SOUTHERN DIVISION OF
THE AMERICAN FISHERIES SOCIETY

SAVANNAH 2015

Hyatt Regency Hotel
Savannah, Georgia
January 29 – February 1, 2015

Welcome to the 2015 Spring Meeting of the Southern Division, American Fisheries Society

Welcome to Savannah! The Georgia Chapter is thrilled to be hosting so many of our colleagues for the 2015 Southern Division meeting. This promises to be one of the largest SDAFS meetings ever and we know that we've got something planned for everyone. In addition to committee meetings, a great selection of workshops, and over 300 oral presentations and posters, we've got some exciting social events planned for you, culminating in a Saturday night banquet held right on the riverfront.

All conference events will take place in the Hyatt Regency Savannah. While there's no need to leave the Hyatt for any official events, we hope you'll take advantage of what Savannah has to offer. Savannah's famous River Street is just outside the hotel doors, and you will find numerous restaurants, bars, and shops along the river. City Market is just a few blocks away as well, so be sure to explore this area at some point to find some of the city's best entertainment. Savannah is a very walkable city, with numerous historic squares throughout the downtown area, so feel free to explore. Consider taking a riverboat cruise or a carriage ride for another way to see what the city has to offer. Whatever you choose, we know that you'll have a great time in one of Georgia's most historic and charming cities.

Should you have any questions or concerns during the meeting, please feel free to find any member of our organizing committee and we'll be happy to help. The command center for the meeting is located on the ground floor in the Savannah room, and you should be able to track someone down there at any point during meeting hours. The hotel staff will also be happy to help you should you have any issues with guest rooms.

I'd like to say thank you to the meeting organizing committee as well as numerous other Georgia Chapter members for helping to put this event on for our colleagues across the South. Having attended many Southern Division meetings in the past, I certainly now have a much greater appreciation for the amount of work that these folks put in to make things run smoothly behind the scenes. Finally, a huge thanks goes out to all of our generous sponsors. Without them, this meeting would not be financially possible, so please take the time to visit them in our trade show and show them your support.

I hope everyone has a wonderful time in Savannah!

Sincerely,
Patrick O'Rouke
President, Georgia Chapter AFS

2015 SDAFS Meeting Planning Team

Joey Slaughter	General Meeting Chair
Patrick O'Rouke	General Meeting Co-Chair, President GAAFS
Rebecca Brown	Registration and Financial Chair
Nicole Rankin	Digital Media Chair, Registration Co-Chair, Webmaster
Chris Harper	Local Arrangements Chair, Hotel Coordinator
Joel Fleming	Local Arrangements Co-Chair, Tradeshow Coordinator
Chris Kalinowsky	A/V Chair, Marine/Coastal Liaison
Steve Sammons	Program Chair
Cecil Jennings	Program Co-Chair
Bryant Bowen	Poster Session Chair
Tim Bonvechio	Workshop Chair
John Kilpatrick	Symposium Chair
Cindy Williams	Volunteer Coordinator, Federal Liaison
Paula Marcinek	GAAFS Raffle and Auction Coordinator
Greg Grimes	Fundraising Co-Chair
Brian Irwin	Student Affairs
Brad Ray	Student Affairs
Steven Patrick	Social Media Coordinator

We also would like to thank all of our volunteers for their efforts to make this meeting a success!

Meeting Venue: Hyatt Regency Hotel

Located on Bay Street, this hotel is situated near popular attractions like River Street, City Market, and Tybee Island also known as Savannah Beach. Stop by the Concierge Desk for maps, brochures, and other helpful information; we'll be happy to help with tickets, tours, reservations, and more. You can even reach out before you travel with our E-Concierge service and via Twitter @HyattConcierge.

Parking

For the convenience of our guests, Hyatt Regency Savannah is pleased to offer secure underground valet parking. There is also self-parking available at a nearby City of Savannah garage.

- Valet Parking is $24.00 per night for standard cars and oversize vehicles/vans.*
- Full in/out privileges as much as needed.
- Self Parking is available in the Whitaker Street Garage at $16 per night. In/out privileges do not apply.

**Vans and oversized trucks are allowed with maximum height of van approximately 7½ feet. There is very limited space available for vans and oversized trucks.*

Transportation Within Savannah

To help you get around Savannah during your stay, the following options offer convenient, local transportation:

Chatham Area Transit (CAT) is the local transit system. Each CAT fare costs you $1 and if you have to transfer buses, you will have to purchase another fare on the second bus for $1. Monthly passes are available.

Downtown Shutle (dot): complimentary shuttle service offering transportation throughout the Savannah Historic District. For route information, visit http://connectonthedot.com

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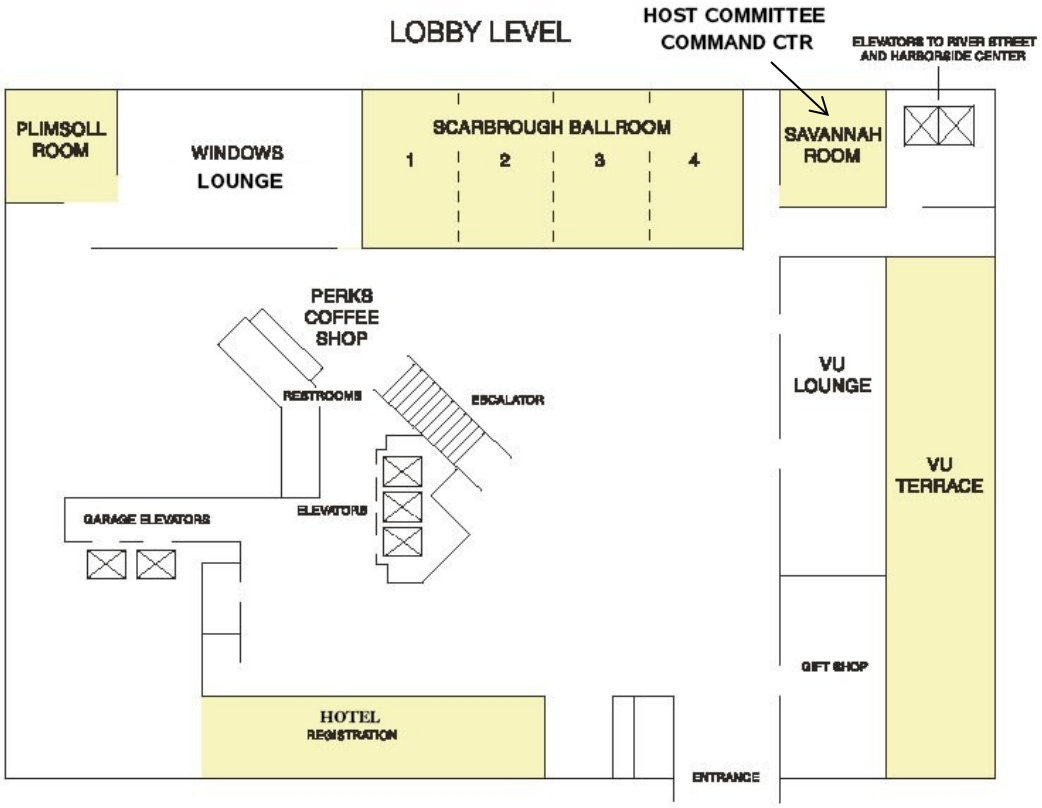

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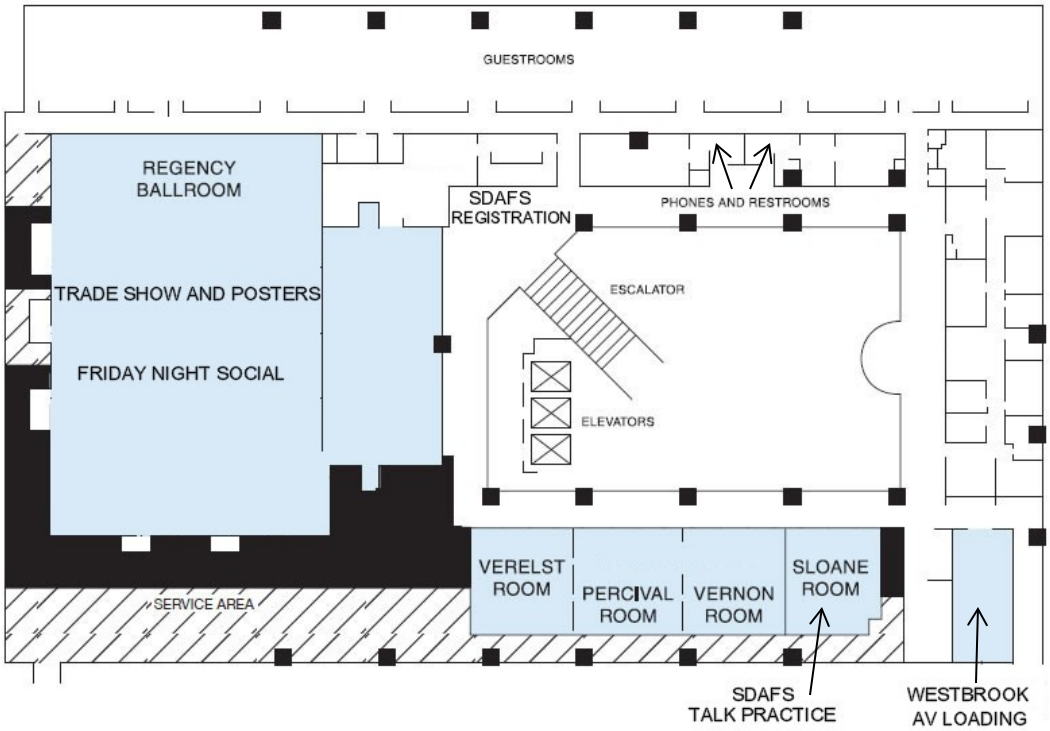

2015 Southern Division AFS Spring Meeting

Savannah, Georgia
January 29 – February 1, 2015

Schedule at a Glance

Thursday: January 29, 2015

7:30am – 5:00pm	Registration Open (Second Floor Atrium)
8:00am – 12:00pm	***Technical Committee Meetings:*** Alligator Gar (Sloane; 8:30 am – 5:00 pm) Aquaculture (Westbrook; 8:00 am – 12:00 pm) Catfish Management (Scarbrough 3; 8:00 am – 12:00 pm) Pollution (Vernon; 8:00 am – 5:00 pm) Reservoir (Scarbrough 4; 9:00 am – 5:00 pm) Striped Bass (Percival; (8:00 am – 12:00 pm) Warmwater Streams (Verelst; 8:30 am – 5:00 pm)
8:30am – 3:00pm	Meeting: SARP Steering Committee (Plimsoll)
8:30am – 12:00pm	Tradeshow Set-up (Regency Ballroom)
9:30am – 10:00am	Break
12:00pm – 1:00pm	Lunch (on your own)
1:00pm – 5:00pm	***Technical Committee Meetings***: Alligator Gar (Sloane; 8:30 am – 5:00 pm) Black Bass Conservation (Hospitality Suite; 1:00 pm – 5:00 pm) Pollution (Vernon; 8:00 am – 5:00 pm) Reservoir (Scarbrough 4; 9:00 am – 5:00 pm) Small Impoundments (Percival; 1:00 pm – 5:00 pm) Warmwater Streams (Verelst; 8:30 am – 5:00 pm)
1:00pm – 5:00pm	AV Presentation Loading (Westbrook)
1:00pm – 5:00pm	Tradeshow/Poster Session Set-up (Regency Ballroom)
3:00pm – 3:30pm	Break
3:30pm – 5:00pm	Southern Division AFS Executive Committee Meeting (Plimsoll)
6:30pm – 7:30pm	Welcome Social (Scarbrough 1-3)

Friday: January 30, 2015

7:30am – 5:00pm	Registration Open (Second Floor Atrium)
8:00am – 9:00pm	Tradeshow/Poster Session (Regency Ballroom)
8:00am – 5:00pm	AV Presentation Loading (Westbrook)
8:00am – 5:00pm	Presentation Practice (Sloane)
8:00am – 12:00pm	***Workshops***: Electrofishing Safety (Scarbrough 2; 8:00 am – 12:00 pm) Introduction to R (Scarbrough 4; 8:00 am – 5:00 pm) Occupancy Modeling (Verelst; 8:00 am – 5:00 pm) Social Media as an Outreach Tool (Percival; 8:00 am – 12:00 pm) SEACAP Fish Passage Prioritization AM (Vernon; 8:00 – 12:00 pm) Standardization of Fish Data for Rivers/Streams (Scarbrough 3; 8:00 am – 5:00 pm)
9:30am – 10:00am	Break
12:00pm – 1:30pm	Past Presidents Luncheon (Vic's on the River) ***Invitation only*
12:00pm – 1:00pm	Lunch (on your own)
1:00pm – 5:00pm	***Workshops***: Getting Hired (Percival; 1:30 pm – 5:00 pm) Introduction to R (Scarbrough 4; 8:00 am – 5:00 pm) Occupancy Modeling (Verelst; 8:00 am – 5:00 pm) SEACAP Fish Passage Prioritization PM (Vernon; 1:00 – 5:00 pm) Standardization of Fish Data for Rivers/Streams (Scarbrough 3; 8:00 am – 5:00 pm)
3:00pm – 3:30pm	Break
5:00pm – 6:30pm	AL-AFS Business Meeting (Plimsoll)
5:00pm – 5:30 pm	GA-AFS Business Meeting (Scarbrough 1)
5:30pm – 7:00pm	Southern Division Business Meeting (Scarbrough 1)
7:00pm – 9:00pm	Welcome Social, Tradeshow, &Poster Session (Regency Ballroom)

Saturday: January 31, 2015

7:00am – 8:00am	Fellowship of Christian Conservationists Meeting (Plimsoll)
7:30am – 5:00pm	Registration Open (Second Floor Atrium)

8:00am – 5:00pm	AV Presentation Loading (Westbrook)
8:00am – 5:00pm	Presentation Practice (Sloane)
8:00 am – 6:00pm	Tradeshow Open (Regency Ballroom)
8:00am – 6:00pm	Posters Open for viewing (Regency Ballroom)
8:00am – 9:30am	Student Oral Presentation Competition Session (Vernon)
8:00am – 9:30am	***General Technical Presentations/Symposia*** (concurrent sessions)
9:30am – 10:00am	Break
10:00am – 11:00pm	Student Oral Presentation Competition Session (Vernon)
10:00am – 11:45am	***General Technical Presentations/Symposia*** (concurrent sessions)
12:00pm – 1:00pm	Student Mentor Lunch (meet in Hotel lobby)
1:15pm – 3:00pm	***General Technical Presentations/Symposia*** (concurrent sessions)
3:00pm – 3:30pm	Break
3:30pm – 5:00pm	***General Technical Presentations/Symposia*** (concurrent sessions)
5:30pm – 6:30pm	UGA Warnell Alumni Reception (Windows Lounge) ***Invitation only*
7:00pm – 9:00 pm	Banquet (Harborside Centre)

