shiners in the Coosa and Cahaba River Systems in Alabama	Salverda*
Mercury accumulation and endocrine disruption in largemouth bass in the Rae's Creek watershed, Augusta, GA	Sayre*
Extreme temperature tolerance of the Alabama non-native Asiatic weatherfish, *Misgurnus anguillicaudatus*	Zettili*

ABSTRACTS (ORAL PRESENTATIONS)

SESSION 1

Gear selectivity in surveys of shark nurseries using hand-retrieved longlines and gill nets

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Georgia's estuaries serve as nursery habitat to numerous species of the small and large coastal shark complexes. The St. Simons and St. Andrew Sounds could be considered Habitat Areas of Particular Concern (HAPC) for their important ecological roles for numerous federally managed species and their susceptibility to human impacts. Ongoing surveys of these nurseries have been conducted using hand-retrieved longlines for 16 years for stock assessment purposes. However, it is understood that gear selectivity can bias such estimates, as the vulnerability to a given gear type often varies across species, sizes, and life stages. Another common method of surveying shark nurseries is using bottom gill nets. Our objectives were to first compare hand-retrieved longlines and gill nets for differences in selectivity and to then identify potential sources of bias. We sampled 10 fixed locations (5 in each sound) with each gear from April through September of 2015. Hand-retrieved longlines captured 229 individuals of 8 species in 110 sets, and gill nets captured 86 individuals of 7 species in 40 sets. Frequency of occurrence was dependent on gear type for at least two species. Subadult finetooth sharks (*Carcharhinus isodon*) occurred often and almost exclusively in gill-nets. Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) were more likely to be encountered by hand-retrieved longlines. Proportions of those species encountered by both gears varied significantly. Hand-retrieved longlines captured a broader range of sizes than gill-nets. These findings suggest that each gear type encounters individuals non-randomly and do so differently from one another as a result of gear selectivity. Dietary preference and individual morphology likely account for much of the observed variability. *C. isodon* frequency in gill nets strongly suggests St. Simons and St. Andrew Sounds to be nursery habitat. This study is useful for addressing issues of uncertainty associated with stock assessments.

Assessing Southern Flounder, *Paralichthys lethostigma*, Populations in the Northern Gulf Of Mexico

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Despite southern flounder, *Paralichthys lethostigma*, being a commercially and recreationally important flatfish species in the northern Gulf of Mexico (GOM), our knowledge of its population dynamics is not well developed. In addition, given their life history (i.e., with offshore-inshore migrations), they may have been impacted by the 2010 Deepwater Horizon oil spill. We collected southern flounder from three sites along the northern GOM-- Barataria Bay, LA, Mobile Bay, AL, and Apalachicola Bay, FL (sites were chosen to cover a gradient of potential oil impact, as well as potential regional differences), and used thin sections of their sagittal otoliths to quantify age-and-growth. Growth was quantified using von Bertalanffy equations and did not differ for fish from Louisiana versus Alabama coastal waters, but did differ significantly for fish from Florida coastal waters versus both Louisiana and Alabama. Significant differences in length-frequency distributions were observed for southern flounder across all three regions, being larger in Alabama versus Louisiana and Florida. We also examined weight-length relationships for these populations (i.e., $W = aL^b$); values of the exponent b for Louisiana, Alabama, and Florida were $b = 3.2752$, $b = 3.1788$, and $b = 2.8448$, respectively. Significant differences in the weight-length relationships among sites (all $p \leq 0.007$) indicate that southern flounder collected from Louisiana and Alabama coastal waters put on more weight per length than did fish from Florida coastal waters. Finally, we used catch-curve analysis to quantify total annual mortality (A) for the three populations, which were 79% in Louisiana, 61% in Alabama, and 54% in Florida. To further distinguish these populations, we are currently quantifying their otolith microchemistry to determine the natal habitat that fish used as well as identifying any potential oil markers across the regional gradient.

Seasonal Movements and Annual Mortality Rates of Tripletail *Lobotes surinamensis* in the Southeast

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The Atlantic Tripletail *Lobotes surinamensis* supports a popular recreational fishery along the Atlantic coast of Georgia and Florida; however, effective management of this fishery has been hampered by a lack of data regarding the fisheries impacts on the population. The objective of this study was to determine the annual mortality rate for the Tripletail population inhabiting the Atlantic coast of Georgia and Florida. During the summers of 2009 through 2014, Tripletail were captured via hook and line sampling in Ossabaw Sound, Georgia. Prior to release, each fish received a surgically implanted acoustic transmitter. A total of 270 stationary receivers were used to monitor the movements of these tagged fish during their annual migrations between Ossabaw Sound, Georgia, and Jupiter, Florida. Over the 5 years of the study, we released a total of 59 tagged fish, yielding a total of more than 500,000 valid detections. Using spatial mark-recapture modeling and tag returns from local anglers, we calculated annual mortality rates of the population for each year of the study. Although these rates were higher than those for several other Atlantic coast sport fishes, additional population dynamics data will be needed to fully assess the sustainability of the current recreational fishery.

Use of portable ultrasonography to detect pregnancy and fecundity in bonnetheads (*Sphyrna tiburo*)

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JoAnn Slack, University of Pennsylvania School of Veterinary Medicine, Kennett Square, PA 19350

James Gelsleichter, University of North Florida, Jacksonville, FL 32256

Reproductive biology is a necessary element for the management of elasmobranch fisheries. Traditionally, characterization of elasmobranch reproduction has involved lethal sampling to examine gross reproductive structures and development of embryos. However, this method is counterproductive to the conservation of shark populations. In the second component of this study, I examined whether portable ultrasonography could be used as a non-lethal method for detecting pregnancy and determining fecundity in bonnetheads. Female bonnetheads (n = 66) were collected weekly throughout their gestation period (April to October). Reproductive status and fecundity were assessed using an 8 – 5 MHz linear and 5 – 2.5 MHz curvilinear array transducer. The shark was then dissected to confirm the results. Overall, detection of reproductive status using ultrasound methods demonstrated good agreement with dissection (90.9%). There was moderate and substantial agreement between the ultrasound methods and dissection method (Kappa coefficient for linear versus dissection = 61.3%; curvilinear versus dissection = 88.9%). Overall mean of fecundity assessed with the linear transducer (5.7 ± 2.4) was not significantly different from overall mean of dissection (6.6 ± 2.5), as was the curvilinear transducer (5.7 ± 2.2). In overall detection of reproductive status, ultrasound methods demonstrated good agreement with the “gold standard” method of dissection.

The state of sturgeon in Georgia: an overview of sturgeon research and sturgeon populations in the Peach State

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Since 2002, the UGA sturgeon research group has conducted long-term population assessments for both Atlantic Sturgeon (ATS) and Shortnose Sturgeon (SNS) on all major coastal rivers within Georgia. Because both species are federally endangered, the current status and population trends of Georgia's sturgeon populations are critically important to both state and federal resource managers. Over the past 14 years, the UGA research team has combined intensive field sampling with modern modeling approaches to produce some of the first quantified estimates of annual recruitment and population abundance for either species in any part of the range. Recent improvements in field methods, have also facilitated long-term telemetry studies that have provided new information regarding life history, behavior, and seasonal habitat use. The objective of this overview presentation is to present a summary assessment of the current status of Georgia's ATS and SNS sturgeon populations based on a combination of quantitative population data and biological parameters, within the context of what is known about populations of both species in other parts of their ranges.

Spawning migrations of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Altamaha River, Georgia

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) has declined throughout its range and the species is now protected under the U.S. Endangered Species Act. Information on the timing and extent of spawning migrations is essential for the development and implementation of effective management and recovery strategies, yet this information is lacking for most populations. The objectives of this study were to document and identify temporal and spatial patterns in the seasonal movements and spawning migrations of Atlantic Sturgeon in the South Atlantic Distinct Population Segment. A stationary array of acoustic receivers was used to monitor the movements of 45 adults in the Altamaha River system, Georgia from April 2011 through March 2014. Telemetry data revealed that the adult spawners exhibited two distinct patterns of upriver migration: a spring two-step migration and a fall one-step migration. During the spring two-step migration, the adults appeared to stage in the upper Altamaha during the spring and early summer, before migrating to suspected spawning habitats in the Ocmulgee and Oconee tributaries during the fall. During the fall one-step migration, fish entered the system in late summer and migrated directly upriver to suspected spawning habitats in the Ocmulgee and Oconee tributaries. Regardless of which pattern was used during the upstream migration, all fish returned downstream and left the system by early January. Although direct evidence of spawning has not yet been obtained, the telemetry and environmental data provide strong circumstantial evidence that Atlantic Sturgeon spawning in the Altamaha population occurs only during the fall months when water temperatures are < 25 ^{o}C. These findings further illustrate the clinal variation in the life history of Atlantic Sturgeon and highlight the need to manage the species as distinct population segments with regionally specific recovery goals.

Juvenile Atlantic Sturgeon Seasonal Movements and Outmigration in Four Georgia Rivers

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a federally endangered anadromous fish found along the east coast of North America. Despite nearly two decades of Federal Protection, many populations have not recovered and many biologists now believe that poor recruitment may be responsible. Unfortunately, the lifecycle and habitat use of early juveniles is not well understood. The objectives of this study were to describe seasonal habitat use and timing of outmigration for age-1 Atlantic Sturgeon within three Georgia Rivers. During the summers of 2014-2015 we collected age-1 Atlantic Sturgeon in the Ogeechee, Altamaha, Satilla, and St. Marys Rivers. A total of 34 fish were implanted with acoustic transmitters. Movements of these fish were monitored using a series of stationary receivers deployed below the heads of tide in each river system. Spatial analyses of the detection data revealed that juvenile sturgeon in all four rivers exhibited a similar pattern of seasonal habitat use; concentrating upriver during the summer and moving downstream into polyhaline habitats during the colder months. Of the 34 age-1 fish that received transmitters, 13 were confirmed to have outmigrated before the following spring. Most of these fish began leaving their natal rivers as temperatures declined in early winter, after which they were detected in several estuaries in both Georgia and South Carolina. These findings have important implications for future monitoring of Atlantic sturgeon recruitment and potential bycatch in several South Atlantic commercial fisheries.

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 from the Saint John River, Canada to the St. Johns River, Florida. Severe overfishing, coupled with habitat losses during the 1900s, resulted in major population declines that eventually led to the species' listing under the US Endangered Species Act in 2012. Although Atlantic and Shortnose sturgeon are now considered endangered, quantified recruitment data are largely lacking for most systems, particularly for populations within the Southeastern United States. The objective of this study was to quantify annual recruitment of Atlantic and Shortnose sturgeon in the Savannah River, Georgia, by estimating annual abundance of age-1 Atlantic and Shortnose sturgeon. During the summers of 2013–2015, we used anchored gill nets and trammel nets to sample juveniles of both species throughout the Savannah River estuary. Ages of captured juvenile Atlantic and Shortnose sturgeon 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 juveniles in 2013, 616 in 2014, and 623 in 2015. Over this same period we estimated annual cohorts of age-1 shortnose sturgeon to be 81 in 2013, 270 in 2014, and 245 in 2015. These findings suggest that the Savannah River populations of both species are likely the 2nd largest within the Southern Atlantic. Future estimates of juvenile abundance for both species should help provide quantified information regarding population trends as well as identify key environmental variables affecting recruitment in the Savannah River system.