Sunday: February 1, 2015

8:00am – 12:00pm	Tradeshow and Poster Session Breakdown (Regency Ballroom)
8:00am – 10:00am	***General Technical Presentations/Symposia*** (concurrent sessions)
8:30am – 10:30am	Crayfish Symposium Roundtable (Plimsoll)
10:00am – 10:30am	Break
10:30am – 12:15pm	***General Technical Presentations/Symposia*** (concurrent sessions)
12:15pm	Adjourn

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Posters

Administration and Education Topics in Fisheries Management

Number	Title
P-1	Implementing a Statewide Recreational Saltwater Angler Survey in Louisiana
P-2	Local Ecological Knowledge about Climate Change Among Anglers in the Southeastern U.S.
P-3	A Look at Oklahoma's State Wildlife Grant Program: A Snapshot of Recent Aquatic Projects

Assessing Efficiency and Effectiveness of Sampling Gears and Data Analytic Methods

Number	Title
P-4	The Effect of Sample Storage Time on Blood Gas and Electrolyte Readings for Channel Catfish, *Ictalurus punctatus*
P-5	Detection of an Invasive Parasite, Anguillicoloides Crassus, of American Eels Using qPCR
P-6	Estimating Discard Mortality in Gray Triggerfish Using Surface and Bottom Tagging
P-7	A Method for Extracting Moray (Muraenidae) Otoliths
P-8	Genetic Identification of Longnose Gar Populations Using Microsatellites in Estuarine Versus Freshwater Environments

Biology and Ecology of Fishes

Number	Title
P-9	Mercury Bioaccumulation and Muscle Tissue Concentration in Six Reef Fish Species in the Snapper/Grouper Complex from the Atlantic Waters of the Southeastern United States
P-10	Spawning Observations of Clinch Dace in a Mountain Stream
P-11	Brook Trout Selection of Aquatic Versus Terrestrial Origin Prey in Four Head Water Streams
P-12	The Phenology of Larval Fish in Kentucky Lake during Early Summer
P-13	Comparison of Abundance, Body Condition, and Growth of Juvenile Green Sunfish and Redbreast Sunfish in an Urban Tributary of the Chattahoochee River
P-14	Evaluating the Effects of Drought and Anthropogenic Alterations on the Growth of Stream Fishes on the Edwards Plateau, Central Texas
P-15	Biotic Responses to Urbanization: Differences in Fish Assemblages Between Burwell Creek, an Urban Stream As Compared to Armuchee Creek, a Forested Stream in Floyd County Georgia USA
P-16	An Assessment of Blue Catfish Weight-Length Relationships in the Coosa River, Georgia
P-17	Rapid Recovery of a Fish Assemblage in Response to a 100-Yr Flood in an Urban Tributary of the Chattahoochee River
P-18	Hypoxia in Shas: Formation, Duration, and Habitat for Age 0 Striped Bass and River Herring
P-19	Spatio-Temporal Distributions of the Zooplankton Community in a Puerto Rican Reservoir

Distribution and Habitat Use of Fishes

Number	Title
P-20	Otolith Chemistry and Genetics Reveal Scale of Ontogenetic Movement of Smallmouth Bass in the James River Basin, Virginia
P-21	Insights into Movement and Hybridization Patterns of Striped Bass *Morone saxatilis* in North and South Carolina Via Use of Genetic Tagging in Stock Enhancement Programs
P-22	Current Northern Snakehead Distribution in Virginia

Do Macro-Consumers Matter? Researching the Effects of Large-Bodied Biota on Aquatic Ecosystems

Number	Title
P-23	Effectiveness of DNA Barcoding in Identifying Tidal Blue Catfish Stomach Contents Containing Fish
P-24	Mercury Accumulation and Effects in the Brain of Atlantic Sharpnose Sharks
P-25	Using DNA Adducts to Examine Polycyclic Aromatic Hydrocarbon Exposure in Shark Populations Impacted By the Deepwater Horizon Oil Spill
P-26	The Effects of Food Web Complexity on Mercury Bioaccumulation in Upper Trophic Level Fish

Fisheries Management

Number	Title
P-27	Using an Individual-Based Model to Assess the Impacts of Stocking Red Drum on Wild Population Genetic Diversity in South Carolina
P-28	Louisiana Crappie: Population Dynamics, Fishery Characteristics, and Evaluation of Size Regulations
P-29	Hindcasting and Forecasting the Effects of Angler Harvest, Land Use and Climate Change on Smallmouth Bass Abundance at the Southern Edge of Their Range
P-30	Post Fish-Kill Monitoring on the Ogeechee River
P-31	Evaluation of the Effect of Stocking Rates and Nursery Habitat on Early Survival of Gulf-Strain Striped Bass in the Apalachicola-Chattahoochee-Flint River System

Management, Biology, and Ecology of Coastal Marine and Estuarine Fisheries

Number	Title
P-32	An Investigation into Sexual Segregation in the Tiger Shark, in the Gulf of Mexico and the Atlantic Ocean, Using GIS Analysis
P-33	Genetic Assessment of the Atlantic Horseshoe Crab in South Carolina
P-34	Comparison of Nektonic Communities Utilizing Artificial and Natural Oyster (*Crassostrea virginica*) Reefs in Coastal Georgia
P-35	Low Temperature Tolerance of Overwintering White Shrimp in South Carolina
P-36	Influence of Salinity on Thermal Preferences and Growth of Mummichogs
P-37	A Preliminary Investigation into Fish Community Dynamics of Three Barrier Islands in the South Atlantic Bight
P-38	Production and Contribution of Cultured Spotted Seatrout (*Cynoscion nebulosus*) to Charleston Harbor, South Carolina
P-39	Evolution of Sexual Dimorphism and Trophic Traits in *Fundulus diaphanus* and Its Descendant Lake Waccamaw Endemic, Fundulus Waccamensis, and Significance in Speciation and Conservation
P-40	Quantifying the Relationship of Juvenile Nekton to Salt Marsh and the Effects of Sea Level Rise
P-41	An Evaluation of Culturing Carolina Diamondback Terrapins for Responsible Stock Enhancement
P-42	Monitoring Movement of Southern Flounder to Elucidate Residency Time and Migration Patterns in a North Carolina Estuary
P-43	Population Genetic Structure of Southern Flounder Inferred from Multilocus DNA Profiles

Meeting Our Data Needs with Limited Resources: Recent Advances in Stream Sampling

Number	Title
P-44	Temporal Influences on Estuarine Mesozooplankton and Fish in the Savannah River Estuary System
P-45	Application of the Index of Biotic Integrity for Assessing Biological Condition of Streams in Alabama

Southeastern U.S. Crayfish Conservation

Number	Title
P-46	Factors Associated with the Distributions and Densities of Three Native and One Non-Native Crayfish in Maryland
P-47	Life History and Distribution of the Oconee Burrowing Crayfish, *Cambarus Truncatus*
P-48	Effects of Residence, Size, and Habitat Complexity on the Aggressive Interactions Between the Invasive *Orconectes palmeri* and the Native *Procambarus gibbus* in Georgia
P-49	A Test of DNA Barcoding in Crayfish
P-50	Populations of the Vernal Crayfish (*Procambarus viaeviridis*) in Alabama
P-51	Life History of the Obey Crayfish, *Cambarus obeyensis*, an Endemic Crayfish of the Cumberland Plateau
P-52	Replacement of the Sharp-Nosed Crayfish (*Procambarus acutissimus*) By the Non-Indigenous Red Swamp Crayfish (*P. clarkii*) in a Disturbed Wetland
P-53	Effects of Simulated Drought on the Burrowing Behavior of the Piedmont Blue Burrower Crayfish (*Cambarus [Depressicambarus] harti*)
P-54	The Conservation Status of *Cambarus eeseeohensis*
P-55	Crayfish in Education: Giving Alabama Students Context for Studying Biology
P-56	Seasonal Dietary Changes of the New River Crayfish in Anthony Creek, WV
P-57	Development of a Captive Rearing Protocol for *Cambarus* Crayfish
P-58	Life History of *Orconectes obscurus* (Allegheny Crayfish) in West Virginia
P-59	Epigean Crayfishes of the North, Middle, and South Forks of the Kentucky River: Life History and Ecology
P-60	Ecology of *Cambarus carinirostris* (Rock Crayfish) in Northern West Virginia
P-61	Phylogenetic Analysis of *Cambarus robustus* (Big Water Crayfish) Complex in the North, Middle, and South Forks of the Kentucky River
P-62	Geospatial Analysis of *Cambarus monongalensis* Across a Habitat Gradient

Topics In Aquaculture

Number	Title
P-63	Biochemical Reference Intervals for Farm Raised Channel Catfish (*Ictalurus punctatus*), Blue Catfish (*Ictalurus furcatus*), and Channel X Blue Hybrid Catfish Utilizing a Portable Bench Top Analyzer
P-64	Effects of Graded Levels of Dietary Soybean Meal Inclusion on Intestinal Morphology and Growth of Red Drum
P-65	Prey Selectivity and Ontogenetic Shifts Related to Gape Size in Larval and Juvenile Spotted Seatrout in Hatchery Ponds of South Carolina
P-66	Determining the Optimal and Most Cost Effective Food for Bluegill

Presentation Schedule

Saturday Morning, January 31, 2015

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	CWA Section 316(b) Regulations *F. Heitman, Moderator*	**Fish Management** *C. Bonds, Moderator*	**Ecology and Conservation of Cypriniform Fishes** *B.Albanese, Moderator*	**Recent Advances in Stream Sampling Techniques** *P.Sakaris, Moderator*	**Coastal and Estuarine Fisheries** *P. Bettoli, Moderator*	**Southeastern U.S. Crayfish Conservation** *Z.Loughman, Moderator*	**Best Student Paper Competition** *B.Ray, Moderator*
8:00 am	***D. Luchsinger*** **Summary of the New 316(b) Regulations**	***Y. Kanno*** **Seasonal Weather Patterns Drive Brook Trout Population Dynamics**	***R. Mayden*** **The Amazing Cypriniformes – Global to Southeastern Diversity**	**Welcoming Remarks**	***E. Knight*** **Maturation and Fecundity of the Two Striped Bass Populations**		***E. Olson*** **Accuracy of Data-Poor Stock Assessment Methods in the Southeast US**
8:15 am	***M. Hoganson*** **Waivers and Exemptions of the Final 316(b) Rule**	***D. Bahr*** **Quantified Population Assessment of Shortnose Sturgeon in the Savannah River, Georgia**		***M. Freeman*** **Confronting Unmeasured Biases in Stream Sampling: Thoughts from a Field Biologist**	***M. Walker*** **Increasing the Genetic Effective Population Size of Hatchery-Produced Spotted Seatrout**	**Introductory Remarks**	***J. Hargrove*** **Using Tournament Angling Data to Assess Alien Fish Invasions**
8:30 am	***H. Schramm*** **Fishing Tournaments Can Teach Us about Measuring Impingement Mortality**	***S. Beck*** **Louisiana Largemouth Bass: Population Dynamics, Fishery Characteristics, and Size Regulation Effectiveness**	***J. Armbruster*** **Evolutionary Ecology of the Cyprinidae**		***E. Arb*** **Beach Nourishment's Effect on Movements of Juvenile Florida Pompano and Gulf Kingfish**	***C. Skelton*** **Distribution of Non-Native Crayfishes in Georgia, USA**	***S. Lusk*** **Evaluating the Effects of Threadfin Shad on Largemouth Bass and Bluegill Populations in Small Impoundments**
8:45 am	***J. Chiulli*** **The Section 316(b) Rule Impingement Mortality Standard and Technologies for Compliance**	***N. Feltz*** **Factors Affecting Largemouth Bass Size Structure at Wheeler and Guntersville Reservoirs, Alabama**	***S. Floyd Jr.*** **Investigating the Role of Parental Care in *Nocomis* Nest Association**	***M. Davis*** **Status of Fish Data Standardization in the Southeastern US**	***M. Stratton*** **Is Cape Hatteras, NC a True Biogeographic Barrier for Nearshore Fishes and Invertebrates?**	***S. Welsh*** **Upstream Dispersal of an Invasive Crayfish Aided By a Fish Passage Facility**	***C. Babb*** **Life History of the Altamaha Shiner,*Cyprinella xaenura***
9:00 am	***R. Clubb*** **Technologies for Complying with the 316(b) Rule Entrainment Mortality Standard**	***Y. Quintana*** **Assessment of the Artisanal Giant Cichlid Fishery in Lake Petén Itzá, Guatemala"**	***B. Peoples*** **Appalachian Cyprinid Stream Fish Communities and the Stress-Gradient Hypothesis**	***B. Hughes*** **Fish Assemblage Sampling Effort**	***D. Ferons*** **Mercury Concentrations in Two Tertiary Consumers in a Salt Marsh**	***J. Kilian*** **Rates of Spread and Effects of Non-Native Rusty Crayfish in the Monocacy River, Maryland**	***M. Acre*** **Can River-Reservoir Interfaces Serve As Surrogate Nurseries for Riverine Fishes?**
9:15 am	***R. Wallus*** **EPA Cooling Water Intake Structure Regulations Revolve Around Larval Fish**	***J. Skaggs*** **Assessing Inland Recreational Fisheries Using Catch-at-Age Methods**	***D. Logue*** **Competitive Interactions of Two Pelagic Broadcast Spawning Cyprinids of the Great Plains**	***J. Parham*** **High Definition Stream and Fish Surveys**	***P. Rudershausen*** **Survival of a Salt Marsh Fish Among Variably Altered Tidal Creeks in a Coastal Landscape**	***S. Adams*** **Crayfishes Along Riverine-Lacustrine Transitions of Lewis Smith Reservoir**	***A. Hyman*** **Do Truck Followers Catch All of the Fish?**
9:30 am	**BREAK**						

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	CWA Section 316(b) Regulations *F. Heitman, Moderator*	**Fish Management** *W. Porak, Moderator*	**Ecology and Conservation of Cypriniform Fishes** *B.Albanese, Moderator*	**Recent Advances in Stream Sampling Techniques** *S. Johnson, Moderator*	**Coastal and Estuarine Fisheries** *T. Bonvechio, Moderator*	**Southeastern U.S. Crayfish Conservation** *Z.Loughman, Moderator*	**Best Student Paper Competition** *B.Ray, Moderator*
10:00 am	***F. Heitman*** **Implications of the New 316(b) Requirements for Fishery Work and Workers**	***L. Dorsey*** **Blue Catfish Management in North Carolina Reservoirs: Starting from the Ground Up**	***C. Coleman*** **Specific Gravity of Ova and Fry of Broadcast-Spawning Cyprinids**	***W. Duncan*** **Rapid and Robust Instream Flow Assessments on Shoestring Budgets**	***D. Bethea*** **Distribution and Community Structure of Coastal Sharks in the Northeastern Gulf of Mexico**	***T. Keller*** **Habitat Suitability and Biogeography of the Piedmont Blue Burrower**	***D. Dippold*** **Estimation and Validation of the Length-at-Age Relationship of Spotted Seatrout**
10:15 am	***M. Schramm*** **Required Environmental Mitigation at Licensed Hydropower Projects**	***A. Marbury*** **Juvenile Gulf Sturgeon Abundance in the Brother's River, FL**	***T. Worthington*** **Pelagic-Broadcast Spawning Cyprinids: Ecology and Conservation Opportunities**	***E. Irwin*** **Monitoring of Temperature in Warmwater Streams: Applications for Decision Making**	***C. Bangley*** **A Potential Emergent Nursery Habitat for the Bull Shark in Pamlico Sound, North Carolina**	***A. Yarra*** **Crayfish Occupancy in Response to Hydrologic Regime and Geomorphology in Ozark Streams**	***D. Hann*** **Habitat Suitability Modeling for Shovelnose Sturgeon in the Lower Mississippi River**
10:30 am		***R. Hyle*** **Using Catch Rate Indices to Monitor American Shad in the St. Johns River, Florida**	***W. Ensign*** **What Can Largescale Stonerollers Tell Us about Urban Streams?**	***R. McManamay*** **Prioritizing Streams for Hydrologic Reserves in the Eastern United States**	***S. Ramsden*** **The Effect of Season on the Residency and Distribution of Atlantic Stingray in Two Georgia Creeks**	***M. Meade*** **Physiological Ecology of Alabama Crayfishes in Response to Temperature and Hypoxia Stress**	***M. Schmidtke*** **Reproductive Characteristics of Blueline Tilefish Off the Coast of Virginia**
10:45 am		***J. Rash*** **Trout Population Monitoring in the Nantahala River in Response to Flow Releases**	***G. Wilde*** **Longterm Changes in the Fish Assemblage of the Upper Brazos River, Texas**	***M. Troia*** **Validating Stream Classifications Schemes for the Eastern US**	***C. Brinton*** **Fine scale movements of the Atlantic Stingray: a tidal or diel pattern?**	***D. Bechler*** **Use of Nest-Traps for the Acquisition of Data on Population Structure, Life History and Behavior in Crayfish**	***D. Bahr*** **Atlantic Sturgeon Recruitment in the Savannah River, Georgia**
11:00 am		***K. Dockendorf*** **Assessment of Spawning Runs of Anadromous River Herring in North Carolina, 2006-2014**	***G. Pandolfi*** **Effects of Land Use, Habitat and Introduced Fishes on Stream Communities**	***D. Walker*** **Using Classification Trees to Model Habitat Partitioning Among Darter Species**	***T. Grabowski*** **Characterization of the Function of Different Call Types in Spawning Spotted Seatrout**	***J. Martin*** **Landscape-Based Spatially Explicit Species Index Models for Everglades Restoration: Crayfish**	
11:15 am		***J. Porter*** **Effects of Hydrology and Temperature on the Growth of Shovelnose Sturgeon in the Lower Mississippi River**	***B. Albanese*** **Status Assessment Mapping for Imperiled Minnows and Suckers in the Southeast**	***E. Rottmann*** **Revealing What Lies Beneath: Utilizing Environmental DNA (eDNA) to Detect Rare Fishes in Louisiana**	***Q. Hall*** **Determination of Seasonal Abundance and Density of Nekton Species Proximal to Cedar Bayou**	***Z. Loughman*** **Determination of Crayfish Occupancy Rates Across Mined Watersheds in Eastern Kentucky**	
11:30 am		***G. Farris*** **A Review of Published Literature on Crappie Supplemental Stocking**	***J. Powell*** **Restoring Habitats and Recovering Species One Shu at a Time**	***J. Wisniewski*** **A New Approach to Old Methods: Incorporating Species Detection into Mussel Surveys**	***C. Kemp*** **Defining Fish Communities: Factors Affecting the Organization of Fish Communities in the Mobile Bay Estuary**	***B. Williams*** **Disentangling the History of the Northern Crayfish, Orconectes Virilis, in the Appalachians**	
11:45 am	**LUNCH**						

Saturday Afternoon, January 31, 2015

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	Distribution and Habitat Use *B. Hess, Moderator*	**Fish Management** *D. Peterson, Moderator*	**Ecology and Conservation of Cypriniform Fishes** *J.Davis, Moderator*	**Recent Advances in Stream Sampling Techniques** *C. Jansch, Moderator*	**Coastal and Estuarine Fisheries** *M. Reichert, Moderator*	**Southeastern U.S. Crayfish Conservation** *Z.Loughman, Moderator*	**Habitat Protection and Restoration** *J. Leitner, Moderator*
1:15 pm	***J. Parkos III*** **Functional Connectivity of Fishes in a Modified Hydroscape**	***J. Schooley*** **Costs and Consequences of Dam Passage for Paddlefish in Northeast Oklahoma**	***M. Moore*** **Prioritizing Conservation of Fragmented Populations of Clinch Dace**	***W. Doyle*** **The New Frontier of Midwestern River Trawling**	***L. Duermit*** **The Ecological Consequences of Claw Removal on Stone Crabs and Their Fishery Implications**	***E. Bloom*** **Systematic Evaluation of *Orconectes cf. barrenensis* from the Red River System of TN and KY**	***E. Granstaff*** **Southeast Aquatic Resources Partnership As a Vehicle for Aquatic Conservation: A Decade of Success**
1:30 pm	***A. Grubh*** **Spatial and Temporal Distribution of Fishes at the River – Reservoir Ecosystem Scale**	***K. Bonvechio*** **What Can We Learn about Florida's American Eel Populations with Ongoing Monitoring Efforts?**	***B. Kuhajda*** **The Laurel Dace: Survey Results for an Endangered Species Endemic to Walden Ridge, Tennessee**	***M. Cantrell*** **Measuring Success of a Long-Term Lake Sturgeon Restoration Program with a Standardized Stream Sampling Scheme**	***A. Margiotta*** **Is Rugosity on Intertidal Oyster Reefs Related to Spat and Associated Resident Fauna?**	***B. Helms*** **What Drives the Assemblage Structure of Crayfish Burrow Associates?**	***J. Kauffman*** **Southeast Connectivity Assessment Project (SEACAP)**
1:45 pm	***C. Saidak*** **Dispersal Patterns and Habitat Characteristics for Lake Sturgeon Restoration**	***J. Dycus*** **Utilization of Genetic Markers to Improve Age Assignment of Striped Bass in Coastal Rivers of North Carolina**	***B. Jones*** **Is the Ironcolor Shiner a Vanishing Species in North Carolina?**	***S. Magnelia*** **Low-Cost Unmanned Aerial System to Manage and Conserve Aquatic Resources in Four Texas Rivers**	***K. Bittler*** **Blue Crabs and Freshwater Inflows: A National Perspective**	***C. Figiel Jr.*** **Laboratory Experiments for the Detection of Environmental DNA in Crayfish**	***K. Hoenke*** **The Barrier Prioritization Tool: A GIS Tool Prioritizing Dams for Removal within North Carolina**
2:00 pm	***D. Buckmeier*** **Influences of Hydrology and Spawning Habitat Availability on Alligator Gar Recruitment**	***Z. Siders*** **Comparing Spatial Effort Allocation Across Fishery Sectors: A Case Study with Gag Grouper**	***M. Hayes*** **Population Genetics of the Broadstripe Shiner**	***K. Hining*** **Use of Trail Cameras to Assess Angler Use on Two Wild Trout Streams**	***W. Pine III*** **The [illegible]rious case of eas[illegible]ster stock status [illegible] Apalachic[illegible]y, Florida** CANCELLED	***M. Gangloff*** **Phylogeography of the Chowanoke Crayfish in the Chowan and Roanoke Basins, Eastern North Carolina**	***J. Gut*** **Identifying Fish Assemblages Near the Savannah River Mouth before the Savannah Harbor Expansion Project**
2:15pm	***C. Katechis*** **Distribution and Habitat Associations of Black Bass in Chattahoochee River Tributary Streams**	***C. Raines*** **The Value of Supplementary Fish Habitat in Lentic Systems: Attraction Versus Production**	***S. Bohn*** **Population Structure and Genetic Diversity of Sicklefin Redhorse**	***W. Budnick*** **Sampling Crayfish Assemblages in Louisiana Coastal Plain Streams: Gear, Protocol, and Timing**		***J. Gilmer II*** **Characterization of Hydrogeochemistry and Soil Texture for the Habitat of an Endangered Crayfish**	***T. Starks*** **Assessing Larval Fish Community Responses to Created Habitats**
2:30 pm	***M. Flinn*** **Movement and Habitat Use of Juvenile Alligator Gar in Western Kentucky**	***D. Beasley*** **Challenges of Establishing Trophy Fisheries in Private Ponds**	***G. Moyer*** **Demographic Processes Influence Genetic Patterns of Sicklefin Redhorse**	***J. Freedman*** **Sampling Large-River Fish Communities – Challenges and Solutions**		***R. Thoma*** **The Conservation Status of *Cambarus bouchardi***	***S. Esswein*** **Stream Conservation Decision Support Tool**
2:45 pm	***Z. Slagle*** **Detection Probability of Blackbanded Sunfish in Florida**	***G. Scholten*** **Catch-and-Release Mortality and Spawning Migration of Sauger**	***J. Zelko*** **Cryopreservation of Robust Redhorse and Sicklefin Redhorse Sperm**	***A. Kaeser*** **Low-Cost Side Scan Sonar Helps Advance the Conservation Mission**		***R. Thoma*** **The Conservation Status of *Cambarus jezerinaci***	***P. Johnson*** **Freshwater Mollusk Recovery Programs of the AL Aquatic Biodiversity Center**
3:00 pm	**BREAK**						

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	Distribution and Habitat Use *H. Schramm, Moderator*	**Fish Management** *L. Dorsey, Moderator*	**Ecology and Conservation of Cypriniform Fishes** *J.Davis, Moderator*	**Recent Advances in Stream Sampling Techniques** *H. Roop, Moderator*	**Energetics and Growth** *R. Bringolf, Moderator*	**Southeastern U.S. Crayfish Conservation** *Z.Loughman, Moderator*	**Administration and Education** *S. McMullin Moderator*
3:30 pm	***D. Wilber*** **Benthic Fauna and Sediment Characteristics Associated with Gulf Sturgeon Habitat Use**	***M. Colvin*** **Upper Willamette River Spring Chinook Prespawn Mortality: Synthesis and Optimal Management Actions**	***R. Heise*** **From Rediscovery to Augmentation: Conservation of the Robust Redhorse in the Pee Dee River**	***T. Grabowski*** **Habitat Associations of a Stream Fish Assemblage at Multiple Spatial Scales Using Side Scan Sonar**	***S. Johnson*** **Field Validation of a Bioenergetics Model for Coastal Striped Bass**	***S. Weaver*** **Population Characteristics, Habitat Preferences, and Distribution of *Cambarus parrishi***	***E. McGinley*** **Working with Flagler College Student Volunteers to Measure Biodiversity in a Northeast Florida Estuary**
3:45 pm	***A. Fox*** **Observations of Shortnose and Atlantic Sturgeons in the St. Marys River, Georgia/Florida**	***C. Bradley*** **Monthly Mortality of Juvenile and Adult Striped Bass in the Lower Neuse River**	***C. Straight*** **Using Passive Acoustic Monitoring to Assess Diel Patterns and Temporal Trends in Spawning Rates of Robust Redhorse**	***N. Marzolf*** **Development of Edna Detection and Sampling Methods for the Invasive Apple Snail in Lake Seminole**	***C. Klimah*** **Swimming Performance of Coastal and Inland Largemouth Bass at Varying Salinities**	***J. Johansen*** **Population Densities and Habitat Use of *Cambarus pristinus*, a Crayfish of Management Concern from the Cumberland Plateau in Tennessee**	***G. Grossman*** **The Use of Original Music Videos As Innovative Instructional Resources for Fisheries and Ecology**
4:00 pm	***D. Owensby*** **Mortality, Dispersal and Habitat Use of Stocked Juvenile Muskellunge in Western North Carolina Rivers**	***J. Buckingham*** **Estimating Capture, Release, and Mortality Rates of Largemouth Bass at Guntersville and Wheeler Reservoirs, Alabama**	***J. Davis*** **Two Years of 'Horse Play: Monitoring and Study of the Georgia Population of the Sicklefin Redhorse**	***K. Hecke*** **Presence/Absence Analysis of Historical Data on the Strawberry Darter**	***K. Anweiler*** **Effects of Temperature and Dissolved Oxygen on Metabolic Scope in a Southern Population of Striped Bass**	***T. Black*** **Distribution of Chowanoke Crayfish in the Chowan and Roanoke River Basins of North Carolina**	***W. Bales*** **Society of Lake Management Professionals**
4:15 pm	***D. Smith*** **Seasonal Movement Patterns of Walleye in a Hydropower Reservoir**	***J. Hightower*** **Estimated Survival of Subadult and Adult Atlantic Sturgeon in Four River Basins in the Southeastern United States**	***M. Cantrell*** **Evaluation of Low Discharge Effects on Savannah River Mid-Channel Gravel Bars, with an Emphasis on Habitat Suitability for Spawning Robust Redhorse**	**Concluding Remarks**	***C. Broderius*** **The Effect of Aquatic Vegetation on Survival and Foraging Return of Juvenile Largemouth Bass**	***J. Westhoff*** **Life History of the Freckled Crayfish in Two Missouri Streams**	***J. Taylor*** **Texas' License Utilization and Revenue Enhancement System (LURES): Ensuring Conservation Funding By Understanding Our Constituents**
4:30 am		***D. Shoup*** **A New Tool for Evaluating Prey Sufficiency in Southern U.S. Reservoirs**	***T. Ivasauskas*** **Swimming Ability of Sicklefin Redhorse Early Life Stages and Implications for Conservation of an Imperiled Species**		***M. Camp*** **Patterns of Growth in Young Mussels in the Green River, Kentucky**	***J. Stoeckel*** **Evaluation of a Low-Cost Sampling Protocol for a Coordinated Crayfish Life-History Sampling Effort**	***W. Schlechte*** **Analysis of Texas Resident Angler License Purchases to Estimate Impacts of Year from Purchase Licenses**
4:45pm					***J. Fischer*** **Determination of Pelagic Larval Duration and Growth of Caribbean Amphidromous Fishes**		
5:00 pm	**ADJOURN**						