Using Side-Scan Sonar to Assess the Atlantic Sturgeon Spawning Run in the Altamaha River

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The use of side-scan sonar (SSS) imaging in fisheries research has expanded in recent years and is now being used in conjunction with traditional sampling methods to estimate fish population parameters for many species. Side-scan sonar technology has shown the greatest promise with fish like sturgeon given their large size and unique shape. During Fall, 2015, we conducted a pilot study in the upper Altamaha River system to evaluate the potential of using low-cost SSS to assess the annual spawning run of Atlantic sturgeon in that system. Our specific goals were to: (1) determine the spatial and temporal distribution of putative fall spawners; and (2) assess the potential of using an N-Mixture model to estimate the number of Atlantic sturgeon adults comprising the spawning run. In total, we surveyed over 475 km of river from September through November, with many sections of river sampled on multiple occasions. Here we provide the preliminary results of that investigation, including count data of likely sturgeon, as well as the temporal and spatial distribution of sturgeon. This preliminary investigation illustrates some of the challenges of using side-scan sonar for abundance estimation within large river systems during spawning season and highlights important factors that may predict the compatibility of using SSS to answer particular fisheries question.

A New Population of Atlantic Sturgeon in the Satilla River, GA

Mark Fritts, University of Illinois

Isaac Wirgin, New York University School of Medicine

Tim King, USGS Leetown Science Center

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The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a federally endangered anadromous fish and an important component of the biodiversity of the North American Atlantic Coast. Many populations have been severely reduced by habitat degradation and chronic overfishing that occurred during the late 19th and much of the 20th century. Historically, spawning populations were known to exist in all major Atlantic Coast rivers from the St. Lawrence River, Quebec to the St. Johns River, Florida. Over the past two decades fisheries surveys suggest that several populations at the southern extent of this range have either declined to remnant status or have been extirpated. The objective of this study was to assess abundance and genetic character of Atlantic Sturgeon in the Satilla River, Georgia. From 2008-2010, 2800 hours of sampling with entanglement gears was conducted in the tidally influenced reaches of the Satilla River. Over these 3 years, we captured a total of 193 Atlantic Sturgeon. Of the 157 specimens collected in 2010, 63 were determined to be age-1 river-resident juveniles. Genetic analyses of these specimens revealed depauperate levels of mtDNA haplotype diversity and the presence of large family units from microsatellite DNA multilocus genotypes, all suggesting that very few parents produced the 2008 year class. Both analyses indicated that the Satilla River juvenile population was genetically distinct from other populations in the South Atlantic Distinct Population Segment. Life history characteristics of Atlantic Sturgeon and genetic results from this study suggest that the 2008 Satilla year-class could have been the offspring of a small remnant pool of Satilla River adults. Additional tissue samples will be needed from future cohorts to more fully describe the genetic character and origin of the current population.

Experimental Passage of Adult Gulf Sturgeon on the Apalachicola River

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The Gulf Sturgeon, *Acipenser oxyrinchus desotoi*, is an anadromous fish that inhabits the Gulf of Mexico (GOM) and coastal rivers from Florida to Louisiana. Historic overfishing accompanied by dam construction led to species declines and subsequent listing as threatened under the Endangered Species Act. In particular, dam construction on spawning rivers has impeded spawning runs of Gulf Sturgeon, leaving them to spawn in only a portion of their historically available habitat. On the Apalachicola River, FL, construction of Jim Woodruff Lock and Dam (JWLD) in 1956 eliminated Gulf sturgeon access to 78% of their historic riverine habitat within Apalachicola-Chattahoochee-Flint (ACF) drainage. Several previous studies have concluded that population recovery has been hindered by chronically poor recruitment, mostly likely resulting from a lack of access to historic spawning habitats located upstream of JWLD. The objective of this study was to evaluate the potential efficacy of future passage at JWLD. To assess the potential downstream (return) passage of adult Gulf sturgeon at JWLD, we conducted a trap-and-transport experiment during the spring spawning run in 2015. Using large mesh gill nets deployed just below JWLD, we captured and transported 10 adult male Gulf Sturgeon from the Apalachicola River to the Lake Seminole above JWLD. Prior to their release, all 10 of these fish received surgically implanted acoustic transmitters so that we could monitor their movements throughout the spawning season. A series of stationary acoustic receivers deployed both above and below JWLD were used to record sturgeon movements throughout the study. Our results showed that 20% of the translocated sturgeon moved 69 RKM upstream into potential spawning habitats in the lower Flint River before returning back to Lake Seminole. Another 60% of the fish were observed falling back through the spillways at JWLD during high flow events. These findings suggest that although some fish may effectively navigate the lake to find suitable habitat upstream of JWLD, downstream passage of Gulf Sturgeon at JWLD may require installation of a fishway or other fish passage structure. Further studies are needed to determine if passage is a viable option for recovery of this population.

Calcium regulation during early ontogeny in *Acipenser fulvescens*

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Stocking out of hatchery-raised juveniles is essential to restore historical population levels of the freshwater lake sturgeon (*Acipenser fulvescens*) in response to substantial anthropogenic reductions. Determining optimal growth conditions in the early life stages is therefore critical for this species. Calcium is in greatest demand in the early life stages, making *A. fulvescens* particularly vulnerable to low environmental [Ca^{2+}] during development. This study considers the effect of external [Ca^{2+}] on the developmental growth of larval lake sturgeon. Eggs from wild-caught Manitoba broodstock were fertilized *in vitro* and reared in three environments which differed only in calcium availability (0.17, 0.34, and 1.78 mM Ca^{2+}, with 0.34 mM representing the natural habitat). The impact of this altered water chemistry on hatching success, survival, whole-body calcium flux, condition index, and growth were measured at four distinct developmental stages, from hatching until the onset of exogenous feeding. Neither hatching success nor larval survival differed significantly due to environmental [Ca^{2+}]. Larval sturgeon in low [Ca^{2+}] water demonstrated higher Ca^{2+} influx rates at all post-hatch developmental phases than fish reared at 1.78 mM [Ca^{2+}], indicating a physiological response to environmental calcium limitation. However, even at the lowest tested concentration, larvae demonstrated sufficient adaptive scope for growth. In fact, larvae reared in 0.17 mM Ca^{2+} were the most precocious, increasing in wet weight faster than larvae in the other treatments. In contrast, larval total length did not vary due to environmental [Ca^{2+}], resulting in a higher condition index (K = mass*total length^{-3}) of larvae in calcium-limited environments after 11 days post-hatch. These differences in calcium uptake and growth rate suggest availability of environmental calcium influences early life development and growth of *A. fulvescens* mainly via whole-animal physiological adjustments that balance the trade-off between developmental rate and ionoregulatory demands.

SESSION 2: STUDENT SESSION

Growth and Mortality of Largemouth and Spotted Bass in Three Georgia Reservoirs

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Growth and mortality rates are important determinants of success and sustainability of competing sportfish populations in reservoirs. In the southern U.S., Spotted Bass (*Micropterus punctulatus*) and Largemouth Bass (*Micropterus salmoides*) elicit a large amount of angler effort yet are harvested at disproportionately low rates. Management approaches to maximize catch rates of bass longer than 356 mm (14 inches) total length vary across north Georgia reservoirs, but population monitoring conducted by the Georgia Department of Natural Resources allows for a multi-system comparison of important demographic rates and population structure. We evaluated the growth, relative weight, age structure, and mortality for angler-targeted bass populations in 3 north Georgia reservoirs: Lakes Lanier, Chatuge, and Nottely. Subsamples of Largemouth Bass and Spotted Bass collected from electrofishing surveys on all three reservoirs were harvested for otolith collection. Otoliths from at least 80 Spotted Bass were collected from each reservoir, and otoliths from 87 Largemouth Bass were collected from Lake Lanier. Otoliths were sectioned and assigned ages by two independent readers. Length-at-age models showed greater than average growth rates of Lanier Spotted Bass, while in Lake Nottely Spotted Bass age structure was more skewed towards younger and smaller fish. In Lake Lanier, Spotted Bass averaged a higher estimated length-at-age than Largemouth Bass and had a lower estimate of annual mortality. Spotted Bass are estimated to need more time to grow to 356 mm TL in Lake Chatuge than in Lake Lanier (t ~ 4 yrs. vs. ~ 3.5 yrs.), but both systems had similar estimates of annual survival. We draw further comparisons by quantifying allometric growth relationships between populations.

Estimation of Stock-Specific Productivity to Assess Trade-offs in Mixed Stock Pacific Salmon Fisheries

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Many fisheries of the world operate on a mixed stock basis, like those for Pacific salmon in which multiple spawning populations are all harvested in the same spatial and temporal location. These substocks are often diverse in their life history and behavioral characteristics which ultimately leads to the resilience of the aggregate stock to environmental variation (i.e., the "portfolio effect"). However, this diversity also results in variability in productivity between substocks, leading to different maximum sustainable harvest rates among populations. Thus a trade-off is apparent: either allow forgone harvests in order to maintain stock diversity or harvest the mixed stock at the rate sustained by the stronger stocks, potentially at the cost of the weaker stocks. A confounding factor is that the necessary data for the estimation of substock-specific productivity (i.e., stock specific harvest) are typically lacking. Thus, it is often difficult to ascertain where in this harvest-diversity trade-off space the aggregate stock is located. The proposed presentation will introduce these issues in more detail and discuss one method for estimating stock-specific productivity that does not require stock-specific harvest observations. The method, termed the "time series approach", estimates spawner-recruit relationships for individual substocks based on stock-specific spawner abundance time series in a Bayesian hierarchical framework. The time series approach relies on assumptions of shared recruitment residuals and a shared fishing mortality. Because the time series approach allows for this between-stock sharing of information, it is hypothesized to perform better than simpler approaches in terms of reducing bias in parameter estimates. Proposed simulation-estimation exercises that test the sensitivity of the model to these assumptions will be presented.

Do residential ponds serve as sources of competitors to the fish assemblages of local streams?

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The impacts of residential ponds on the fauna of local streams are not fully understood. Bluegill sunfish are commonly stocked in these ponds, and they may migrate into local streams through either a direct connection with the stream or through an inundated floodplain. These migrating fishes may compete for resources with fishes that are native to the stream. Our project aims to evaluate the potential ecological effects of bluegill sunfish that disperse from three interconnected residential ponds into Nickajack Creek, a tributary of the Chattahoochee River. Our specific objectives were to: 1) Confirm that bluegill sunfish are highly abundant in these ponds, 2) Conduct standardized sampling of the sunfish assemblage in Nickajack Creek from upstream locations near the impoundment inlet to downstream locations, 3) Use scales to estimate the age and growth of sunfishes in Nickajack Creek, and 4) Compare the age structure, abundance, and body growth and condition of the sunfish species to evaluate the potential competitive effect of bluegill sunfish on the native sunfish assemblage. Sampling was conducted in summer and fall of 2012 and 2015. Scales removed from fish in 2012 have been aged, and final growth curves (TL vs. Age) were computed and compared between species. Preliminary analyses suggest that bluegill abundance has increased from 2012 to 2015. In Fall 2015, we also observed a substantial increase in bluegill abundance from downstream to upstream locations, suggesting that fish are migrating into the creek from the residential ponds. Final analyses with be presented at the meeting.