Sunday Morning, February 1, 2015

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	Biology and Ecology *J. Long, Moderator*	**Anthropogenic Effects** *T. Birdsong, Moderator*	**Angling and Harvest** *D. Harrison, Moderator*	**Gear and Data Assessments** *N. Rankin, Moderator*	**Diadromous Fish Passage** *D. Coughlan, Moderator*	**Do Macro-Consumers Matter?** *M.Freeman/K.Wheeler, Moderators*	**Reef Fishes** *T. Grabowski, Moderator*
8:00 am	***S. Sullivan*** **Habitat Metrics, Land Use, and Index of Biotic Integrity for Georgia Streams**	***B. Alford*** **Fish Assemblages and Agricultural Land Use in the Nolichucky River Basin, TN**	***M. Allen*** **Need for Empirical Estimates of Fishing Effort Dynamics in Recreational Fisheries**	***E. Irwin*** **Integration of a Multi-Metric Index for Informing Instream Flow Criteria Decisions**	***P. Jacobson*** **Protection of Downstream Migrating Adult American Eel at Hydropower Projects**	***T. Kwak*** **Ecological Drivers, Functions, and Services of Caribbean Freshwater Fishes**	***R. Bassett*** **The Effects of a Newly-Established Marine Protected Area on Snapper-Grouper Species**
8:15 am	***R. Andrew*** **Large Woody Debris in Headwater Streams of the Central Appalachians**	***J. Pease*** **Morphological Response of Guadalupe Bass to Hydrologic Alteration and Urbanization**	***B. Baker*** **Minimum Length Limit Evaluation on Largemouth Bass in the Ocmulgee River, Georgia**	***M. Curran*** **Seasonal Flatfish Abundance Patterns in a Shallow Estuarine Creek in Georgia**	***C. Avalos*** **European Eel Passage Survival and Injury through Three Propeller Type Turbines in France**	***A. Engman*** **Temporal Dynamics and the Role of Recruitment in Caribbean Fishes**	***P. Mudrak*** **Estimation of the Number Artificial Reefs in the Gulf of Mexico with Side Scan Sonar**
8:30 am	***D. Bechler*** **Blackbanded Sunfish and Other Species of Concern in Georgia**	***J. East*** **Aquatic Food-Web Structure and Anthropogenic Influences**	***E. Camp*** **Assessing Angler Effort and Fish Abundance Couplings**	***R. Jiorle*** **Comparing Data Collected Using Two Reporting Programs**	***J. Phipps*** **Estimates of Turbine Passage of Fingerling and Yearling Lake Sturgeon**	***M. Snyder*** **Diet-Switching By Omnivorous Freshwater Shrimp**	***L. Williams*** **Red Snapper Fine-Scale Movement Patterns Around Artificial Reefs**
8:45 am	***W. Cross*** **Fish Assemblages of the Wichita River, Texas**	***M. O'Connell*** **Response of Lake Pontchartrain Nekton Communities to the Deepwater Horizon Disaster**	***H. Roop*** **Assessing Fishing Pressure and Angler Harvest from Marben Public Fishing Area in Middle Georgia**	***B. Matthias*** **Combining Samples from Multiple Gears Helps Avoid Fishy Growth Curves**	***M. Balazik*** **Dual Spawning Behavior By Atlantic Sturgeon in the James River and Beyond**	***T. Simon*** **Local Adaptation in Trinidadian Guppies Alters Ecosystem Structure at Multiple Spatial Scales**	***D. Camak*** **Fine-Scale Population Genetic Structure of Red Snapper in the Gulf of Mexico**
9:00 am	***J. O'Bryhim*** **Mercury Concentrations in 23 Tissue Types for 3 Shark Species**	***J. Gelsleichter*** **Pollutant Exposure and Effects in St. Johns River Fish**	***C. Gerken*** **Influence of River Conditions on Angler Catch Rates in the Tallapoosa River, AL**	***V. DiCenzo*** **Use of Stated-Preference Choice Models for Virginia Anglers**	***B. Post*** **Evidence of Atlantic Sturgeon Fall Spawning in South Carolina Rivers**	***S. Poland*** **Trophic Ecology of Large Pelagic Fishes in the U.S. South Atlantic**	***N. Ducharme-Barth*** **Classifying VMS Data in Gulf of Mexico Reef Fisheries**
9:15 am	***M. Urich*** **Metabolic Profiles of Intersex Largemouth Bass**	***J. Guentzel*** **Can Invasive Aquatic Plants to Contribute to Fish Mercury Methylation and Bioaccumulation?**	***A. Nealis*** **Angler Use of Two Reservoir Populations of Paddlefish in Northeast Oklahoma**	***J. Ballenger*** **Moving Toward Treating Continuous Covariates As Continuous Variables**	***D. Coughlan*** **Timing, Size, and Movement of Upstream Migrating American Eels in the Santee-Cooper Basin**	***H. Mallikarachchi*** **Impact of Submerged Vegetation on Predator-Prey Interactions in Everglades Canals**	***W. Bubley*** **Temporal Size Differences of Vermilion Snapper in the Atlantic Ocean**
9:30 am	***A. Dutterer*** **Techniques for Determining Maturity Schedules for Female Black Crappie**	***J. Fore*** **Fish Community Response to Channel Restoration in the Coastal Plains**	***M. Horton*** **Effects of a 9-Inch Minimum Length Limit on Crappie Exploitation**	***V. Shervette*** **Comparison of Two Aging Structures for Longnose Gar**	***F. Rohde*** **Movement By Adult American Shad in Western Albemarle Sound, NC**	***M. Catalano*** **Harvest-Induced Size Structure Shifts Alter Nutrient Release By Omnivorous Fish**	***T. Smart*** **Spatiotemporal Trends in Abundance and Life History of Gray Triggerfish**
9:45 am	***H. Grice*** **Fecundity of Alabama Shad in the Apalachicola River**	***H. Glassic*** **Stream Restoration Efforts for Eastern Brook Trout**	***P. Nguyen*** **Exploitation of Largemouth Bass and Suwannee Bass**	***B. Pracheil*** **Choosing and Prioritizing Study Species and Surrogate Species**	***R. Rulifson*** **Stocking for Striped Bass Stock Restoration**	***B. Taylor*** **Asiatic Clam in Lake Marion, SC**	***C. Roberts*** **Uptake of PAHs in Red Snapper after Deepwater Horizon**
10:00 am	**BREAK**						

	Percival	Scarbrough 1	Scarbrough 2	Scarbrough 3	Scarbrough 4	Verelst	Vernon
	Biology and Ecology *A. Wales, Moderator*	**Anthropogenic Effects** *K. Dockendorf, Moderator*	**Angling and Harvest** *C. Figiel, Moderator*	**Gear and Data Assessments** *M. Cantrell, Moderator*	**Diadromous Fish Passage** *D. Coughlan, Moderator*	**Do Macro-Consumers Matter?** *M.Freeman and K.Wheeler, Moderators*	
10:30 am	***A. Urbanczyk*** **Predation By Juvenile Longnose Gar on Brazos River Fishes**	***S. Michaelsen*** **Fish and Oil: Not the Tasty Outcome You Expect**	***A. Weston*** **The Effects of Black Bass Fishing Tournaments on Smallmouth Bass in the New River**	***J. Shiflet*** **Influence of Bait Type on Catch and Bycatch in Tandem Hoop Nets Set in Kentucky Small Impoundments**	***J. Aldinger*** **Nocturnal Periodicity of Upstream Migration of Yellow-Phase American Eels at an Eel Ladder**	***B. Tumolo*** **Investigation of Invasive Silver Carp in Kentucky Lake**	
10:45 am	***B. Richardson*** **Strong Diet Overlap in Four Sympatric Gar Relatives in Western Kentucky**	***M. Albins*** **Fish Community Composition on Artificial Reefs before and after the Deepwater Horizon Oil Spill**	***P. Snellings*** **Economic Impact of Tournament Black Bass Angling on Lake Guntersville, Alabama**	***P. Rudershausen*** **Simple Gear Modifications to Reduce Sub-Legal Bycatch but Maintain Target Catch in Trap Fisheries**	***A. Stuart*** **Preliminary Observations of American Shad Usage of an Alaskan Steeppass Fishway**	***N. Copeland*** **Predation of White Perch in Sooner Reservoir: Is a Biological Control Possible?**	
11:00 am	***S. Doss*** **Can Changes in Regulations and Stocking Strategies Affect Predatory Interactions Between Muskellunge and Smallmouth Bass**	***J. Robinson*** **Genetic Impacts of Net Pen Failures on Gulf of Mexico Cobia Populations: A Simulation Study**	***K. Nault*** **Seasonal, Non-Tournament Catch and Release Mortality of Largemouth Bass Caught on Artificial Lures**	***J. Johnston*** **Seeking Rare Fish in a Fragmented, Hydropower Driven, Metro-Area, Braided Prairie Stream**	***A. Weaver*** **American Shad Passage at a Vertical Slot Fishway in the James River**	***W. Nowlin*** **Contributions of Native and Non-Native Fishes to Nutrient Cycling in a Spring-Fed River**	
11:15 am	***A. Taylor*** **Genetic Substructure within the Native Range of the Shoal Bass**	***R. Vazquez*** **Osmotic Stress Limits the Distribution of New Zealand Mud Snails within Redwood NP**	***N. Trippel*** **Impacts of Angling for Nesting Florida Bass on Nest Success and Recruitment**	***J. Burroughs*** **Tag Retention of Dart Tags By Riverine Smallmouth Bass**	***C. Holbrook*** **Adult American Shad Movement through Santee Cooper Reservoir System**	***J. Perkin*** **Modeling Ecosystem Effects of Fishes Across Stream Network Gradients**	
11:30 am	***M. Wegener*** **Genetic Composition of Largemouth Bass in Coastal Rivers of Northwest Florida**	***L. Grove*** **Effects of the Introduced Blueback Herring on the Fishery of Lewis Smith Lake, Alabama**	***B. Thompson*** **Simulating Population Level Impacts of Fishing Spawning Largemouth Bass**	***N. Smith*** **Use of Side-Scan Sonar to Identify and Count Alligator Gar**	***A. Kern*** **Status and Conservation of Anadromous Alabama Shad in the ACF Basin**	***K. Wheeler*** **A Quantitative Synthesis of Fish Effects on Temperate Stream Ecosystem Structure and Function**	
11:45 am	***J. Knight*** **Morphometric and Meristic Analysis of the Choctaw Bass (*Micropterus sp. cf. puntulatus*)**	***J. Schmitt*** **Predation of Anadromous Alosines By Non-Native Ictalurids in Tidal Rivers**		***W. Schlechte*** **Selectivity of Gillnets for Alligator Gar and the Effects on Estimates of Population Metrics**	***M. DeLucia*** **Discussions of River Herring Restoration Needs in the Santee-Cooper River Basin**		
12:00 pm		***J. Buckwalter*** **Introduced Stream Fishes in the Middle and Upper New River Drainage**					
12:15pm	**ADJOURN**						

List of Abstracts – 2015 SDAFS Meeting, Savannah, Georgia
January 29-February 1, 2015

The Amazing Cypriniformes – Global to Southeastern Diversity

Richard Mayden*, St Louis University

With an estimated diversity of over 5,000 species worldwide, the Cypriniformes typically dominate most freshwater communities and ecosystems on all continents except Central and South America and Australia The largest family currently recognized evolved a key-innovation early on that is hypothesized to have led to the great diversity in the family relative to all others The group includes species with morphological adaptations to habitats ranging from caves, warm desert and intermittent waters to high elevations in the Himalayas The southeastern United States is no exception to the diversity seen globally except that only two families are recognized – Cyprinidae and Catostomidae Similarly, even in this most species diverse part of the continent, they form an important and major element to various types of communities Fishes and their ecosystems in the Southeast have served as important exemplars of many evolutionary and ecological studies and a great amount of information is known in particular areas Scientists from the region are making substantial progress towards understanding the existing natural diversity and how to best conserve it and its ecosystems With the large number of genera and species in the region, there is a great range of morphologies, guilds, habitats, spawning areas and behaviors, diets, and dispersal capabilities These attributes are moderately well known for some species but for others there is a complete void of detailed information Likewise, while there have been taxonomic and systematic studies conducted at the species and supraspecific levels on many groups, and population genetics on some species, these two areas remain vital to a successful understanding of these communities and their future More diversity remains in the Southeast that has not been officially recognized, too few genetic studies have been conducted to document that recovery efforts through captive rearing are not detrimental to source populations and populations being planted in one region or another Success in this journey is not the sole responsibility of agencies as this will be ineffective It must come from everyone from citizen scientists and groups with special interests in North American fishes (eg, NANFA) and a great range of expertise from the scientific community We are all doing our best with the great limitations on resources but the advances come more quickly and effectively when territoriality of collection information, databases, knowledge bases, and uncompromised focus, even between different factions, is at the heart of the effort

Habitat Suitability and Biogeography of the Piedmont Blue Burrower (*Cambarus [Depressicambarus] harti*)

Troy Keller*, Columbus State University, keller_troy@columbusstateedu, Brian Helms, Auburn University, Chris Skelton, Georgia College and State University, George Stanton, Columbus State University and James Stoeckel, Auburn University

Crayfishes rank second only to freshwater mollusks as the most imperiled taxonomic group in the US Because some crayfishes have limited distributions, they may be at risk for extinction The conservation status of rare crayfish species is often assessed using limited distribution and population data The conservation status of one endemic burrowing crayfish, *Cambarus harti* has been difficult to assess because of a paucity of information about its actual geographic distribution To solve this problem, we developed a habitat suitability model that highlights potential new habitat based on geospatial features (eg, soils, hydrography, landcover, etc) common to locations with known *C harti* populations We assessed the validity of this GIS model using field surveys and discovered new *C harti* populations outside of its known range The model showed only limited success in predicting actual locations of *C harti* populations presumably because it was constructed

based on 1) limited, biologically relevant data sets (eg, no groundwater data), 2) too few known *C harti* locations, and 3) too low resolution geospatial data Additional survey data of known and unknown *C harti* populations would be needed to develop a more robust geostatistical habitat suitability model

The Conservation Status of *Cambarus jezerinaci*

Roger F Thoma*, Midwest Biodiversity Institution, cambarus1@maccom and James Fetzner Jr, Carnegie Museum of Natural History

Cambarus jezerinaci Thoma 2000 has been reported from the Powell River basin of Virginia and Tennessee Taylor and Schuster (2004) commented on *C jezerinaci* stating the species' character states overlap with those of *Cambarus parvoculus* They suggested a genetic analysis was warranted to define the relationship of the two species At that time, Taylor and Schuster reported no *C jezerinaci* from KY Thoma 2009 reported on the species' life history and conservation status in VA for Virginia Department of Game and Inland Fish (VDGIF) Fetzner 2008 analyzed the genetics of *C jezerinaci* for VDGIF It was found a Powell River population and a Cumberland River population existed for the species and that *Cambarus parvoculus* and *Cambarus distans* were distinct from *C jezerinaci* A consequent study (Thoma, 2010) of KY's *C jezerinaci* and *C parvoculus* populations showed *C jezerinaci* to be present in the upper Cumberland River basin upstream of Pine Mountain and *C parvoculus* to be confined to one site in the Obey River basin in Clinton County, KY All other localities reported for *C parvoculus* were found to be *C distans* Though currently considered to be one species, genetic differences between the Powell and Cumberland River populations of *C jezerinaci* warrant individual conservation efforts and recognition as separate species No physical differences have yet been found between the two populations

Ecological Drivers, Functions, and Services of Caribbean Freshwater Fishes

Thomas J Kwak*, US Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, tkwak@ncsuedu, Augustin C Engman, North Carolina Cooperative Fish and Wildlife Research Unit, Jesse R Fischer, North Carolina Cooperative Fish and Wildlife Research Unit and Craig G Lilyestrom, Puerto Rico Department of Natural and Environmental Resources

Caribbean island freshwater habitats support fishes that provide recreational and subsistence fishery value and are critical components of the lotic ecosystem Of the 82 fish species found in the freshwater habitats of Puerto Rico, USA, 26 are primarily freshwater species, and fewer than 10 are native All the native fishes are diadromous and require access to freshwater river and marine habitats for existence These freshwater fisheries span over 9,000 river km in Puerto Rico Historically, they received relatively little attention by fisheries scientists, but that interest is expanding Their conservation and management is complex, as the native species are harvested as migrating post-larvae (cetí) and as adults in recreational and subsistence fisheries — in a region with one of the highest human population densities globally Primary drivers of the fish resource include land use and stream channel alteration, occurrence and operation of dams and other stream barriers, introduction of exotic and invasive fishes and invertebrates, freshwater quality and quantity, and human interactions with the resource Fish assemblages and trophic dynamics are especially strongly influenced by instream barriers and dams, with predictable longitudinal patterns Our research over the last decade on ecological and management scales, basic fish biology and ecology, and ecological and human ecosystem drivers has enhanced public interest, appreciation, utility, and management potential of the stream fisheries resource, as well as facilitating a broader environmental awareness The native freshwater fishes have critical influence on lotic ecosystem function, and human activities have altered that role in many systems Attention to each of these driving mechanisms as affected by humans is critical to ensure ecological integrity and the future sustainability of these fishery resources

Native or Not? Disentangling the History of the Northern Crayfish, *Orconectes virilis*, in the Appalachian Region

Bronwyn Williams*, Southern Illinois University

The northern crayfish, *Orconectes virilis*, is among the most widespread crayfish species in North America, with a contiguous range spanning from Alberta and Montana in the northwest to New Brunswick and Maine in the northeast, and south into Missouri and Kansas *Orconectes virilis* has also been widely introduced beyond the boundaries of its assumed native range, and occurs in 40 states, six Canadian provinces, and several areas of Europe The species is present throughout a large portion of the Appalachian region, where it is commonly considered to be non-native; however, the history of *O virilis* in this area is poorly understood, and recent evidence brings into question the distinction between native and introduced My objective is to use a phylogeographic approach to elucidate the colonization history of *O virilis* in the Appalachian region within the context of an extensive range-wide study of the species Multi-locus molecular genetic data from ~100 individuals from Pennsylvania, West Virginia, Virginia, Maryland, Tennessee, and North Carolina suggests that the history of *O virilis* in eastern North America is complex and warrants closer attention from both ecological and evolutionary perspectives

Distribution of Non-Native Crayfishes in Georgia, USA

Christopher Skelton*, Georgia College & State University and Doug Oetter, Georgia College & State University

In The Crayfishes of Georgia, HH Hobbs, Jr mentioned the introduction of one non-native species to the state *Cambarellus shufeldtii* was reported to have been introduced to a pond in the Chattahoochee River system, but as yet, has not been documented in the state Two additional species, *Faxonella clypeata* and *Procambarus* (*Ortmannicus*) *acutus acutus*, are native to Georgia, but Hobbs documented introductions of both species into areas outside of their native ranges *Faxonella clypeata* was introduced along with the aforementioned *C shufeldtii* There is one collection of *F clypeata* near the introduction site, but it is not clear if the population is native or introduced *Procambarus (O) acutus acutus* was known in Georgia from the Atlantic Slope, but was introduced from a population in Louisiana to a fish hatchery in the Piedmont province in the Flint River system This species as increased its range in the Flint Since The Crayfishes of Georgia was published, four additional non-native crayfish species have been introduced to the state *Procambarus (Scapulicambarus) clarkii* is now found in all of the major river systems in Georgia, and is extremely common in the upper Ocmulgee River system and the middle Savannah River system *Procambarus (Ortmannicus) hayi* is known from three collections in the upper Oconee River system *Orconectes (Procericambarus) juvenilis* can be found in the impounded portions of Murder Creek and Little River in Lake Sinclair (Oconee River system), and appears to be spreading upstream in Murder Creek Lastly, *Orconectes (Buannulifictus) palmeri* is widespread in the lower Flint River system It is apparently displacing the native *Procambarus (Pennides) spiculifer* there, and threatens *P (Pe) gibbus*, which is endemic to the Muckalee and Coolewahee creek systems in the lower Flint

Temporal Dynamics and the Ecological Role of Recruitment in Caribbean Amphidromous Fishes

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Amphidromous fishes are a major component of tropical coastal and island lotic fish assemblages In the amphidromous life-history, adults grow and spawn in freshwater streams, their embryos or larvae are transported downstream, larvae grow and develop in the marine environment, and post-

larvae recruit to the estuary, and undergo metamorphosis during river ingress Dispersal during the marine larval phase and subsequent recruitment by post-larvae allows for population colonization, re-colonization, and replenishment Post-larval amphidromous fish recruitment also provides important ecosystem functions and services In some locations post-larvae synchronize river ingress to specific times periods in the lunar cycle, which results in periodic, upstream pulses of biomass from marine to estuarine and freshwater environments Culturally and economically valuable artisanal fisheries exploit the monthly pulses of post-larvae in locations where this phenomenon occurs Since post-larvae can be highly abundant, recruitment also represents a vital source of resources for estuarine, and freshwater fishes, as well as other predators Despite the critical role of post-larval recruitment for Caribbean inland fisheries and ecosystems, their ecology and management have received little research attention We sampled amphidromous post-larvae at the mouths of the Río Grande de Arecibo and Mameyes rivers in Puerto Rico during the 2013 to 2014 recruitment season Additionally, we sampled the diet of estuarine and freshwater predatory fishes in the Río Grande de Arecibo during a peak recruitment episode Our results reveal temporal relationships between the lunar cycle and amphidromous post-larval recruitment, document intra-annual variation in peak recruit abundance, and demonstrate predation on post-larvae by fishes that are recreationally and ecologically valuable Our findings provide crucial information for the management and ecology of Caribbean inland fisheries and tropical lotic ecosystems

Spatial Distribution, Genetic Structure, and Morphological Variation of Multiple Endemic Crayfishes of the Mobile Basin

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Crayfishes reach their peak biodiversity in North America, with the Mobile Basin of the southeastern US harboring exceptional endemism However, the genetic diversity and phylogeography of crayfishes from this region are poorly understood In an ongoing effort to shed light on these animals, we are exploring the genetic structure and shape variation among populations of multiple endemic crayfishes in the Mobile basin In the Tallapoosa River, *Cambarus englishi* and *C halli* were examined from three watersheds of the drainage (Upper, Little, and Middle) using mitochondrial cytochrome c oxidase subunit I (COI) gene sequences and geometric morphometrics Three discrete COI haplotype networks were recovered from both species, implying appreciable genetic divergence within each Significant genetic differentiation was identified between nearly all populations This suggests genetic separation is manifested in part by shape variation and overall, these crayfishes appear to represent “cryptic species complexes” We will extend this line of work to the lower Mobile and Coastal drainages of south Alabama, where three species of burrowing crayfish (*Fallicambarus burrisi, F byersi,* and *F danielae*) are found in association with pitcher plant (*Sarracenia* spp) bogs Burrowers, whom make up a fourth of the imperiled crayfish species in the US, are potentially exposed to increased isolation given their limited dispersal abilities and patchy distribution However, the level connectivity between multiple populations and associated genetic diversity is unknown These studies will help identify regional and local biodiversity patterns and assignment of associated Evolutionarily Significant Units beneficial to managing and preserving cryptic diversity within endemic North American crayfishes

"Crayfish Occupancy in Response to Hydrologic Regime and Geomorphology in Ozark Streams"

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Hydrologic regimes and geomorphology have important effects on stream ecosystem structure and function We sought to determine the effect of hydrologic regime (ie, groundwater flashy streams vs intermittent streams) and geomorphology on crayfish occupancy in the Ozark Highlands Program

PRESENCE was used to relate crayfish occupancy to hydrologic regime and other covariates Preliminary analysis indicated that the most important covariates for crayfish occupancy were water depth and current velocity Substrate composition, hydrologic regime, and Rapid Habitat Assessment scores also impacted crayfish occupancy Crayfish occupancy is related to hydrologic regime and geomorphology in the Ozark Highlands and these factors can be used to improve crayfish conservation

Confronting Unmeasured Biases in Stream Sampling: Thoughts from a Field Biologist

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The work of field biologists, arguably, is more important than ever Field observations of changing species abundances are essential to understanding how biota are likely to respond to accelerating environmental change Fortunately for freshwater conservation, biologists have amassed decades of field data on biologically rich, southeastern US streams, and new sampling technologies promise to extend our observational power Recent literature, however, emphasizes the shortcomings of organism counts in the absence of some measure of sampling bias Even though we employ standardized sampling protocols, we cannot standardize field conditions Time and funding limitations generally prohibit direct efficiency estimation at each sampling location, or collection of datasets large enough to estimate parameters of statistical distributions underlying capture processes We can, however, begin to account for variable and incomplete detection of stream biota with minor modifications in data collection and analysis In particular, partitioning samples into replicates across habitat units, or aggregating samples into spatial or temporal replicates, can allow estimates of species detection Analyses of counts can include tests for the influence of factors likely to influence capture efficiency However we chose to address the known sampling unknowns, being clear about sampling assumptions will improve inferences from our field data

Evolutionary Ecology of the Cyprinidae

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With over 260 species, the Cyprinidae is the largest family of freshwater fishes in North America They occupy many different niches from deserts, to large rivers, to mountains There are species with transcontinental ranges and species with very small ranges 14 species or subspecies are considered extinct, accounting for 35% of the extinct North American fishes; thus, understanding the diversity of the Cyprinidae is imperative We have been examining the evolutionary ecology of North American Minnows and will discuss three topics: the ecology of minnows of a North Carolina assemblage, the changes in biodiversity from upstream to downstream habitats in Alabama, and the overall evolutionary history of shape change in North American minnows Shape is being assessed using Geometric Morphometrics and is being used as a proxy for understanding overall ecology of the fishes We have additionally examined diet through gut content analysis and stable isotope data for the North Carolina minnows We explore the evolution of shape and diet through phylogenetic regression of characteristics, and find that many of the characters show phylogenetic signal In Alabama, we find that as we go downstream, species are added within the main body of shape space (phenetic packing) vs being added to the periphery (phenetic dispersal) Across North America, we find that basal clades occupy most of the fringe of shape space whereas the shiner clade fills in the space between all of the basal clades suggesting an initial burst of morphological diversity (phylogenetic phenetic dispersal) followed by further subdividing of shape space (phylogenetic phenetic packing) All these studies give us a greater understanding of the ecological place of cyprinids in North America, and will aid in future studies on conservation

Upstream Dispersal of an Invasive Crayfish Aided By a Fish Passage Facility

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Abstract - Fish passage facilities for reservoir dams have been used to restore habitat connectivity within riverine networks by allowing upstream passage for native species These facilities may also support the spread of invasive species, an unintended consequence and potential downside of upstream passage structures We documented dam passage of the invasive virile crayfish (*Orconectes virilis*) at fish ladders designed for upstream passage of American eels (Anguilla rostrata) in the Shenandoah River drainage, USA Ladder use and upstream passage of 11 virile crayfish occurred from 2007–2014 during periods of low river discharge (<30 m3s–1) and within a wide range of water temperatures from 90–286 °C Virile crayfish that used the eel ladders were large adults with a mean carapace length and width of 480 mm and 241 mm, respectively Our data demonstrated the use of a species-specific fish ladder by a non-target species, which has conservation and management implications for the spread of aquatic invasive species and upstream passage facilities

Diet-Switching By Omnivorous Freshwater Shrimp Diminishes Differences in Nutrient Recycling Rates and Body Stoichiometry Across a Food Quality Gradient