Disentangling exogenous drivers of Alewife population dynamics in Lake Michigan

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Population declines, whether anticipated or not, can have broad reaching effects in terms of ecosystem dynamics, conservation efforts, and stakeholder interests. The ability to disentangle the influence of extrinsic sources of mortality from internal dynamics on population fluctuations remains challenging. We used time series analysis and simulation modeling to investigate whether predation pressure on Alewife *Alosa pseudoharengus* in Lake Michigan would be capable of altering the population's vulnerability to environmental variability. Alewife are an important prey fish for salmonids, which support valuable recreational fisheries. In recent years, reduced Alewife abundance appears to be the norm. We hypothesized that age-truncation, resulting from strong predation pressure has reduced the Alewife buffering capacity against changing environmental conditions. We show that with the contraction of the reproducing age classes, the internal population cycles have been altered, which subsequently has resulted in the population tracking environmental variability more closely. Simulations were used to investigate whether the correlation between Alewife population dynamics and recent environmental conditions stems from erosion of the age structure, or alternatively, response to undesirable conditions for Alewife, irrespective of the population structure. The ability to disentangle the potentially dynamic effects of ecological and environmental forces on population dynamics has important implications for management of fisheries resources.

Downstream Changes in Periphyton Communities from Gaps in Riparian Forest Cover

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Alan Coats

Riparian buffers are important for stream health, and development in stream corridors has the potential to impact riparian buffers. This can lead to changes in not only the physical characteristics of a stream but the biological characteristics as well. Methods of characterizing the biotic integrity of streams include benthic macroinvertebrates, fish, and periphyton community bioassessments. Periphyton is benthic algae and is often the main source of primary production in a stream. The goal of this study was to determine if periphyton community composition is affected by gaps in riparian forest cover. Moreover, this study was conducted concurrently with studies by Alan Coats, a MS student at the University of Georgia's Warnell School of Forestry and Natural Resources, and Carrie McCarty, an undergraduate student at the same school. Alan Coats focused on how the physical characteristics of the stream changed in response to gaps in riparian forest cover while Carrie McCarty examined changes in the macroinvertebrate community. Upon completion of the other studies, information obtained from all three studies will offer a clearer picture of how streams are changed both physically and biologically by gaps in riparian forest cover. We used two methods of assessing periphyton diversity, the Simpson Diversity Index and the Shannon Weiner Diversity Index. We found a significant difference in cyanobacteria diversity (α=0.05) for stream samples from areas with gaps in riparian forest cover versus stream samples from areas with intact forest cover. We used pairwise t-tests to determine differences between the upstream samples and the gap samples and the upstream samples and the downstream samples. This suggests that periphyton might be helpful in understanding the local impacts of riparian buffer loss. In the future, we wish to learn how these changes relate to fish and benthic macroinvertebrate communities.

Optimizing a Standard Sampling Program for Non-wadeable Rivers in Alabama to Estimate Species Abundance and Richness of Fish Communities

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Alabama's non-wadeable rivers support high biodiversity of fishes but no formal sampling program has been developed to monitor the fish community in these systems. Recent developments in Alabama have caused increased interest by Alabama Department of Conservation and Natural Resources biologists to develop such a sampling program, but studies determining adequate sampling effort are lacking. This study was developed to compare three different boat-based electrofishing methods (bank-line, point sampling, and night-time) to sample the fish community and determine the most cost effective method to accurately represent the fish communities present. Four rivers of various sizes (Alabama, Tallapoosa, Choctawhatchee, and Sipsey) were sampled along two 100-mean-stream-width transects. Because habitat complexity can affect sampling effort, substrate was mapped using side-scan sonar within 12 to 40 km reaches of stream, and low and high complexity transects were identified for electrofishing sampling. Sampling was done in summer and fall of 2015 and will take place in summer and fall of 2016. Results are limited at this early stage of the project but summer 2015 sampling alone yielded 11,455 individual fish representing over 100 species in 25 families.

Fish Community and Health Assessment in a Blackwater System in SE Georgia

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In May of 2011, the Ogeechee River was the site of the largest fish kill in Georgia's history. In the wake of this event Georgia Southern University initiated a three-year monitoring project in June 2014 to better understand the ecology of the Ogeechee River in the coastal plain. The Ogeechee River basin is a blackwater system characterized by low gradient, low conductivity, high dissolved organic carbon, extensive floodplains, variable discharge, and predominantly sandy substrate. Monitoring ranges from assessments of potential stressors of the river to fish abundance and diversity measures. Fishes are being monitored quarterly at six sites, three upstream from a textile processing plant discharging treated waste into the river and three downstream from the textile plant. Fishes are sampled at each site in single-pass boat electrofishing transects. Using data from six sampling periods, encompassing four seasons we will look at changes in community structure in relation to season, longitudinal position, location up or downstream from the textile finishing plant, and habitat. Habitat variables include bank height, presence of woody debris, cover, substrate and others as recommended by the USGS. Utilizing data from two sampling periods we will also look at fish health using a modified version of the Health Assessment Index (HAI) in regards to the same parameters.

Endemic Black Bass Habitat Use and Availability at Multiple Scales in Middle Chattahoochee River Tributaries

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The focus of this study was on tributaries of the Middle Chattahoochee River where Shoal Bass *Micropterus cataractae* and Chattahoochee Bass *Micropterus chattahoochae* are experiencing declines, mainly due to anthropogenic disturbances of streams and introductions of non-native congeners. This study examined Shoal Bass and Chattahoochee Bass habitat use and presence/absence at multiple scales. Point and transect surveys, canoe surveys, and available land use data were used to measure habitat characteristics at each scale. Black bass were sampled by both backpack electrofishing and by canoe-mounted electrofishing. Results indicated that suitable habitat for Shoal Bass included rocky boulder habitats with shallow depths and wide stream banks in heavily forested areas of large watersheds and Chattahoochee Bass were found in highly natural and forested land cover areas of small watersheds in wider sections of the stream in rocky and shallow fast-moving shoal habitats. Surveys revealed that Shoal Bass populations can persist in smaller watersheds with enough ideal habitat. Chattahoochee Bass would likely benefit from habitat restoration for Shoal Bass in streams where they are sympatric. Conclusions of this study indicated that priority streams for Shoal Bass and/or Chattahoochee Bass restoration, restocking efforts, and the reduction in non-native bass populations included the Dog River, Snake, Centralhatchee, Hillabahatchee, Wehadkee, Mountain Oak, and Osanippa creeks.

Is Nitrate a Potentiator of Estrogens in Fish?: a Multi-Tiered Approach

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Endocrine disrupting compounds (EDCs) are of growing concern in the aquatic environment for their ability to alter reproduction, behavior, and development in fish. Nitrate (NO_3) is a global pollutant and is unregulated for aquatic organisms. Growing evidence supports NO_3 as an endocrine disruptor, but little is known about its effect on reproduction, development, and physiology in fish. Additionally, there is little evidence to indicate the mechanism behind the observed effects or how it will interact in the presence of other EDCs. Therefore our goal is to investigate if NO_3 is able to potentiate the effects of estrogens and to further explore the effects of NO_3 on fish. A three-tiered approach will be used to evaluate these questions. Tier 1 will evaluate effects on development. Tier 2 will evaluate effects on physiology and behavior. Tier 3 will evaluate the effects on reproduction. Together the results of these studies will improve our understanding of how NO_3 and EDCs interact to affect freshwater fish species.

Investigation of Environmental and Biochemical Factors Associated with Intersex in Freshwater Fish

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The increasing frequency of reports of intersex among freshwater teleost fish has led to concerns about the ecological well-being of fisheries around the world. Intersex is associated with adverse reproductive, immunological, and metabolic effects in fish, but our current understanding of causative factors, environmental effects, and prevalence of intersex among wild fish populations is insufficient to accurately assess the potential ecological risk associated with the condition. Several compounds with estrogenic activity have been shown to induce intersex in male fish individually, yet wild fish are exposed to complex mixtures of endocrine active compounds from municipal, industrial, and agricultural sources, curtailing efforts to pinpoint causative factors. Methods for detecting intersex are lethal, severely limiting the ability of researchers to test hypotheses regarding intersex, particularly among imperiled species. The proposed research includes a comprehensive assessment of intersex and blood chemistry variables among multiple fish species throughout a gradient of agricultural land use in the Upper Conasauga River and adjacent watersheds, accompanied by monthly monitoring of estrogenic activities in sediments and surface waters. Additionally, methods for non-lethal determination of intersex through identification of potential biomarkers and biochemical mechanisms of intersex, will be investigated using an untargeted metabolomics approach to measure and identify discriminatory metabolic analytes in non-lethally sampled tissues.

Effects of Hydrologic Change on Stream Fish Assemblages in Alabama

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Past studies within single watersheds in the Southeast have found that unnatural changes in stream hydrology affect the fish assemblage negatively. With increases in land development and water withdrawals, significant declines in discharge have been seen in some Southeastern streams over the past 50 years. In this study, contemporary fish assemblage data collected in the summers of 2013 and 2014 were compared to historic collections in 6 unregulated watersheds across the physiographic regions of Alabama. Environmental variables such as hydrology and land cover were used to understand shifts in the assemblages. Shoal Creek in the Coosa River drainage is the least developed and most completely forested watershed in the study, and the assemblage in this piedmont stream showed the least interannual change based on Jaccard's and Morisita's similarity indices. Five Runs Creek, a slightly more developed tributary to the Yellow River on the lower coastal plain showed a significant relationship between changes in fish assemblage and discharge over time with a positive relationship between discharge and time. Shoal Creek, a tributary to the Tennessee River in North Alabama located in the Highland Rim physiographic region also saw a significant relationship between hydrology, time, and assemblage; though in this watershed there was a negative relationship between discharge and time. Inclusion of more environmental variables will likely account for more variance in the data and strengthen the relationships seen in the data.