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Freshwater shrimp are common in tropical streams world-wide and have been shown to influence ecosystem structure and function where they occur at high densities In tropical streams, omnivorous shrimp may be important nutrient recyclers, because they have a lower body P demand than other macroconsumers such as fish However, little is known about the controls on nutrient recycling by freshwater shrimp nor about the importance of freshwater shrimp as consumer nutrient recyclers in streams where they occur at relatively low densities Across a series of lowland tropical streams that range in dissolved P, we describe: (1) shrimp body stoichiometry in relation to stream P level; (2) rates of P excretion by shrimp; (3) shrimp trophic level using natural stable isotope values (d15N) and (4) the importance of shrimp as nutrient recyclers Shrimp body elemental composition varied across the study streams, with higher shrimp %C and %N in low-P streams P content of shrimp did not change despite large differences in P-content of their likely food resources Also, shrimp P-recycling rates did not increase in high-P streams with P-enriched food resources Stable isotope results combined with change in body nutrient content (%N and %C) suggest that shrimp show different diet choices over the P-gradient, feeding at a higher trophic level in low-P streams This dietary shift may partially compensate for the lower P content in a given food resource in the low-P streams However, P-recycling rates were more variable than predicted based on diet choice and stream P level, suggesting that other physiological or behavioural mechanisms are involved In comparison to fish species in these same study sites, shrimp species recycle P at lower rates per unit body mass than the majority of fish species, despite their lower body P content Diet switching may be an important strategy for omnivorous shrimp in correcting the stoichiometric imbalance between food resource and consumer biomass

Investigating the Role of Parental Care in *Nocomis* Nest Association

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Nocomis nest association is common throughout the eastern United States, but the mechanisms by which hosts and associates benefit are largely unstudied Past work has shown that associates will not spawn on unguarded artificial nests, leading to the hypothesis that host-provided parental care (nest guarding and egg burying) is the primary beneficial mechanism Understanding the relative risk of spawning on guarded/unguarded nests vs open substrate can provide insight into the benefits of

nest association vs broadcast spawning Spatial position of eggs can influence survival Hosts and associates deposit eggs in a spawning trough on the upstream ends of nests Eggs become buried as gravel is deposited over the eggs If buried eggs experience lower predation rates than eggs located near the surface, more eggs should be found in lower upstream portions of nests

We compared predation rates on eggs glued to stones and placed just below the surface on ten pairs of open substrate, artificial and guarded nests Egg survival on guarded nests did not differ from other locations (p=0759), probably because eggs were placed near the surface and eaten We divided eight nests vertically and laterally and compared egg counts between the four sections General linear models with nests as block effects revealed that division was a significant predictor (p=0001), with bottom-upstream sections containing significantly more eggs than the other three sections We then glued eggs to stones and buried one in the nest and placed one near the surface of the spawning trough A paired t-test corroborated that buried eggs had significantly higher survival than eggs near the surface (p=0001) These results suggest that egg burying, not combative predator prevention, is the parental care mechanism by which associates benefit Without egg burying, spawning on *Nocomis* nests may be just as risky for associates as open substrate spawning

Status of Fish Data Standardization in the Southeastern US

Mary Davis*, Southeast Aquatic Resources Partnership and Stephan Magnelia, Texas Parks and Wildlife Department

Species distributions rarely follow geopolitical boundaries and aquatic scientists are increasingly challenged to manage species on watershed or regional scales The formation of regional Fish Habitat Partnerships and Landscape Conservation Cooperatives are examples of attempts to manage at this broader scale However, freshwater fish community data are collected by various entities with little standardization The need for comparable data from different sampling and data management agencies has been identified as a priority to advance aquatic sciences in the Southern US

Standardized data collection techniques, data management, and reporting are not new concepts Since the 1980's recommendations by the American Fisheries (AFS) Society Computer User Section and the AFS Fisheries Techniques Data Standardization Committee have been made in an effort to improve fisheries information systems and standardize sampling techniques, with the goal of improving the ability to share data between organizations Many of those recommendations have been implemented in the Multistate Aquatic Resources Information System (MARIS; wwwmarisdataorg) However, a recent effort by the Southeast Aquatic Resources Partnership (SARP) to define regional flow-ecology relationships using MARIS data illustrated deficiencies which greatly limited the results While a multitude of data was available from multiple State Agencies, much of it could not be used for analysis Several improvements for data collection and reporting were identified that could be implemented with minimal effort

The Southern Division AFS Warmwater Streams Committee (SD AFS WSC) and SARP recognize the need to continue improving data collection and reporting for aquatic species in rivers and streams of the region Without improvement it is likely broader landscape scale research will continue to be hindered The SD AFS WSC and SARP are sponsoring a workshop to address some of these issues at this meeting and sent out a pre-workshop survey to gauge the level of freshwater fish sampling and reporting standardization among state fish and game agencies in the Southern United States Results of the survey will be presented along with recommendations from the workshop for continued improvement of data collection and management standards

An Invasion in Progress: Rates of Spread and Effects of Non-Native Rusty Crayfish in the Monocacy River, Maryland

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Over a seven year period (2007-2013), the Maryland Department of Natural Resources and partners monitored an invasion of Rusty Crayfish (*Orconectes rusticus*) in the Monocacy River to document changes in crayfish species distribution, abundance, and size structure related to the spread of this invasive species We annually surveyed 35 fixed sites in the river and tributaries (2007-2010) and measured the downstream dispersal of Rusty Crayfish by delineating the leading edge of its distribution each year (2008-2011, 2013) Rusty Crayfish dispersal rate was variable, ranging from 06 to 31 km/year, with a mean of 25km/year By 2013, it occupied approximately 29 river km of the Monocacy River in Maryland As it invaded, Rusty Crayfish appeared to affect Virile Crayfish (*O virilis*), another non-native, invasive species long established in the river Rusty Crayfish achieved numerical dominance over Virile Crayfish usually within two years, despite being smaller in size on average Virile Crayfish abundance declined in areas occupied by Rusty Crayfish The size structure of Virile Crayfish populations was also altered in the presence of Rusty Crayfish –young-of-year individuals <20mm CL were absent from collections at sites where Rusty Crayfish was present The native Allegheny Crayfish (*O obscurus*), historically found throughout the watershed, has been displaced by both invasive species from over 70% of the river within the state

Physiological Ecology of Alabama Crayfishes in Response to Temperature and Hypoxia Stress: Implications on Energy Availability and Use

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Many anthropogenic factors contribute to stress on aquatic organisms Human activities such as deforestation, which reduces canopy, damming, which alters hydrology, and fuel emissions, which influence global carbon signatures, all influence environmental temperatures, and all are of concern to environmentalists Alabama harbors some of the most unique aquatic species in the nation, including over 325 freshwater fishes, 180 mussels, and 83 crayfish species Many of these aquatic endemics in NE Alabama are specialists requiring specific environmental conditions and habitats to survive Among those most influenced, animals inhabiting springs are likely the most susceptible to temperature fluctuations One of the most noticeable effects of temperature fluctuations is a change in metabolism Changes in metabolism associated with temperature stress have been shown to alter energy use and allocation and result in reduced growth and reproduction in many aquatic species Several species of native NE Alabama crayfish (the white tubercled crayfish, *Procambarus speculifer*, the Coosa crayfish, *Cambarus coosae*, and the variable crayfish, *Cambarus latimanus*) were collected and acclimated to three temperatures, 15, 20, and 25C The white tubercled crayfish and the variable crayfish are predominantly stream species whereas the variable crayfish can often be encountered in cool temperature springs Following a two-week acclimation period, metabolic rates of the crayfish were determined using an intermittent flow, closed loop respirometer Oxygen consumption rates varied for crayfish of different size classes, as expected, with larger animals having a lower weight specific metabolic rate For *C latimanus*, overall mean oxygen consumption rates for animals acclimated to 15, 20, and 25C were 64±114, 81±225, and 106±182 mg O_2/kg*sec, respectively Calculated Q10 values of 162 and 169, for the change in metabolic rate from 15-20C and 20-25C, suggests the animals are responding normally to temperature and are not stressed or beyond their range of tolerable temperatures

Systematic Evaluation of *Orconectes Cf barrenensis* from the Red River System (Cumberland River) of Tennessee and Kentucky

Erin Bloom*, Austin Peay State University, Brittany McCall, Austin Peay State University, Rebecca Johansen, Austin Peay State University, John Johansen, Austin Peay State University and Mollie Cashner, Austin Peay State University

Orconectes barrenensis is endemic to the Green River system of KY and TN The closely related species, *Orconectes mirus*, is restricted to Tennessee River tributaries in TN and AL Neither has been reported from the Red River (Cumberland River) of KY and TN; however, a crayfish that is morphologically similar to *O barrenensis* and *O mirus*, has been reported from this system The objectives of this work were to use molecular and morphological data to resolve the phylogenetic relationships and taxonomic status of *O cf barrenensis* Previously published primers were used to amplify and sequence two mitochondrial (COI and 16s) and two nuclear (28s and GAPDH) gene regions, for the three focal taxa Individual genes and a concatenated data set including all genes were used to generate hypotheses of relationships with Maximum Parsimony and Bayesian inference methods A suite of standard measurements were taken from each focal taxon Univariate and multivariate analyses were used to assess variation among the taxa and the clades identified in the genetic analyses Phylogenetic results support the morphology-based assumption of a close relationship among *O cf barrenensis, O barrenensis and O mirus*, which were recovered as a well-supported clade Within this clade, *O cf barrenensis* was monophyletic and divergent *from O barrenensis* and *O mirus* However, relationships among these taxa were unresolved, and *O barrenensis* and *O mirus* were not monophyletic, suggesting potentially unrecognized diversity in these species *Orconectes cf barrenensis* was morphologically diagnosable from the other focal species based on combination of characteristics, further illustrating the distinctiveness of this crayfish The genetic and morphological data support recognizing *O cf barrenensis* as a distinct species

Population Characteristics, Habitat Preferences, and Distribution of *Cambarus parrishi*, a State-Endangered Crayfish

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Crayfishes are keystone species in headwater aquatic ecosystems that process organic material, increase nutrient availability and engineer complex benthic stream habitat This studied defined distribution, range, population characteristics, and habitat preferences of a state-endangered, data-deficient crayfish species, *Cambarus parrishi* in the upper Hiwassee River watershed in northeast Georgia Crayfish were collected at streams of varying stream order and elevation within three different sub-watersheds over a three year period Multiple habitat parameters including substrate size, depth, water velocity, and stream roughness were measured at a microhabitat scale Additionally, macrohabitat parameters including stream order, width, discharge, gradient, and elevation were recorded Correlation analysis identified habitat variables associated with presence which were incorporated into logistic regression models *C parrishi* were less abundant at lower elevation sites than the sympatric *Cambarus bartoni* *C parrishi* were also more abundant in smaller, high gradient streams, which represents a possible expansion of its range *C parrishi* prefer slower water velocities, cobble substrates and shallow depths whereas *C bartoni* preferred faster velocities and tolerated greater depths In particular, young-of-year *C parrishi* were found only in shallow side pools near undercut banks Various population characteristics related to growth and reproduction will be evaluated Data collected from this study greatly expands the existing knowledge on this species, which was quite limited previously

Crayfishes Along Riverine-Lacustrine Transitions of Lewis Smith Reservoir, Bankhead National Forest, Alabama: Surprises and Suspicions

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Cal Johnson, Alabama Department of Environmental Management and Stuart McGregor, Geological Survey of Alabama

Reservoirs impose dramatically altered habitat conditions on landscapes and profoundly alter biotic communities not only in the impounded areas, but also down- and upstream and into nearby terrestrial zones The biotic responses within river-reservoir transition zones, areas that are sometimes riverine and sometimes lacustrine, have received little attention From 2012 to the present, we documented the crayfish, fish, and mussel fauna of transition zones in Lewis Smith Reservoir, Black Warrior River drainage, Winston County, Alabama Transition zones studied include those of two major and six minor tributaries We used a variety of methods, including backpack and boat electrofishing, trawling, trapping, and visual surveys to assess faunal composition Distributions associated with the transition zones of the major tributaries showed qualitatively similar patterns across all three faunal groups, with riverine-dependent species transitioning to generalist or lacustrine species at similar locations Riverine-dependent species typically appeared toward the upper end of the transition zone where the river was inundated only at the highest reservoir levels but the habitat was not greatly modified by long-term impoundment Although our mainstem crayfish surveys were qualitative, crayfish abundance in the impoundment and lower transition zones appeared to be influenced by substrate composition In the minor tributaries, crayfish became common in the upper halves of the transition zones The most common crayfishes encountered were *Orconectes validus* and *Cambarus obstipus*, with occasional captures of *C striatus* We also found two species, *O lancifer* and *O ronaldi*, not previously known from the study area, nor from the Black Warrior River drainage Suspicions about the sources of the latter two species will be addressed

What Drives the Assemblage Structure of Crayfish Burrow Associates?

Brian Helms*, Auburn University, Mallary Clay, Auburn University and Jim Stoeckel, Auburn University

Although generally associated with open water, many species of crayfish spend much of their lives in terrestrial burrows that extend to the groundwater These burrows create spatially-defined habitat patches that are often used by other organisms Generally little is known about these burrowing crayfish and much less is known about the community structure and dynamics of the co-inhabitants of their burrows We this in mind, we initiated a study with a population of *Cambarus harti* (Piedmont Blue Burrower) in Warm Springs, GA to describe and identify potential physical predictors of the invertebrate assemblage structure within their burrows In September 2014, water and associated organisms from 20 burrows were removed and quantified Physical parameters associated with each collection included burrow width, burrow activity, burrow water volume, groundwater depth, and surficial distance to permanent water Initial observations revealed multiple invertebrate taxa representing various feeding strategies, including primary and secondary consumers, with densities of 20 to 2500 invertebrates/L in a given burrow Nearly all burrows contained cyclopoid and harpacticoid copepods as well as multiple ostracod, cladoceran, and acari taxa Larger predacious dipteran invertebrates such as Culex (Culicidae), Culicoides (Ceratopogonidae), Limnophila (Tipulidae), and Tanypodinae (Chironomidae) were present in 75% of the burrows examined Taxonomic richness and predator density were negatively correlated with groundwater depth, whereas richness was positively correlated to burrow water volume These preliminary data suggest that there is considerable spatial variation in the composition of these subterranean communities and that they possess a dynamic trophic structure potentially determined not by direct crayfish activity but by the volume of water associated with a burrow (system size) and the degree of surface connection

The Use of Nest-Traps for the Acquisition of Data on Population Structure, Life History and Behavior in Crayfish

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Nest-traps, used to study the cavity nesting fish the naked goby in Texas, were used to study population structure, life history and behavior of *Procambarus spiculifer* in the Alapahoochee River basin in South Georgia from March to October 2007 Trap occupancy rate was 348% (n = 136 crayfish), and involved 80 females, 54 males and two juveniles for whom gender could not be determined Size class gender distributions were similar in pattern to that of a more extensive life history study in the same river basin, but statistical differences existed Occupancy rates in traps correlated with monthly average rainfall events One to five crayfish occupied individual nest-traps Soft-shelled crayfish, shed exoskeletons and dead crayfish were found in traps Five species of fish and seven invertebrate taxa co-occupied nest-traps with crayfish The results of this study indicate that valuable data on population life history data, population structure and behavioral activities involving conspecific and heterospecific co-inhabitants can be acquired; and at the same time result in little to no harm to the crayfish studied, which would be especially valuable for the study of crayfish species of concern

Appalachian Cyprinid Stream Fish Communities Can be Structured As Nest Webs and Predicted By the Stress-Gradient Hypothesis

Brandon Peoples*, Virginia Polytechnic Institute and State University, bpeoples@vtedu and Emmanuel A Frimpong, Virginia Polytechnic Institute and State University

Little is known about how positive biotic interactions structure vertebrate communities Nest association, a communal spawning activity among fishes, is a reproductive facilitation in which associates spawn in nests constructed by hosts Nest associative behavior is nearly obligate for some associates, but is facultative for others; this can complicate interaction network topology Nest web models can be used to understand interaction topologies in nesting-structured communities, but have thus far only been applied to avian communities We constructed a nest web based on spawning observations over three years in several streams in southwestern Virginia We then used structural equation modeling (SEM), implemented through an information-theoretic framework, to identify the most plausible nest web topology in stream fish communities at 45 sites in the New River Basin of the central Appalachian Mountains, USA Next, we sought to identify the contexts in which nest association would be an important driver of community structure, using the stress-gradient hypothesis (SGH) to generate predictions The SGH predicts that the importance of facilitation should increase with physical stress We defined physical stress as the combination of stream size and anthropogenic disturbance, and interaction importance as (1) the per-nest reproductive success of species that rely strongly on hosts for reproduction, and (2) the domination of community structure by these species and their hosts, quantified using principal coordinates analysis (PCoA) Seventy-one percent of SEM model evidence supported a parsimonious interaction topology in which strong associates rely on a single host (*Nocomis*), but members of other reproductive groups do not PCoA results identified a gradient of community structure dominated by *Nocomis* and associates, to communities dominated by other reproductive groups Both metrics of facilitation importance responded significantly and positively to physical stress This study suggests that vertebrate communities can be driven by positive interactions, and that the SGH can generate useful predictions about their composition

Population Densities and Habitat Use of *Cambarus pristinus*, a Crayfish of Management Concern from the Cumberland Plateau in Tennessee

John Johansen*, Tennessee Technological University and Hayden Mattingly, Tennessee Technological University

The Pristine Crayfish (*Cambarus pristinus*) is receiving regional and federal conservation attention due to its limited geographic range The species is restricted to second- through fourth-order streams in the Bee Creek and upper Caney Fork watersheds on the western edge of the Cumberland Plateau in Tennessee Previous surveys provided semi-quantitative abundance estimates indicating that the species is generally uncommon at occupied sites Our objective was to conduct a current status assessment to provide managers with quantitative data for habitat use and population estimates A total of 45 reaches across the range of this species were isolated using block nets and surveyed during the summers (May – September) of 2011 – 2013 Single-pass surveys consisted of a two-person crew sampling all available aquatic microhabitats using a combination of visual searches, dip nets, and seines At each site, the total number *C pristinus* collected was recorded and a suite of reach-scale habitat variables were measured Logistic regression models were developed to predict the probability of *C pristinus* presence as a function of habitat attributes In addition, Petersen mark-recapture population estimates were made at six reaches during the summer of 2013 A linear regression model was constructed to predict population size at all occupied localities *Cambarus pristinus* was detected in 13 of the 45 reaches, with single-pass capture rates of 1–56 crayfish per 100 m Logistic regression habitat models indicated that *C pristinus* presence was positively related to mean substrate size and negatively related to substrate sedimentation The linear regression population-density model was useful in predicting population estimates based on single-pass capture rates The mean abundance estimate was 79 ± 28 Pristine Crayfish per 100 m and with a mean estimated density of 18 ± 8 Pristine Crayfish per 100 m2 These values are similar to density estimates for other rare crayfish species on the Cumberland Plateau Our results will assist in prioritizing areas for protection and remediation, as well as developing adaptive management plans specific to the species

Fish Assemblage Sampling Effort

Bob Hughes*, Amnis Opes Institute &

Increasingly, fisheries biologists are being tasked with assessing entire fish assemblages at many sites because of the value of those assemblages in making regional and national ecological assessments Whether or not those assessments are based on species richness or some sort of fish assemblage index, it is important to determine cost-effective options regarding sampling gear, site extent, number of individuals sought, study designs, and number of sites sampled In this presentation, I use results from sampling effort studies conducted in the Pacific Northwest and Brazil to document feasible approaches Depending on water body conditions and objectives, we found that electrofishing or hand nets, site extents of 40 to 100 wetted channel widths, >150 individuals, probabilistic study designs, and 15 to 40+ sites per reporting unit were appropriate for making assessments

Local Adaptation in Trinidadian Guppies Alters Ecosystem Structure in Situ at Multiple Spatial Scales

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Here we address two questions: (1) does evolutionary change, as expressed by local adaptation of a fish consumer (the guppy, *Poecilia reticulata*) have ecosystem-level consequences in situ? and (2) do the observed ecosystem consequences of local adaptation persist at a landscape-scale despite high environmental variability? First, we experimentally assessed how two distinct guppy phenotypes (abbreviated here as GP1, GP2) affected algal primary producers and invertebrate consumers in situ, in paired reaches of one headwater stream We then measured algal and invertebrate biomass in

paired reaches of seven additional streams within the larger watershed that differ in terms of the presence of GP1 or GP2 guppies Experiments showed that the two guppy phenotypes had different top-down effects: GP1 guppies significantly reduced algal accrual rates by 20% and biomass by 42%, with no effect on invertebrate biomass, while GP2 guppies had no effect on algal accrual rates and biomass but significantly reduced invertebrate biomass by 84% In our expanded landscape study, stream reaches characterized by GP1 guppies had significantly less algal biomass (by 24%), and no difference in invertebrate biomass relative to paired guppy-free reaches upstream In contrast, reaches characterized by GP2 guppies had similar algal biomass, but significantly lower invertebrate biomass (by 32%), relative to guppy-free reaches upstream Our study provides strong experimental evidence that local adaptation of guppies has resulted in significantly different top-down effects of the two resulting guppy phenotypes on algal and invertebrate abundance and algal standing crop accrual in nature Moreover, we found that the effect of GP1 guppies on algae biomass and GP2 guppies on invertebrate biomass was similar in effect size to that of canopy openness on algae and invertebrate biomass across our 8 study streams Therefore, our findings suggest that divergent effects of guppy phenotypes are not only persistent at the landscape-scale, but are also ecologically significant relative to an important environmental variable

High Definition Stream and Fish Surveys: A New Approach for Rapid Fish Habitat Assessment

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As fisheries professionals, we develop models representing fish habitat and water quality conditions as the basis for response to many management issues However, most of these models are based on point samples or descriptions of short (several 100m) sections of stream or rivers By using a new multi-attribute stream survey technique that integrates GPS, video, depth, water chemistry, and side-scan sensors, it is now feasible to survey many miles of stream (10 to 15 miles typically) in a single day with data collected approximately every meter This new surveying approach can rapidly and cost-effectively transform the data-poor stream reaches into multi-attribute, high-resolution maps of the instream habitat, stream channel, and water quality conditions The multi-attribute habitat surveys can be combined with underwater video surveys to document fish occurrence and habitat use These combined outputs allows resource managers to move from statistical assumptions about the “average condition” of a stream based on a few small samples to a census of conditions with highly accurate, site-specific data available All of the data collected is georeferenced and can be classified in GIS software to support multiple management objectives An overview of the process of field data collection, data management, classification, mapping, and analysis will be shown from a number of recent studies from boat and backpack mounted survey systems These projects address issues associated with classifying stream bank erosion susceptibility, monitoring the effects of dam removal, and assessing habitat distribution for fish species These case studies show the range of data collected and its utility in GIS mapping, fish habitat identification, and overall stream health applications

Laboratory Experiments for the Detection of Environmental DNA in Crayfish: Examining the Potential

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Abstract-Molecular tools provide an excellent means for species detection when collections of individuals are difficult For example, environmental DNA (eDNA) is a sensitive and efficient tool for documenting aquatic species, especially at low densities This device has been assessed for fish and amphibians but has rarely been examined for other taxa In this study, we wished to determine whether this detection method was sensitive enough to identify the presence of *Procambarus zonangulus*, the white river crayfish We used six rectangular tanks (244 cm x 61 cm) with garden soil placed on the bottom (~5 cm deep) and used flowing spring water to examine two types of

eDNA kits (soil isolation kit versus water isolation kit) Three of these tanks contained one crayfish per tank and the remaining three tanks contained four crayfish per tank We tested for the eDNA of *P zonangulus* at four time intervals (on day 2, day 4, day 8, and day 15) Isolation kits were used on the same day as samples were collected and total DNA was measured using a NanoDrop spectrophotometer Generally, the soil isolation kit yielded more total DNA than the water isolation kit There was no difference in total DNA between tanks containing one or four crayfish and only a slight increase in total DNA through time An eDNA polymerase chain reaction (PCR) assay targeting cytochrome oxidase I (COI) was developed for *P zonangulus* and screened for specificity across sympatric crayfish species Although this assay is able to detect *P zonangulus* DNA at low concentrations, additional work is needed to examine whether these methods can be a cost-effective tool for detection of crayfish

Landscape-Based Spatially Explicit Species Index Models for Everglades Restoration: Crayfish

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As we place increased emphasis on the value of ecological restoration, it is important to effectively evaluate alternative projects and proposed environmental benefits during the planning phase Restoration of historical wading bird populations, which are believed to have declined because water extraction has limited prey production and/or availability, is a central goal for restoration of the Florida Everglades Depending on species, wading bird prey are primarily small fish and crayfish A conceptual model linking hydrological management to prey production has been used to identify a number performance measures for evaluation of proposed restoration projects We used Spatially Explicit Species Index (SESI) Models to predict how the biomass and density of two crayfish species, *Procambrus fallax* and *Procambrus alleni*, would change in response to three different restoration scenarios These are the only species of crayfish found in the Everglades and they have different hydroperiod tolerances and life histories; *P alleni* thrives in short-hydroperiod situations and *P fallax* in long-hydroperiod situations The adult size of *P alleni* is larger than *P fallax; P alleni* exhibit different predator avoidance behaviors than do *P fallax* Similar models are already in use for evaluating impacts on fish production We evaluated the three restoration options by comparing them to an existing conditions scenario and a full restoration scenario that has proven unrealistic because of a shortage of clean water We parameterized our models using monitoring data collected systematically over an 8-year period from 150 sites located throughout the Everglades The three restoration models predicted longer hydroperiods in most regions when compared to the existing conditions, which generally increases fish production *P alleni* populations decreased 25%, overall, in response to all three restoration models while *P fallax* populations experienced a ~5% increase Under these three restoration options, total crayfish biomass is expected to experience greater fluctuations than crayfish densities We found that all three restoration scenarios would cause crayfish biomass to decrease system-wide when compared to the existing conditions The three scenarios did not differ greatly from the full restoration scenario; average total crayfish density and biomass estimates for each of the three restoration plans differed from full restoration by less than 25% Future work is needed to determine if wading birds show a preference for feeding on either species of crayfish and the relative impacts of diminishing crayfish production while increasing fish production

Competitive Interactions of Two Pelagic Broadcast Spawning Cyprinids of the Great Plains

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Invasive species are a primary threat to southwestern rivers Historically, Arkansas River Shiner *Notropis girardi* has been a characteristic species in both the Cimarron and South Canadian rivers However, this fish species is currently listed as threatened by the USFWS due to major

anthropogenic alterations to the stream landscape It has been speculated that the establishment of the invasive Red River Shiner *Notropis bairdi* in the Cimarron River reduces the chance of recovery of Arkansas River Shiner This study examined the habitat occupancy of both *Notropis* species in the Arkansas River Drainage, Oklahoma to determine if there is an overlap of their ecological niche We seined ten Cimarron River and ten South Canadian River reaches and collected microhabitat information including: depth, flow profile, substrate, sand-bar type, and vegetation or debris in the immediate proximity Single-species occupancy modeling and mixed regression were used to assess the probability of presence or absence of each species at both the reach and microhabitat scale Arkansas River Shiner and Red River Shiner do not appear to co-occur within either river The occupancy information acquired through this study helps shed light on the possibility of habitat overlap of Arkansas River Shiner and Red River Shiner However, more information about physicochemical processes is currently being accumulated to determine if Red River Shiner competitively excludes Arkansas River Shiner

Assessing the Trophic Ecology of Large Pelagic Fishes in the US South Atlantic Using Diet and Stable Isotope Analysis

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In pelagic ecosystems, the functional role played by large pelagic predators is poorly understood, yet this knowledge is essential to the application of ecosystem based approaches to fisheries management To assess the trophic structure of the pelagic community in the US South Atlantic, stomachs and muscle tissue samples were collected from blue marlin (*Makaira nigricans*), wahoo (*Acanthocybium solandri*), dolphinfish (*Coryphaena hippurus*), yellowfin (*Thunnus albacares*) and blackfin tuna (*T atlanticus*) through participation in organized fishing tournaments and cooperation with charter fishing fleets operating in the offshore waters of North and South Carolina from spring 2010 through fall 2013 Diet items were removed from stomachs, identified to lowest possible taxon, and sizes reconstructed when possible Indices of relative prey mass and occurrence were used to describe the diets and to evaluate the potential for resource competition among predators Analysis of carbon (δ13C) and nitrogen (δ15N) stable isotopes was performed on muscle and liver samples from predators as well as muscle samples and whole body samples of prey to elucidate the trophic structure of the community and identify important predator and prey guilds Stomach contents revealed fishes as the most important prey by mass for all predators during all seasons Fishes of the family Scombridae contributed the most to mass diet indices for all predators Invertebrates were as equally important in the diets of blackfin tuna and yellowfin tuna with the most dominant prey being Ommastrephidae squid and amphipods Ontogenetic shifts in prey size and composition were observed for all predators Schoener's index calculated from prey mass and frequency of occurrence showed high diet overlap between dolphinfish-blackfin tuna (α = 0649) and wahoo-yellowfin tuna (α = 0770) suggesting direct competition for prey resources between the predators Stable isotopic analysis indicated seasonal shifts in primary prey use and trophic position by only blackfin tuna Measures of isotopic niche overlap also suggested the potential for competition between dolphinfish-blackfin tuna (SEA = 0691) and wahoo-yellowfin tuna (SEA = 0515) Clustering of the bivariate isotopic data revealed a trophic hierarchy in which larger predators occupied the highest trophic positions within the community while most prey species were grouped in the lowest levels Results suggest that all predator species forage in similar habitats and rely on a few dominant prey items Further work is need to describe the abundance and dynamics of these dominant prey species before ecosystem approaches can be implemented within the US South Atlantic