Freshwater Mussel Larval Metamorphosis Response to Elevated Cortisol in Host Fishes

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More than 70% of the approximately 300 species of North American Unionid mussels are currently imperiled or of special concern. In addition to threats such as habitat destruction and degradation, mussel populations are vulnerable because of their reliance on the presence of suitable fish hosts. Some mussel species are known to metamorphose on a variety of fish species, while others have been shown to metamorphose on only a single fish species. Host information is limited for many mussel species, particularly those that are imperiled. Until host relationships are established for the many imperiled unionid species, and host populations are recovered in the wild, captive propagation programs may serve as a bridge to sustain the remaining wild populations. Evidence suggests that the mechanisms regulating host specificity and successful metamorphosis are immunological in nature. Cortisol, the primary corticosteroid in fish, is released as part of a stress response and has system-wide immunosuppressant effects. Elevated levels of plasma cortisol may increase metamorphosis levels of attached glochidia to the juvenile stage. In the present study we administered two levels of exogenous cortisol (0.05 and 0.20 mg/g fish) to five fish species (*Micropterus salmoides, Lepomis macrochirus, Oreochromis aureus, Ictalurus punctatus,* and *Carassius auratus*) to induce a physiological state mimicking chronic stress. Fish were then exposed to the glochidia of *Ligumia subrostrata* and monitored individually for sloughed glochidia and successfully metamorphosed juveniles. Mean metamorphosis success was consistently high for all treatments of *M. salmoides* (65.5% to 69.2%) and *L. macrochirus* (69.7% to 82.3%). However, a significant, dose-dependent response to cortisol was observed in the levels of glochidial metamorphosis success on *O. aureus*. By studying the effects of exogenous cortisol on glochidial metamorphosis rates, this project has contributed to the existing knowledge of the physiological factors underpinning the mussel/fish host relationship and may provide captive propagation alternatives for mussel species for which a natural (ecological) host has not yet been identified.

Economic Value of Recreational Fishing on Reservoir and Tailrace Sections of Millers Ferry Reservoir, Alabama

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Recreational fishing creates a large source of income within the state of Alabama through both direct sales for local communities and taxes for local, state, and federal governments. Knowing how much and where anglers spend money fishing specific destinations allows fisheries managers to better understand the economic impact of these fisheries to the local economy as well as various levels of government. This economic impact was evaluated for Millers Ferry Reservoir, on the Alabama River, located in Dallas and Wilcox Counties, Alabama. We conducted roving creel surveys from January to December 2015 twice a month for four days each trip (total days = 96). The reservoir was split into six sections covering 157.1 km of the Alabama River that were sampled using a stratified, non-uniform probability sampling design. Sampling was conducted over three possible time periods (morning, mid-day, and afternoon) and each day anglers were sampled from two randomly chosen reservoir sections during two of these time periods (total sections sampled = 192). An initial count of anglers was made at the beginning of each section to obtain instantaneous fishing effort. Recreational fisherman were then contacted and asked about their effort, catch success, trip origination, and assumed monetary cost of the trip. A total of 730 interviews were recorded throughout the sampling period. A subsequent phone interview was conducted after completion of the trip to obtain final effort, willingness to return, type of lodging utilized, and final expenditures of the trip. These data will be used to estimate the total economic value of the fishery to the local and state economies.

SESSION 3

Use of pectoral fin rays to age sicklefin redhorse *Moxostoma sp.* and effect of stream discharge on annual growth

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The sicklefin redhorse (SFR) *Moxostoma sp.* is a rare Catostomid fish in the upper Tennessee River watershed of western North Carolina and north Georgia whose listing status is under review. Status reviews rely on the best available scientific data, but age data, which is used to estimate population survival, growth rates, and recruitment for SFR, is difficult to collect and usually involves sacrifice of sampled individuals. We tested the utility of aging SFR with pectoral fin rays, which is a non-lethal procedure, from SFR collected in the spring of 2014 and 2015 from Brasstown Creek, GA. Pectoral fin rays were aged blindly and independently by two readers. Annual growth increments were measured with the use of ImageJ software to determine growth rates. Growth models constructed from growth curves were similar to published data. Captured SFR (n=48) were PIT tagged for future tracking and population estimation. Using age data, we compared growth rates of SFR to stream discharges. Annual growth did not vary significantly in response to annual stream discharge (P=0.40) although, among seasons, spring discharges (P=0.19) had the greatest effect on growth. SFR are long-lived (max observed age=21 years) and experience slow growth after reaching sexual maturity. Factors such as climate change and landscape development may increase discharge but may not affect SFR growth. Future research will investigate other factors such as temperature, evaluate population metrics such as mortality and recruitment, and estimate population abundance by establishing capture histories of recaptured, tagged individuals.

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 66 males collected from Little Tennessee and Tuckasegee rivers, NC and Brasstown Creek, GA in 2014-2015. Also in 2015, a fertilization trial was initiated and will be repeated next year. 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.

Taxonomic diversity of blood flukes (Digenea: Schistosomatoidea) infecting Alabama turtles

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Little is known about the parasites of Alabama's turtles. The turtle blood flukes (TBFs) infect the vascular system of turtles and are most closely related to the avian and mammalian schistosomes, which cause human schistosomiasis. TBF life cycles are indirect, using a gastropod mollusk as the intermediate host and a turtle as the definitive host. TBF eggs are deposited in blood and enter the environment via the turtle's feces or urine. The eggs hatch in water releasing miracidia, which penetrate the intermediate gastropod host, wherein asexual reproduction occurs that results in fluke larvae (cercariae) being shed from the gastropod. These larvae then penetrate the turtle host wherein they mature and sexually reproduce. Although Alabama has the highest turtle and gastropod diversity in the United States, no records of blood flukes infecting Alabama turtles exist. Because of the lack of records, rich host (intermediate and definitive) diversity, and many highly endemic turtle species, Alabama is alluring for investigating taxonomy, ecology, and systematics of TBFs. To date, we have sampled 8 of 31 (25%) turtle species ranging in Alabama: collecting TBFs from all but one species. All of these TBFs comprise new geographic and host locality records for Alabama (*Apalone spinifera* [2 TBFs], *Chelydra serpentina* [2 TBFs], *Graptemys ernsti* [1 TBF], *G. pulchra* [1 TBF], *Sternotherus odoratus* [2 TBFs], *S. peltifer* [1 TBF], *Trachemys scripta* [2 TBFs]), and 3 of these 7 records are from never before sampled turtle hosts (*Graptemys ernsti* [1 TBF], *G. pulchra* [1 TBF], *S. peltifer* [1 TBF]). Some may represent unnamed TBF species.

Comparison of Induced Mutations in TICAM 1 Gene in Different Tissues of Channel Catfish *Ictalurus Punctatus*

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Transcription activator-like effector nucleases (TALENs) are powerful genome editing tools that can be engineered to specifically target any sequence in the genome. Different approaches have been used to introduce TALENs into the fertilized eggs including TALEN plasmid construct electroporation and microinjection and mRNA microinjection. The success of TALENs in inducing the mutations in all the tissues of a fish depends on how quickly they start working after they are introduced into the cells.

Previously, we generated toll / interlukin 1 receptor domain-containing adapter molecule (TICAM 1) gene-mutated channel catfish. In the current study, we investigated how efficient TALENs are in mutating all tissues in P_1 founder mutated fish. The presence of mutations was compared in 9 different tissues including adipose fin, barbles, gills, muscles, brain, liver, spleen, kidney and gonads. DNA was extracted from the 9 tissues and a partial segment of TICAM 1 gene containing the expected mutation site was amplified with polymerase chain reaction (PCR) using a high fidelity Taq enzyme. Mutations were detected using the surveyor mutation detection assay. PCR products were cloned and sequenced.

The same mutation pattern was found in all 9 tissues of mutated fish as well as different mutated fish. Non-mutated fish had no mutation in all of the 9 tissues. However, in the same tissue there should be mutated and wild type cells. Also, based on the mutations patterns and DNA sequencing, the mutation sites were found to be the same in all of the tissues and even in tissues from different mutated fish. The results suggest that TALENs begin working soon after they are introduced. This is important for testing P_1 mutated founder fish. Unlike transgenic fish, fin or barble tissues could be effectively used for analysis of P_1 mutated fish since the same mutations were found in the gonads.

Age, growth, and mortality of the White Catfish, *Ictalurus catus*, in the tidal St. Mary's River

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We estimated the age, growth, and mortality of the white catfish, *Ictalurus catus*, in the St. Mary's River. Few studies have examined the population characteristics of the white catfish. Furthermore, the St. Mary's River is one of the last coastal plain rivers in Georgia that has not been impacted by flathead catfish and blue catfish introductions. White catfish dominate the native catfish assemblage in the St. Mary's River, so we aimed to provide baseline population data prior to a potential invasion by flathead catfish or blue catfish. We used boat electrofishing to collect 184 white catfish from the St. Mary's River on 29 July and 5 August 2015. All fish were measured (mm TL) and weighed (g), and the gender of each fish was identified. Lapillar otoliths were extracted from each fish and stored dry before processing. Otoliths were embedded in a clear epoxy resin and then sectioned along a transverse plane with a high precision sectioning saw. Otolith sections were aged by two experienced readers. Any disagreements in age were resolved by a third independent reader. Only one otolith section was considered unreadable and was removed from the sample. Initial agreement between the two readers was 74.3% (136/183). The majority of disagreements were resolved by the third reader, resulting in final ages estimated for 97.8% of the sample (179/183). Ages of white catfish ranged from one to 11 years. The von Bertalanffy growth model (L_∞ = 486, K = 0.246, t_o = -0.29) predicted that white catfish would reach 270 mm TL by age 3, 383 mm TL by age 6, and 437 mm TL by age 9. Weighted catch-curve regression revealed a 55% annual mortality rate for this species. We hope that our data can be used to assist the future management of this important native species.

Evaluation of Management Alternatives for Gulf Striped Bass

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Gulf-strain Striped Bass (*Morone saxatilis)* have been managed cooperatively for the last thirty-years by Federal and State agencies in Georgia, Florida and Alabama (Gulf Striped Bass Technical Committee). The Committee has recently focused on developing an adaptive framework for conserving and restoring Gulf striped bass in the Apalachicola, Chattahoochee, Flint River (ACF) system. To evaluate the consequences and tradeoffs among management activities, population models are being constructed to inform management decisions. We constructed a stochastic matrix model with varying recruitment and stocking rates to simulate effects of management alternatives on Gulf Striped bass population objectives. We used an age-classified matrix model that incorporated stock fecundity estimates and survival estimates to project population growth rate. In addition, we evaluated how combinations of management alternatives (Harvest regulations, Stocking rates, *Hydrilla* control) influenced population growth rate. Annual survival and mortality rates were estimated from catch curve analysis and fecundity was estimated and predicted using regression analysis of fish length versus egg number from hatchery brood fish data. Stocking rates and stocked-fish survival rates were estimated from census data. Results of the model will be used to update data provided by the Committee for informing decisions related to selection of management alternatives. In addition, the results can be applied to other populations of Striped Bass in the Gulf Region.

Influences of Different Types and Rates of Mechanical Aeration on Water Temperature and Evaporation Rate in Aquaculture Ponds

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Aeration is increasingly used to improve water quality and increase yields in aquaculture ponds. Surface aerators increase oxygenation by creating a greater area of contact between water and air – a process that also favors higher evaporation rate. Evaporation results in heat loss from water bodies; therefore, it affects temperature that is an important factor determining the growth rate of fish. Despite the importance of water temperature on fish growth and the increase in water use associated with greater evaporation, little is known about the increase in evaporation caused by aeration. This study evaluated the influence of aeration on evaporation and water temperature in ponds, and compared effects of different types of aerators on pond evaporation and water temperature. Water loss by evaporation and water temperature were monitored in ponds with different rates of aeration (9.2, 18.4, 27.6 and 36.9 kW/ha) during the first year of the study. In the second year, the effects of different types of aerators on evaporative loss and water temperature were measured. Both surface water temperature and temperature at a 70 cm depth were different for ponds with different numbers of 0.37-kW vertical pump aerators ($p < 0.0001$). The decreases in surface water temperature with 9.2 kW/ha or 18.4 kW/ha of aeration with paddlewheel aerators were more than that of both rates of 'h'-unit™ aerators and non-fertilized control ponds ($p < 0.001$). An aeration rate of 18.4 kW/ha by the Air-O-Lator, paddlewheel and 'h'-unit™ aerators resulted in 57.49 %, 54.24 % and 9.45 % increase in pond evaporation respectively.

Update on Programmatic Activities of the Watershed Protection Branch of the Georgia Environmental Protection Division

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Several Branches of the Environmental Protection Division (EPD) of the Georgia Department of Natural Resources have undergone various levels of restructuring and reorganization over the past few years. The Watershed Protection Branch (WPB) of EPD which manages water resources in Georgia through the issuance and enforcement of permits to local governments and industry to discharge treated wastewater and through the issuance and enforcement of permits to local governments, industry, farmers and subdivisions for surface water and groundwater withdrawals. The WPB also conducts water quality monitoring and modeling of Georgia's waterways and manages activities associated with implementation of the Georgia's Comprehensive State-wide Water Management Plan.
Information about the Watershed Protection Branch of EPD may be found at:
http://epd.georgia.gov/watershed-protection-branch
Information about Georgia's State-wide Water Planning process may be found at:
http://www.georgiawaterplanning.org/

Instream flows in Alabama: informing decisions regarding water allocation with science-based assessment

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The state of Alabama is a global center of freshwater biodiversity that boasts the rich fish diversity and high number of endemic fishes compared to most areas in North America north of Mexico. The natural patterns of seasonal flows in streams and rivers are the drivers for many of the ecosystem functions and processes on which riverine and coastal natural and human economies rely. Alteration of natural flows by increased human demands for water and global climate change have been identified as priority threats to the health of southern rivers. Despite the fact that water resources in Alabama are 'plentiful' compared to other states, water allocation issues almost always involve multiple-competing users with different values and objectives. Science-based frameworks (e.g., Ecological Limits of Hydrologic Alteration; ELOHA) that incorporate the needs and values of decision makers are available to assist with decision making; however, there is no well-developed process for incorporating this into a broader social and political process of making flow allocation decisions. To address this problem, water resource managers and governance entities require science-based resources, tools, and information to support the development and testing of sound instream flow management and practices. Instream flow assessments that incorporate deliberative analytic tools have been case-by-case and although examples are becoming more prevalent, broader scale delivery is warranted. This paper will describe application of structured decision making methods to instream flow management on multiple spatial scales, with specific attention to structural uncertainty. The approach involves defining the problem, decision space, alternatives and appropriate decision analytic tools. Ultimately the framework can incorporate existing data on flow-ecology relations in a way that explicitly links potential water allocation strategies and management scenarios to expected outcomes. The approach will build the capacity of decision-makers in the state to apply data in a socio-ecological context by providing a scientific framework for assessing trade-offs between social values, management needs, and environmental outcomes.

SESSION 4: DAM REMOVAL SESSION

Can we redeem the dammed?

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Dams have well-known effects on rivers. Rivers downstream from dams experience altered flow and sediment regimes, often with novel thermal and water quality conditions. Consequences for biota are only partly predictable. Diadromous fishes typically are extirpated upstream from high dams; sensitive or less-mobile taxa are often extirpated downstream. Between these extremes, fishes persist with less predictability, a topic of ongoing research on the influence of species traits and dispersal. Scientists and managers around the globe are experimenting with dam operations to improve biological integrity upstream and downstream. In some cases, managers are choosing to restore habitats by removing dams. These efforts can have unintended as well as desired outcomes, but also create opportunities to test ecological predictions and to build a stronger scientific basis for conserving biodiversity in a dammed world.

River Restoration through Dam Removal: National and Regional Perspectives

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Dam removal is gaining momentum as a restoration tool to increase aquatic habitat connectivity, public safety and recreational opportunities. Millions of dams exist on streams nationwide. While many still provide hydroelectric power, store water supplies or protect communities from flooding, the vast majority of these structures—especially those built to power sawmills, grist mills or textile mills—are no longer serving their intended purpose, or any economic purpose at all. Removal is an increasingly effective tool to free dam owners of liability and restore habitat. American Rivers' Restoration Program advances dam removal at the local, state and national levels, and we are excited to help educate Georgia resource managers as to the state of dam removal practice nationwide. With limited resources and thousands of small- and medium-sized dams to prioritize for removal, information to guide the process is of principal importance. From an aquatic habitat restoration perspective, dam removal provides "functional restoration" that removes a major cause of impairment, allows a river to be self-sustaining, has broad impacts and a whole-system focus, benefits multiple species and life stages, and doesn't depend on human intervention or maintenance going forward. This presentation will aim to introduce the best practices for prioritizing and removing dams and offer glimpses of case studies from completed projects in North Carolina and elsewhere. General steps for a dam removal will be outlined, including initial reconnaissance, site visits, planning meetings, fundraising, design and engineering, community outreach, permitting, project implementation, and monitoring.

The Southeast Aquatic Connectivity Program: Building Capacity for Dam Removal in the Southeast

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Fragmentation of river habitats by anthropogenic barriers is one of the primary threats to aquatic species in the United States. To help address this problem, The Southeast Aquatic Resources Partnership (SARP) has developed the Southeast Aquatic Connectivity Program. This program is a partnership with American Rivers and consists of three parts:

1) A GIS based fish barrier inventory and assessments.
2) On the ground partner interaction: Providing technical support and training for assessment tools to facilitate on the ground restoration from assessment results.
3) Initiation of Connectivity Teams in the 14 SARP states and bringing these teams together to initiate and develop working relationships.

To date, SARP, together with the Nature Conservancy (TNC), USFWS and other partners have completed a largescale barrier inventory and various prioritization scenarios of dams, ranking them based on their potential ecological benefits if removed or bypassed. With the completion of these assessments and the barriers in-hand, SARP together with American Rivers performs desktop and on the ground reconnaissance of top ranking dams to provide high quality potential projects to statewide connectivity teams and local project managers. In addition to these efforts, SARP is working to develop and assist new “Connectivity Teams” or dam removal partnerships in other SARP states. In October, multiple partners came together to hold a Georgia Dam Removal Workshop, and to initiate the first Georgia Aquatic Connectivity Team, a statewide group of resource managers that will build capacity for dam removal throughout the State of Georgia.

Movement of Transported Alabama Shad in the Alabama River, AL

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The Alabama Shad *Alosa Alabamae* is an anadromous alosine which lives in the northern Gulf of Mexico and ascends freshwater rivers during springtime to spawn. Alabama Shad once ranged from the Suwannee River in northwestern Florida west to the Mississippi River and as far inland as central Iowa and Ohio. The Alabama Shad has experienced substantial range-wide population declines over the past 100 years, and are considered extirpated from the Mobile River system in Alabama. The proliferation of dams, which block access to historical spawning grounds, during the 20thcentury is a likely driver behind these population declines. During April 2014-2015 adult Alabama Shad were collected from downstream of Jim Woodruff Lock and Dam on the Apalachicola River, Florida using boat electrofishing. Fish were implanted with either radio or ultrasonic tags, and transported to the lower Alabama River, AL in an effort to characterize movements within that system. A total of 80 Alabama Shad were tagged and transported over both years, and provided 479 detections. Fallback is a term used to describe anadromous fishes which abandon their spawning migration as a result of handling or unfavorable environmental conditions. Fallback rates were high, with 87-92% of tagged fish rapidly moving downstream of the stocking location in both years. Trap-and-transport activities have proven successful for repatriation of both American Shad *Alosa sapidissima* and Alabama Shad, and should be an integral part of future conservation efforts for Alabama Shad in the Alabama River.

Effects of Dam Removal & Habitat Restoration on Migratory Fishes of Green Bay with Emphasis on Northern Pike (*Esox Lucius*)

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Two low head dams on Duck Creek (Green Bay, Wisconsin) were removed in 2012. Removal opened several miles of potential spawning habitat for migratory fishes. However, the conversion of riparian habitat to agricultural or urbanized areas leaves the overall impact in question. The study objectives included: 1) determining how fish species composition and habitat use change after barrier removal, and 2) comparing northern pike recruitment success between restored and reference habitats.
Larval box traps were used to quantify the number and size of larval fish out-migrating from Duck Creek (downstream and upstream of the dam removal site), as well as reference systems around Green Bay (13 sites). Larval fish captured were counted, measured, and released. Over two years, migratory fishes, including white sucker and walleye, were observed spawning upstream of the dam removal site and out-migrating larval white sucker were captured at study locations downstream of dam removal. More than 30 fish species were identified within the box traps, including yellow perch, shortnose gar, and banded killifish, a WI species of concern. However, no larval northern pike were captured upstream of the dam removal site as expected given the increase in river connectivity. In contrast, northern pike larvae were observed at nearly all reference locations and larvae showed steady (but significantly different) growth rates throughout the out-migration period. This research suggests while the dam removal can have a positive effect on the fish community, some migratory fish may not realize the added benefit without concurrent habitat restoration.

Potential for White Dam Removal

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The presence of run-of-river structures has negatively affected in-stream biota and ecological processes for centuries. White dam, owned by the Warnell School of Forestry in Athens, Georgia is typical of many such structures in Georgia in that the structure is aging, provides no economic benefit, and exposes the owner to substantial liability risk. However, this project presents a unique opportunity for a removal, based on its location on university property with a largely undeveloped riverbank upstream and down. When it was decommissioned, the control structures were removed. While these two breaches allow substantial sediment passage, our models indicate that the openings allow upstream fish passage for many native species only under rare flow conditions, if at all, due to swim speed constraints. The area is also a potential site for the restocking of juvenile American shad fry by the GA DNR. Several UGA classes have addressed the issues around removal of this structure and we will briefly summarize the pre-permitting efforts, to date. These include the legalities of 404 and NWP27 permitting, local buffer ordinances, FEMA flood risk assessment, HEC-RAS modeling, passage rate equations for species of concern, investigation of present invasive species, restoration opportunities, and sources of funding. Additional interests with the project are historic preservation of the mill section of the damn and pre- and post-monitoring of sediment and species movement and any changes in species assemblage.

Response of Fish Assemblages to Removal of Two Mainstem Dams on the Chattahoochee River Between Phenix City, Alabama, and Columbus, Georgia

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Two mainstem dams on the Chattahoochee River, Alabama-Georgia, USA, were breached in 2012 and 2013 to restore an approximately 3.7-km reach to an unimpounded condition. Fish were sampled in summer and fall 2014 and again in summer 2015 using electrofishing from three areas within the restored area, as well as from the small reservoir immediately above the upstream dam, which served as a reference area. A total of 3,069 fish was collected in summer 2014, 1,906 in fall 2014, and 2,035 in summer 2015, representing 30, 24, and 25 species, respectively. Number of species collected declined progressively from the most-downstream to the most-upstream sites below the remaining dam. More species were collected above the dam than in the two areas within the removal area, but the highest species diversity was below the dam removal area, despite also being effectively the headwaters of the large mainstem reservoir downstream. Overall, the fish community appears to be characterized by relatively low species diversity and composed mainly of reservoir or river-reservoir fishes. True recovery of the fish community to pre-impoundment conditions is likely to be a long process, and may need to involve active management actions such as stocking or transporting fish into the restored reaches.

SESSION 5

Distribution and Community Structure of Fish Species in Large Tributary Streams of the Middle Chattahoochee River, Georgia and Alabama

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We sampled 18 large tributaries of the Chattahoochee River in Alabama and Georgia from Atlanta to Georgia in 2014-2015 to determine species assemblage and community structure. These streams ranged from 3rd to 5th order, with drainage areas varying from 117 to 991 km^2. Fish were sampled from 12-20 quadrats from 2-4 areas within each stream. Over the course of the project, more than 5,500 fish were collected, representing 12 families; number of species collected in each stream varied from 10-27. Blacktail Shiner *Cyprinella venusta*, Alabama Hogsucker *Hypentelium etowanum*, Redbreast Sunfish *Lepomis auritus*, and Blackbanded Darter *Percina nigrofasciata* were generally the most numerous species in each stream above West Point Reservoir, with Bluefin Stoneroller *Campostoma pauciradii* also locally abundant in some samples. Alabama Hogsucker was less abundant in streams below West Point Reservoir, but abundance of the other three species followed similar patterns to those observed in the streams above the reservoir. Abundance and prevalence of Weed Shiner *Notropis texanus* was higher in the streams below West Point Reservoir than in those above it. Cyprinids composed a larger proportion of the fish community in streams above West Point Reservoir than those below, and average composition of centrarchids was 55% higher in streams below the reservoir compared to those above it. Suckers and catfish composed < 10% of the fish community each in streams above and below the reservoir. Diversity indices indicated that species assemblages in these streams were relatively diverse, with evident no upstream to downstream gradient. Neither in-stream habitat nor land use patterns were correlated with measures of diversity, species richness, or evenness. Quadrats appeared to be an adequate means to sample these streams, able to collect 95% of the species found with a minimum of 12 samples.

Evaluation of Mean Rank Shift for Discerning Changes in Reservoir Fish Assemblages

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Comparing communities over time and space has long been a central topic in ecology and new approaches are continually being developed. Mean Rank Shift is a recently proposed "species rank" approach that has been suggested as offering promise for detecting changes in assemblages derived from long-term monitoring studies. MRS has been used in a fisheries context in a few published studies, but the approach has not been critically evaluated. Given the simplicity of the approach, we evaluated the sensitivity and performance of MRS for detecting temporal changes in reservoir fish assemblages. We also constructed alternative formulations to use the general approach in a before after context and restricted calculations to subsets of the data that focused on "core" species. A simulated dataset based on 14 years of gill-net sampling was used to evaluate the performance and sensitivity of the MRS formulations based on four ranking metrics including number, weight, index of relative importance (IRI) and the prey-specific index of relative importance (PSIRI). The original MRS was not sensitive to directional changes resulting from simulated perturbations (i.e., reductions or increases of 10%, 25%, and 50%) of subsets of species. Two modified formulations of MRS that used the initial assemblage as the basis for calculating differences and resultant MRS scores (MRS10 – based on the top 10 species and MRS20 – based on the top 20 species) were useful for detecting directional changes in a management relevant time frame of 4 to 8 years when PSIRI was used as the ranking metric. Modified versions of MRS based on PSIRI rankings may offer managers a new tool for quantifying changes in the structure of reservoir fish assemblages in response to perturbations.

Will the Increasing Alkalinity of Surface Waters Affect Fisheries Management Decisions?

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A much publicized, recent study reported that alkalinity of streams in the eastern United States are increasing greatly as a result of fracturing of limestone and erosion of concrete by acid rain. However, the present study revealed that the alkalinity in surface waters in Alabama and contiguous physiographic areas in Mississippi has increased by an average of only 13.5% since 1973. Moreover, average annual pH of rain water – at least at Auburn, Alabama – increased from 4.51 in 1980 to 5.14 at present (June 2014 – July 2015).

Carbon dioxide concentration in the atmosphere increased from 0.0330% in 1973 to 0.0399% in 2014 increasing the equilibrium aqueous carbon dioxide concentration from 0.48 mg/L to 0.58 mg/L. The calculated solubility of pure calcium carbonate increased from 54.2 mg/L in 1980 to 57.9 mg/L at present. This agrees with the observation that measured equilibrium alkalinity obtained for limestone from a quarry at Auburn, Alabama increased from 58.5 mg/L in 1980 to 64.8 mg/L in 2014. Solubilities of calcium silicate and feldspars – the other sources of alkalinity – also increase with greater aqueous carbon dioxide concentration. The modest increase in alkalinity in Alabama surface waters since 1973 probably resulted mostly from higher atmospheric carbon dioxide concentration rather than from effects of acid rain.

The modest increase in alkalinity observed in this study should not affect surface water pH or buffering capacity appreciably. The increase certainly is not large enough to accelerate algal growth in streams – a prediction made in the report on alkalization of streams in the eastern United States. Moreover, limestone solubility has not increased enough to influence pond liming rates.

Abiotic competition between Alabama native and non-native aquatic species

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The impact of non-native aquatic species to non-native habitats is of longstanding concern to ecological managers. Through either accidental or purposeful intent, numerous aquatic species occur in non-native habitats worldwide. The direct impact of non-native species has been documented and includes many detrimental changes to aquatic systems including changes in water quality, habitat quality, and biotic quality. The direct, or biotic, competition between non-natives and natives is clearly of concern to managers; however, information on indirect, or abiotic, competition between non-natives and natives can further be used to assess population stability and viability. Physiological measurements of respiratory rates, indicative of overall metabolic rates, have been used to compare metabolism between non-native and native aquatic species in response to changing environmental conditions. Our overall goals have been to establish the effect of changing environmental parameters on the ability of species to maintain energy for optimal growth and reproduction. We have measured and compared the respiratory rates of the non-native Asiatic weatherfish, *Misgurnus anquillicaudatus*, and the Asiatic clam, *Corbicula fluminea*, acclimated to various environmental temperatures (15 – 40C) to those rates of several native Alabama species (*Cyprinella caerulea*, *Etheostoma brevirostrum*, *Villosa lienosa*) acclimated to similar environmental temperatures. Data on native species was collected up to a maximal of 25C whereas the two non-natives were easily acclimated to temperatures near 40C. Comparisons of Q_{10} response over similar temperature ranges indicates that the non-native species are physiological generalists with the ability to maintain relatively stable metabolic rates as temperatures increase. Estimated energy budgets suggest that native species will show reduced growth and fecundity if environmental temperatures increase compared to the non-natives. The abiotic (temperature) advantage of the two non-native species is likely one factor contributing to their ability to adapt to habitats around the globe.

Distribution of the introduced island apple snail (*Pomacea maculata*) in the lower ACF

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Island apple snails (*Pomacea maculata*) are large caenogastropods that have become established in the southeastern United States. They pose ecological and human health threats where they occur outside their native range. Previous work proposed that island apple snails could expand their range across the coastal plain to the Piedmont, but little work has been conducted to establish their current distribution. We conducted surveys throughout the lower Apalachicola, Chattahoochee, and Flint (ACF) basin to map their distribution in this region of Georgia. Island apple snails have spread across Lake Seminole to the northern shore at the Spring Creek Resort. They have also spread east and west along the southern shore. We found no evidence that island apple snails have reached the Chattahoochee arm of Lake Seminole. Interestingly, we discovered a population of Florida apple snails (*Pomacea paludosa*) in the western portion of Lake Seminole. The isolated population in Albany, GA is well established and appears to expand into adjacent canals during rainy periods. We propose that the Albany population might be a candidate to attempt eradication. We found no evidence of apple snails in the main stem of the Flint or Chattahoochee Rivers, Walter F. George Lake, or Lake Blackshear.

Invasive crayfishes of the lower ACF basin

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Crayfish serve as an important food resource for predatory fish, turtles, and terrestrial vertebrates. This makes them a key link in the trophic transfer of energy from producers to higher consumers in aquatic ecosystems. Their prolific burrowing alters the structure of benthic habitats and has earned them the title of ecosystem engineers. Georgia and Alabama are home to 150+ crayfish species making these states among the most speciose crayfish habitat in the world. Habitat alteration and exotic species introductions have displaced native crayfishes in some cases causing local extinctions. One of the more troubling exotic crayfish introductions involves the Creole Painted Crayfish (*Orconectes palmeri creolanus*) from Louisiana, Alabama, and Mississippi. Historically only documented along the Flint River, there is concern that this species is expanding throughout the ACF basin. In this study we evaluated the distribution of this species by conducting surveys using baited traps and dip nets in the upper Apalachicola, the lower Chattahoochee, and the lower Flint Rivers. The goal of this research was to characterize the current distribution of *O. palmeri* and to determine if it is spreading across the ACF watershed. Results showed that *O. palmeri* populations remain in previously reported sites throughout the lower Flint. It is established along the Flint River in Lake Seminole, Lake Blackshear, Fowltown Creek, Kinchefoonee Creek, and Swift Creek. This invasive species has also spread into the Chattahoochee Watershed as far north as Walter F. George Lake and below the dam in the main-stem of the Apalachicola River. Another invasive crayfish, the Louisiana Red Swamp crayfish (*Procambarus clarkii*), was also discovered on the Alabama and Georgia sides of Walter F. George Lake. These two species represent a pending danger to native crayfishes and possibly fishes throughout the ACF. Research is needed to identify the mechanism of introduction so that conservation actions can be taken to stop the human assisted spread of these invasive crayfishes.

A Comparison of Benthic Macroinvertebrates Colonizing leaf, Wood, and Artificial Substrates in Two Southeastern Coastal Plain Rivers

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Despite their widespread use in wadeable streams, macroinvertebrates are less frequently incorporated into formal assessments of non-wadeable streams. The size and depth of large rivers make many wadeable stream bioassessment techniques difficult. As a result, passive samplers of natural or artificial materials are commonly used. These samplers are placed in the water for a predetermined period of time to allow for colonization by macroinvertebrate communities. We compared macroinvertebrate assemblages collected from two natural substrates (leaves and woody debris) and one artificial substrate (masonite board; i.e., Hester-Dendy samplers) collected from the Southeastern Coastal Plain region of the Ogeechee and Savannah River Basins. In the Fall of 2014, three replicates each of Hester-Dendy samplers, mesh bags filled with leaves, and mesh bags filled with woody debris were deployed at six sites (three per river, N=54). After 30 days, samplers were retrieved and macroinvertebrate assemblages were assessed for differences in: Abundance, Biomass, Composition Metrics (% Ephemeroptera-Plecoptera-Trichoptera (%EPT), % Diptera, % Chironomidae], Functional Feeding Group Structure [%gatherer, %filterer, %predator, %scraper-grazer, %shredder], and Tolerance Metrics [% intolerant taxa, % tolerant taxa, Hilsenhoff Biotic Index]. Preliminary results indicate that each substrate type may sample differentially, thus resulting in different estimates for the metrics tested. These differences may be associated to each substrate type resulting in a preferred or 'more suitable' habitat for colonization for specific macroinvertebrate taxa (e.g., EPT taxa vs. Chironomidae). Furthermore, some variability was expected due to site-specific differences (Savannah vs. Ogeechee). However, all three substrates types provide an efficient mean for collecting macroinvertebrates as part of bioassessment practices.

Watering our Mussels: Can Water Augmentation Benefit Freshwater Mussels?

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Recurrent and prolonged droughts, coupled with agricultural water withdrawal are threatening mussel populations through stream drying, elevated water temperatures, and low dissolved oxygen concentrations. Augmentation of stream flows via groundwater pumping has been proposed as a strategy to temporarily maintain flows and adequate water quality in reaches with important freshwater mussel populations. We investigated the effects of water augmentation on mussel populations in Spring Creek, Georgia between August 2011 and September 2014. Using capture-mark-recapture methods, we monitored mussel populations in a non-augmented stream reach and two adjacent stream reaches with augmented streamflows. We hypothesized that mussel survival would be higher in augmented reaches than in the non-augmented reach and temporary emigration (burrowing) would be higher in the non-augmented reach than in augmented reaches. Mean survival between sampling occasions was high among all species (0.95-0.98) and did not differ among study reaches. Temporary emigration differed among study reaches but did not support our hypothesis. In contrast to our expectation, temporary emigration increased with increasing stream stage rather than at lower stream stages suggesting that stream flows did not drop below a threshold which would invoke burrowing as a behavioral response. Water temperature was on average 3.8°C cooler and dissolved oxygen was 4.0 mg/L higher in the augmented reaches than in the control reach. Hence, water quality conditions measured during our study indicated that water augmentation in Spring Creek could alleviate thermal and hypoxic stress on freshwater mussels during exceptionally low flow periods. Several factors may be responsible for not observing the hypothesized beneficial effects of water augmentation on mussel survival. Because, mussels within the control reach were able to survive previous drought, this reach may contain sufficient flow during low flow periods and preclude mortality or behavioral responses except under extreme conditions.

Revision of Georgia's State Wildlife Action Plan and Implications for Aquatic Species Conservation

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As part of the 2015 revision of Georgia's State Wildlife Action Plan (SWAP), the SWAP aquatic species technical team assessed the conservation status and needs of 251 rare aquatic species. The assessment was completed using expert opinion, published reports, and range maps that depicted watersheds categorized by the date of the species' last known occurrence. While many species persist in all or most of their historically-occupied watersheds, an alarming proportion of fishes (42%), mollusks (43%) and crayfishes (25%) have been documented from half or fewer of their Georgia historic watersheds within the last decade. Overall, 152 species are considered imperiled and an additional 48 species are considered historic (not seen in 20-40 years) or extirpated from the state. Altered water quality, incompatible agricultural practices, altered hydrology, residential development, and dam and impoundment construction were identified as the most significant threats to our aquatic fauna. The technical team identified 53 conservation actions for high priority aquatic species and ranked their relative importance. The most highly-rated actions included the protection of aquatic connectivity in free-flowing streams, the development of environmental flow recommendations, and land protection. To help focus conservation actions, the technical team also identified 165 high priority watersheds to protect the best known populations of rare aquatic species. A GIS assessment was then carried out to characterize existing condition and future threats, which can help guide conservation strategies at the watershed scale. Meeting the conservation needs of Georgia's aquatic species is a daunting task and will require increased capacity and coordination, as well as the implementation of watershed-scale conservation actions with the potential to simultaneously benefit multiple species.

Longevity and Habitat Use of the Imperiled Okaloosa Darter

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Studies involving movement and longevity of fishes are important for the management and conservation of imperiled species. This study used a mark-recapture technique to investigate these characteristics in the imperiled Okaloosa Darter (*Etheostoma okaloosae*). We captured Okaloosa Darters from 20 m reaches at six different streams, marked them with a florescent subcutaneous tag on the left or right dorsum to indicate the side of the stream from which they were captured, and then released all fish at the middle of the 20 m reach on the margin from which they were captured. We then recounted the darters 24 h after release, one month after release, one year after release, and once per year for the following eight years. In the eighth year, we captured all darters from the 20 m reach (marked and unmarked), measured standard lengths, and constructed length frequency distributions to identify distinct cohorts. We found that a significant number of darters remained within the 20 m reach after 24 hrs, one month, and one year. We also found that darters rarely crossed sandy stream channels, with crossings mainly limited to areas with a vegetation corridor traversing the width of the stream. Our length frequency distributions, and the recapture of one Okaloosa darter that was at least 8 years old, suggest that Okaloosa darters live longer than the 2-3 years proposed by previous authors.

Black Bass SNPs: An Update

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New high-throughput methods of sequencing have dramatically reduced the costs of molecular marker development in non-model species. Single nucleotide polymorphism (SNP) markers are the most abundant marker in vertebrate genomes, can be easily multiplexed, and can be rapidly scored, providing cost savings in the form of reduced time and labor. SNP marker approaches have revolutionized conservation genetics/genomics approaches in salmonid fishes, but have been lacking in species endemic to the Southeastern US. Through genotyping-by-sequencing approaches, we have developed SNP marker resources for Largemouth bass, and more recently, for other black bass species including Redeye bass, Shoal bass, Alabama bass, Spotted bass, and Smallmouth bass. While initial panel development and utilization has focused on detection of species purity and introgression, we are also developing markers with expected utility for traditional population genetic measures. The presentation will provide an update on the latest developments in these ongoing projects.

Evaluation of Stocking All Female Largemouth Bass in Alabama Ponds

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Excessive largemouth bass *Micropterus salmoides* recruitment in small impoundments leads to density-dependent growth depression, causing populations to become slow growing with length distributions skewed towards smaller fish. To address this issue, we conducted three trials that evaluated stocking all female largemouth bass (F-LMB) in two small Alabama ponds (0.5 and 2.0 ha) where the drainage basin was isolated. Age-1 fish were sexed, individually tagged, and stocked at 38-40 F-LMB/ha into ponds that contained pre-established sunfish (*Lepomis* spp.) populations. Female largemouth bass were collected with electrofishing, angling, and rotenone over a 2.5 to 5 year period among the three trials. Sex was correctly identified for 179 of the 180 F-LMB stocked; one male was detected in the first trial which resulted in successful largemouth bass reproduction. After largemouth bass reproduction, F-LMB weight declined and this trial was terminated. Growth was rapid the first 2 years after stocking as 3-year old fish reached an average of 429 to 459 mm and 1.37 to 1.66 kg in all 3 trials. However, 2 years after stocking, growth was nil in the second trial even though relative weights of F-LMB were generally greater than 100. In this second trial, removal of about 30% of the F-LMB inhabiting the pond and stocking small Nile tilapia *Oreochromis niloticus* (25-75 mm) resulted in average weights increasing from 1.30 to 2.34 kg in 1 year. Where F-LMB growth continued in the third trial, average size approached 500 mm and 2.2 kg three years after stocking. Annual survival rates of F-LMB were high and ranged from 0.78 to 0.93 among the 3 trials. Stocking F-LMB offers an attractive alternative in ponds to create a low density largemouth bass population that displays fast growth and high survival when catch-and release fishing is primarily practiced.

Development of a Range Wide Shoal Bass Management Plan

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The Native Black Bass Initiative (NBBI) provides a framework for watershed-scale conservation of native fishes in the southern US, with a focus on restoring and preserving key processes that support functional habitats and wild, naturally-produced native fish populations. Since 2010, the initiative has implemented 8,239 acres of habitat restoration projects, providing direct benefits to endemic black basses and other native fishes in more than 150 miles of focal rivers. Shoal Bass (*Micropterus cataractae)* is native to the Apalachicola-Chattahoochee-Flint (ACF) river basin and is a focal species of the NBBI. An identified conservation need for Shoal Bass is a range-wide management plan that identifies priority conservation actions, geographic priorities for those actions, and knowledge gaps to focus research. We are leading the effort to develop this management plan with input from wildlife agencies, conservation organizations, and stakeholders throughout the ACF basin. This presentation will provide an overview of the plan structure and progress to date and a brief update on the Native Black Bass Initiative activities in the southeast region.

Shoal Bass Standardized Sampling along the upper Flint River

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Shoal Bass (*Micropterus cataractae*) are a popular riverine sport fish where they occur in Georgia. On September 17, 2014, a 381-mm minimum length limit (MLL) went into effect for shoal bass in the upper Flint River (upstream of Warwick Dam). The MLL was implemented to improve the size structure of the shoal bass population. The upper Flint River is sampled biannually during odd years by the Fisheries Management Section of the Georgia Department of Natural Resources. During the fall of 2015, 10 standardized sites were sampled with electrofishing gear. The 2015 catch per unit effort (CPUE) for shoal bass was 16 per hour whereas in 2013 the CPUE was 14 shoal bass per hour. The size structure had a slight decrease from the previous sample in 2013. Although shoal bass condition (kn) increased from 0.95 in 2013 to 0.98 in 2015, the mean (SD) total length (TL) of a shoal bass decreased between sampling events with a mean TL of 263 (100) mm in 2013 and 209 (104) mm in 2015. There appears to be a strong year-class produced in the spring of 2015. There does not appear to be any noticeable differences in the shoal bass size structure following the implementation of a MLL increase from 305 mm TL to 381 mm TL. Once several more years of data collection occur, a more in-depth statistical analysis will be administered on this data set.

POSTER ABSTRACTS

Growth and Mortality of Largemouth Bass in Georgia Waters: Implications for Research and Management

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The Wildlife Resources Division is interested in overall growth and mortality assessments on Largemouth Bass (*Micropterus salmoides*) have been impacted by the documented declines in mortality due to voluntary catch-and-release practices by anglers. Growth and or total mortality data was gathered for 7 Georgia populations that were assessed in the past five years (2010-2015). Mean (TL)-at-age across 6 of the populations was $TL = 626 (1 - e^{-0.222[age + .788]})$ for females and $TL = 422 (1 - e^{-0.449[age + .266]})$ for males. Growth and mortality were variable across systems and gender specific differences in growth were observed with females growing to larger sizes than males. Catch-curve analysis revealed total annual mortality for genders combined across 6 populations averaged 39% but ranged from 26% to 55%. A total of 1,569 bass were aged with a maximum age of 14 for females and 13 for males. On average, it took 2.22 years for a female bass to reach 12 inches (305 mm TL) but ranged from 1.28 to 3.38 years. Growth to 14 inches (356 mm TL) ranged from 1.6 years to 4.25 years but averaged 3 years. Georgia waters produced the most sought after record in freshwater fishing, George Perry's 22 pound 4 ounce world record largemouth bass. In recent years, other states have challenged this record and have even tied it (Japan). In an effort to be proactive in the management of largemouth bass and to draw a more accurate representation of the population dynamics, biologists will perform additional growth and mortality assessments on selected waterbodies. The data collected have been and will continue to be used in simulation models to predict the potential benefits of a change in a size or bag limit.

Age, growth, and condition of sunfishes in an urban stream

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Our main goal was to compare population characteristics among sunfishes in a highly degraded urban stream. An additional objective was to compare otoliths and scales in estimating age and growth of three sunfish species. Otoliths are typically considered to be the more accurate aging structure, but otolith extraction is a lethal method. Therefore, we set out to determine if fish scales, a non-lethal method, could provide reliable enough estimates of age. Beginning in June 2015, we conducted monthly sampling for redbreast, bluegill, and green sunfish in the Yellow River Watershed near Georgia Gwinnett College. Approximately 5-10 individuals of each species were collected each month and were measured (mm Total Length), weighed (g), and then processed in the lab. Processing included identifying gender, removing scales, extracting otoliths, and weighing gonads of each individual. We have used scales to age 88 sunfish that were collected from June through September, and we are in the process of aging the otoliths from these individuals. Results from these analyses will be presented at the meeting.

Effect of elevated temperature on the metabolic physiology of non-native Alabama Asiatic clam, *Corbicula fluminea*

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The Asiatic clam, *Corbicula fluminea*, also known as the golden or good luck clam, is native to temperate and tropical regions in Asia, Africa, and Australia. The species is small, light colored, and can be distinguished by its distinct sulcations on the shell. The periostracum is yellow-green to light brown and the nacre is blue in living individuals. Since its introduction to the US in 1938, the species has spread rapidly. Its ability to reproduce as a hermaphrodite and independence of larval host stages is believed to facilitate the species spread. Biofouling is the major issue associated with large populations of the species. It is suggested that the spread of *Corbicula* is limited to temperature, however limited information exists on the effects of temperature to the species. It is also suggested that *Coribula* can tolerate temperatures from 2 to 30C with little tolerance to hypoxia. We acclimated *Corbicula fluminea* individuals (1-3g total weight) to temperatures of 15, 20, and 25C and measured oxygen consumption rates using an intermittent flow respirometer. Preliminary mean oxygen consumption rates were 180±37 mg O_2 $sec^{-1}hr^{-1}$, 343±44 mg O_2 $sec^{-1}hr^{-1}$, and 650±224 mg O_2 $sec^{-1}hr^{-1}$ for animals acclimated to 15, 20, and 25C, respectively. Although rates were not consistent at the higher temperatures, calculated Q_{10} values over the temperature ranges from 15 to 20C and from 20 to 25C were 3.63 and 3.59, respectively, suggesting a normal response to the increased temperatures. Critical oxygen tensions, or P_c, were reached at 4-5kPa pO_2 at any temperature. Animals remaining anoxic for 30 min or longer experienced no adverse affects other than a substantial increase in oxygen consumption following the hypoxic conditions (paying back the oxygen debt). These preliminary findings suggest the species is tolerant to higher temperate-environment temperatures as well as hypoxic conditions.

Consumer community structure along a ~200-km stretch of the Ogeechee River

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The Ogeechee River is a fifth order blackwater river that flows through Georgia's Southeastern Coastal Plain. The majority of the Ogeechee River basin (~95%) lies in the Outer Coastal Plain Mixed Forest Province and is comprised of secondary forest, agricultural lands, and wetlands. These differences in land use likely impact the biological communities that inhabit the river. Examining consumer assemblages along a longitudinal gradient of the Ogeechee River allows for an assessment of spatial patterns in community structure in this system. As part of a long-term study we used benthic macroinvertebrate and fish data collected across six sites along a ~200-km stretch of the Ogeechee River from 2014-2015 to assess for spatial patterns in consumer communities. Sampling sites were numbered (1-6) from the upstream-most to the downstream-most site to reflect a gradient in drainage area. Differences in community structure can be observed along the longitudinal gradient for both benthic macroinvertebrates and fish assemblages. Preliminary data for benthic macroinvertebrate assemblages grouped sites into two distinct groupings (sites 1-2 'i.e., upstream sites' and sites 3-6 'i.e., downstream sites'). Chironomids were consistently the dominant contributors at the two sites furthest upstream (>40% of total) and isopods as the most common contributors to at the downstream-most sites (16-79% of total). Preliminary data for fish assemblages grouped sites into three distinct groupings (sites 1-2 'upstream sites', sites 4-6 'downstream sites', and site 3 'mid-reach'). Despite differences in fish assemblages between sites, redbreast sunfish (*Lepomis auritus*) were usually the dominant contributor across all sites (>25% of total). Continuous monitoring of fish and benthic macroinvertebrates in the Ogeechee River will further detail the structure of consumer communities in this river and ultimately allow for more thorough assessments of trophic relationships between these major groups and their role in river ecosystem function.

Comparison of age and growth of redhorses in Brasstown Creek, Georgia

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Brasstown Creek in the upper Tennessee River watershed of north Georgia contains five species of Catostomids in the genus *Moxostoma* (the redhorses), representing one of the most biodiverse streams for *Moxostoma* in the U.S. Recent studies of *Moxostoma* in Canadian and Midwestern U.S. rivers have estimated ages and growth rates of redhorses by using pectoral fin rays, a non-lethal procedure, and have compared these estimates to other structures useful for aging. Pectoral fin rays were collected in spring 2014 and 2015 from five species of redhorse (n=152), mounted in epoxy resin, sectioned into 0.75-µm sections, and aged blindly and independently by two readers. Annual growth increments will be measured with ImageJ software to determine growth rates, and von Bertalanffy growth models will be constructed. Growth models will be compared through analysis of covariance and to other published studies. Additionally, the utility of pectoral fin rays for aging will be compared to scales. It is hypothesized that growth rates may differ from other studies due to stream morphology, regional climate differences, and increased competition between species. Additional population metrics such as mortality and recruitment will be estimated.

Environmental DNA Monitoring for Blue Shiners in the Coosa and Cahaba River Systems in Alabama

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The blue shiner (*Cyprinella caerulea)* is listed by the US Fish and Wildlife Service as threatened (species code: E05Y V01) and by the Alabama Department of Conservation and Natural Resources (ADCNR) as a GCN (greatest conservation need) species. Historically, blue shiners were found within the Cahaba and Coosa River systems in Alabama. The need for current blue shiner population distribution data is essential in order to address possible impacts and management decisions. In the reported study, an environmental DNA (eDNA) sampling methodology, which represents an efficient, non-invasive sampling approach, was developed to assess populations of blue shiners from both of the aforementioned river systems. A real-time PCR assay was developed for the amplification of a section of the NADH dehydrogenase subunit 2 (ND2) gene, located on the mitochondrial DNA of blue shiner. The primers and dual-labeled (fluorescent) oligonucleotide probe were designed to anneal to a region of the blue shiner ND2 gene to allow for species-specific DNA amplification, while excluding sister taxa [Tricolor shiner (*Cyprinella trichroistia*) and Alabama shiner (*Cyprinella callistia*)] known to cohabitate the survey sites within these two river systems. Results indicate that only the blue shiner ND2 gene is amplified and detected in samples in which all three species are present. Furthermore, the primers and probe failed to amplify the ND2 gene in samples with only tricolor shiners and/or Alabama shiners. Thus there was no cross reactivity of primers and probe with these other closely-related *Cyprinella* species. Water samples are currently being collected from sites in the Coosa and Cahaba river systems in Alabama. These samples will be monitored for the presence for blue shiner DNA to determine population distributions within these river systems.

Mercury accumulation and endocrine disruption in largemouth bass in the Rae's Creek watershed, Augusta, GA.

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The Savannah River Basin, in Augusta, Georgia, has a history of heavy metal contamination. Industrialization in the 19th century led to elevated concentrations of lead contamination. Notable examples of contributors to the problem included the Confederate powder works (1861-65) and the Augusta arsenal (1816-1955). Significant mercury contamination has become apparent in this century. Possible causes include industrial chlorine and paper production. In 2011 and 2015, we investigated two lakes in the Rae's Creek watershed. Aumond Lake and Lake Olmstead are impoundments of Rae's Creek and flow into the Augusta Canal and ultimately into the Savannah River. Our interest was in mercury contamination in *Micropterus salmoides* (largemouth bass) because these lakes are popular for anglers who provide fish for family consumption. We also examined endocrine disruption via assessment of vitellogenin. Mercury analysis in fish in this watershed has typically been reported as a composite sample and includes fish other than largemouth bass. Our data show that the mercury concentration in largemouth bass (since 2011) has decreased in both impoundments, but the concentration of mercury is significantly higher in Aumond Lake than Lake Olmstead. Our data indicate that endocrine disruption is occurring in male largemouth bass.

Extreme temperature tolerance of the Alabama non-native Asiatic weatherfish, *Misgurnus anguillicaudatus*

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The Asiatic weatherfish, *Misgurnus anguillicaudatus*, is a member of the Cobitidae family of Old World freshwater fishes known as the true loaches. The species is native to Asia, from Siberia to Vietnam, and Japan but has worldwide distribution due to exploitation as a food source and as an aquarium pet. Asiatic weatherfish prefer muddy or silty habitats although they can be found in any lotic or lentic system. Researchers suggest that weatherfish cause habitat destruction and directly compete with native species. Native population declines have been associated with Asiatic weatherfish occurrence in Hawaii. In Alabama, the species has only recently been documented and its impact on native fauna is unknown. Studies examining the physiological ecology of native Alabama fish species and Alabama weatherfish suggest that the non-native maintains an abiotic physiological advantage over natives at environmental temperatures ranging from 15-25C. Reports of extreme temperature tolerance have been suggested for *Misgurnus anguillicaudatus* however limited experimental data supports these claims. We have successfully acclimated adult Asiatic weatherfish in the lab to temperatures as high as 40C. Preliminary standard metabolic (respiratory) rates of fishes acclimated to 30C were 330.5 mg O2 sec-1hr-1. This rate is low and compares to the rate of the Alabama Holiday darter, *Etheostoma brevirostrum*, acclimated to 15C. A calculated Q10 value of 3.95 over the temperature range from 25-30C suggests the species is experiencing a normal increase in metabolism for an ectothermic organism. Compare this value with the Q10 value of 5.2 for *E. brevirostrum* over the temperature range from 20-25C, a value indicating stress in the organism, and, again, it appears that Asiatic weatherfish have a physiological advantage over native Alabama species at higher temperatures.