Distribution of *Orconectes virginiensis* (Chowanoke Crayfish) in the Chowan and Roanoke River Basins of North Carolina

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Orconectes (Crockerinus) virginensis (Chowanoke Crayfish) is a rare crayfish restricted to the Chowan and Roanoke River basins in northeastern North Carolina and southeastern Virginia and is one of two *Orconectes* species native to the Atlantic Slope of North Carolina *Orconectes virginensis* is a state Special Concern species and is being considered for federal listing under the Endangered Species Act In North Carolina, historical data for *O virginensis* is limited to 21 localities in nine waterways Thus, the primary objective was to determine the contemporary distribution of *O virginensis* We used the National Hydrography Dataset Plus (NHD+) to stratify reaches by the number of segments within stream orders ≥ 3rd order and subsequently stratified the number of sites per stream order by segment length (ie, longer segments were surveyed more times than short segments) Surveys were typically restricted to wadeable portions of ≥ 3rd order streams because historical and preliminary surveys in 2011 indicated that *O virginiensis* inhabits larger waterways Surveys were conducted at 91 100-m reaches during 2012 and 90 100-m reaches were surveyed during 2013-14 in the Chowan and Roanoke River basins, respectively Eight crayfish species were collected during the surveys, representing 6 native species and 2 non-native species *Orconectes virginensis* inhabited 16% of reaches and 13% of reaches in the Chowan and Roanoke River basins, respectively Contemporary data indicates that *O virginensis* is restricted to the Chowan River and tributaries entering the river from the west, and the Roanoke River downstream of Roanoke Rapids Dam and the Grassy Creek subwatershed Distributional knowledge of *O virginensis* in occupied waterways was greatly expanded by our surveys, including detection in three waterways without prior occurrence knowledge; however, *O virginensis* was not detected in two waterways with historical records Our study suggests that O virginensis is currently stable in North Carolina; however, periodical surveys are recommended to monitor expansion and impacts of non-native crayfishes

Life History of the Freckled Crayfish *Cambarus maculatus* in Two Missouri Streams

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Information on the life history of a species informs its conservation and management It can improve monitoring programs, increase sampling efficiencies, and parameterize trait-based models that project future changes in its abundance and/or distribution Despite widespread endangerment of crayfish in North America, only 12% of the species have described life histories; of the 36 that occur in Missouri, 19 (53%) have published life history studies Our objective was to contribute to this baseline knowledge by conducting a two-year life history study on the Freckled Crayfish (*Cambarus maculatus*), a species of conservation concern endemic to only the Meramec River basin in Missouri We established sampling reaches on two streams in the Meramec River basin and have visited reaches monthly since May 2013 Crayfish caught by seining were measured (carapace length), counted, and examined for reproductive or molting status We captured 19 and 12 gravid females in the spring of 2013 and 2014, respectively; these were used to estimate fecundity and egg size In addition, we implanted passive integrated transponder (PIT) tags in 92 adult crayfish; recapture of tagged animals will be used to estimate growth and longevity Results of our study will reveal timing of reproductive activities, size at maturity, sex ratios, population size structure, and other related life history metrics

Determination of Crayfish Occupancy Rates Across Mined Watersheds in Eastern Kentucky

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In the coal fields of eastern Kentucky coal extraction occurs via surface mining, where coal seams are exposed to the Earth's surface through the elimination of mountain tops The current status of the epigean crayfishes in the greater Kentucky River headwaters, composed of the North, Middle, and South Forks of the Kentucky River, where this form of mining is prevalent is currently unknown To remedy this lack of knowledge the goals of this project were to determine the crayfish fauna of the region, identify habitat use for each crayfish species, and finally ascertain conservation concerns for the crayfish fauna as a whole During the summer of 2014 crayfish were sampled across all three watersheds at 60 sites Both physiochemical and habitat quality data acquisition was completed at each 150 m stream reach Physiochemical data were collected with a YSI datasonde; habitat data were collected through completion of the OEPA QHEI habitat form Mining presence was identified for each stream through collection of a water sample, which was later tested in the laboratory for sulfates, with sulfate concentrations>50mg L^{-1} indicating mining activities All of the aforementioned data were used to create occupancy models through use of logistic regression for each species Sampling results determined that 6 species (*Cambarus cf robustus A, Cambarus cf robustus B, Cambarus distans, Cambarus sphenoides, Cambarus jezerinaci,* and *Orconectes cristavarius*) occurred in the three basins, with *C distans, C jezerinaci, C sphenoides* and *C cf robustus B* limited to single watersheds Of the 33 covariates modeled for each species, sulfate levels proved to be the most predictive covariate driving site occupancy for 50% of the crayfish species; elevated sulfate levels always were associated with either crayfish absence or low crayfish CPUE In addition to sulfate, sediment scores proved to be predictive for the other three species Overall, elevated sedimentation scores were always indicative of low crayfish CPUE, both on an individual and pooled basis This study indicates that mining influences this region's rich crayfish diversity Understanding stream and habitat quality will allow for proper conservation of the epigean crayfishes of the Kentucky River watershed

Phylogeography of the Chowanoke Crayfish (*Orconectes virginiensis*) in the Chowan and Roanoke Basins, Eastern North Carolina

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The Chowanoke crayfish (*Orconectes virginiensis*) is endemic to the Chowan and lower Roanoke River basins in eastern North Carolina and Virginia and is currently being evaluated by the North Carolina Wildlife Resources Commission and US Fish and Wildlife Service for possible state and/or federal listing To date, little is known about the population connectivity, genetic structure or phylogenetic affinities of *O virginiensis* To better understand population and range-wide genetic structure in this endemic crayfish we quantified intra- and inter-specific genetic diversity levels for *O virginiensis* among known populations Genetic data will be used to answer three key questions First we will examine the phylogenetic placement of *O virginiensis*, second we will assess gene flow between populations (including possible assessment of the impact of large barriers like dams to gene flow) and finally we will identify local and range wide patterns of genetic diversity (including the detection of rare genotypes or regions of unusually high genetic diversity) These data will allow managers to understand evolutionary history of *O virginiensis*, assess possible barriers to gene flow and threats to population persistence and understand range wide genetic diversity in a highly range-restricted crayfish

The Impact of Submerged Vegetation on Predator-Prey Interactions in Everglades Canals

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The dynamics of the predator-prey interactions in the southern Everglades is affected by many factors Seasonal fluctuation in surface water depth directs fish migration from shallow wetland marsh to and from the more stable canals We hypothesize that during the dry season fish are forced

to coexist in a compact space, causing the frequency of the predator-prey interactions to increase We also hypothesize is that within the canal system, predator-prey interactions are governed by vegetation structural complexity One proposal for the restoration of the Everglades includes filling or partially filling sections of the canals to diminish the flow of nutrient-enriched waters across the landscape We evaluated how canal depth and vegetation cover affect predator-prey interactions in a canal experimentally filled to marsh level or partially filled We examined seasonal and diel patterns of size-structured interactions using fish size, swimming speed, and density estimated from acoustic data obtained with a duel frequency identification sonar camera (DIDSON) The sonar was submerged off the side of an anchored boat and aimed towards the canal-marsh edge, as well as down the length of the canal Using Echoview (a sound imaging analyzing program) videos from the DIDSON were analyzed for individual fish tracks permitting quantification of behavioral, schooling, and swimming patterns The effect of the fill was quantified by comparing data before and after the fill We observed a positive correlation between the density of small and large fish resulting from seasonal changes in the canal Increased density of small fish in the dry season was also correlated with an increase in the frequency of schooling; the number of schools observed was higher during the day than at night During the day there is an increased density of fish in the vegetation Partially filled canals held higher densities of fish than unfilled canals, probably because of increased vegetative cover over the entire width, including areas previously too deep to support submerged aquatic vegetation Understanding the structural effects of vegetation on foraging and predator-prey behavior within Everglades canals will provide information to manage restoration of canal fisheries in the southern Everglades

Characterization of Hydrogeochemistry and Soil Texture for the Habitat of an Endangered Primary Burrowing Crayfish

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North American freshwater fauna are highly imperiled, with a majority of these taxa being invertebrates Crayfish are the second most imperiled taxonomic group in North America Despite the fact that primary burrowing crayfishes constitute 32% of those considered imperiled, little is known about the ecology of burrowing crayfishes To advance our knowledge about the niche dimensions of burrowing crayfish, hydrogeochemistry and soil texture were assessed to determine their importance for the primary burrower Cambarus harti This state-listed endangered species is only found in 2 counties in Georgia Hydrogeochemistry was analyzed by collecting groundwater samples every 1-4 weeks (1/16/2014-8/1/2014) from shallow wells installed at 4 sites within Meriwether County (GA) Water samples were collected from wells in areas with active C harti burrows and similar areas without burrows (<100 m away) Water samples were also collected from crayfish burrows to measure the similarity between burrow and well water chemistry To assess crayfish soil preferences, 3 soil cores were collected from randomly determined locations within 10 m of each well Soils were dry sieved and sorted to determine percent sand and silt/clay Wells (with and without crayfish) and burrows showed no differences in potassium, iron, manganese, and silica concentrations However, chloride concentrations were on average 16-19 times more concentrated in burrow water In general, soils were sand-rich (855% ±295 SD) and contained only minor amounts of silt/clay (113% ±428 SD) Soils differed slightly among sites but showed no difference between locations with and without burrows Similarity in hydrogeochemistry between wells and burrow water suggests that bedrock composition is relatively homogeneous over small spatial scales Further experiments would be needed to determine if crayfish burrowing activity explains the elevated chloride concentration observed in burrow water These results corroborate previous research suggesting that hydrogeochemistry and soil texture are not the exclusive environmental factors controlling the distribution of primary burrowing crayfish

Evaluation of a Low-Cost Sampling Protocol for a Coordinated, Crayfish Life-History Sampling Effort

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The southeastern United States has the highest diversity of freshwater crayfish in the world – but this group is highly imperiled Despite the importance of life-history information to the design of efficient conservation strategies, as of 2013, life-history studies had been published for only 12% of the 347 crayfish species in the US and Canada In response to this need, the Southeastern Crayfish Biologist Working Group was formed to coordinate life-history research efforts amongst the southeastern states As part of this effort we developed a preliminary core sampling protocol that could be reliably conducted on a frequent (monthly) basis with minimal funding Using this protocol, we quantified basic life-history parameters (ie, seasonal changes in form, size at maturation, brood size, etc) for *Procambarus versutus* and compared these parameters between two Coastal Plain watersheds in east Alabama Length-at-maturity (carapace, mm) was approximately 25 mm for males and did not differ between watersheds The proportion of Form I males did not vary seasonally (June – October) or between watersheds, but remained consistently >80% A power analysis suggested that the current core protocol had a 50 to 90% probability of detecting seasonal changes in proportion of Form I males if changes had occurred In contrast to the male data, we were unable to determine size at reproduction for females, seasonal patterns in the occurrence of gravid females, or accurate brood-size parameters This was primarily due to low sample sizes The frequent capture of small, YOY *P versutus* throughout the year suggests that females were frequently producing broods, but our sampling methodology was not sufficient to capture/detect berried females Development of effective sampling techniques for gravid females, perhaps via the use of cavity traps, should be a main priority for further development of a core protocol before implementation as part of a coordinated, large-scale, sampling effort

Specific Gravity of Ova and Fry of Broadcast-Spawning Cyprinids

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ABSTRACT: Many cyprinids native to streams and rivers of the US Great Plains belong to a reproductive guild that broadcast-spawn semi-buoyant ova into the current Fertilized ova and early larval stages require current to remain within the water column and it is believed this is important in preventing them from settling to the bottom where they are susceptible to being buried by shifting sediments Previous studies have measured the specific gravity of ova from a small number of broadcast spawning cyprinids, yet no study yet has measured the specific gravity of developing larvae Developing ova hatch within one or two days, depending on water temperature, and larvae generally are incapable of maintaining themselves in the water by swimming until an age of five days We measured specific gravity of fertilized ova and larvae of five broadcast-spawning cyprinids using a calibrated, graded density-column ranging from 0 to 30ppt (ova) or 35 to 130 (larvae) Fertilized ova and larval fish were inserted into the column and the height of the ova and larvae within the column allowed us to estimate specific gravity, which is a surrogate measure of the amount of current required to keep them afloat Fertilized ova were semi-buoyant, with specific densities ranging from 10043 to 101 However, fry of the five cyprinid species examined had specific gravities that were significantly denser than the ova, ranging from 1027 to 105 Given that larvae are weak swimmers until an age of 5 days and are significantly denser than ova, we suggest that hypothesized effects of river discharge on survival of early life-history stages of broadcast-spawning cyprinids is most likely attributable to survival of early larval stages

Harvest-Induced Size Structure Shifts Alter Nutrient Release By a Population of Omnivorous Fish

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Body size can have important consequences for physiological factors, such as feeding, respiration, and nutrient excretion Thus, the size structure of a fish population can greatly impact its role in lake nutrient cycles We examined how shifts in body size impacted phosphorus cycling by gizzard shad in Lake Dora, Florida, which underwent a size selective fish harvest during 2005 and 2006 We combined a size structured stock assessment model with excretion prediction coefficients to determine how shifts in population biomass and size distribution impacted nutrient cycling The harvest selectively removed larger gizzard shad, reducing the population biomass by ~27% during the two years after removal, and shifting the population toward dominance by smaller size classes However, phosphorus excretion decreased by only ~18% during this time period because smaller fish excreted more P per gram Three years following the harvest, biomass averaged 8% below the pre-harvest average, but phosphorus release returned to near the baseline average in ~1 year Our results indicate that size shifts that accompany many biomanipulation efforts may offset some of the reductions in internal nutrient cycling

Rapid and Robust Instream Flow Assessments on Shoestring Budgets

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Instream flow studies are powerful information sources that can be used to leverage effective conservation Although there is widespread recognition regarding their utility, the expertise required to implement instream flow studies has shifted from the public to private sectors within the past two decades Commensurate with this shift has been increased financial costs that often make such studies prohibitive or limited in geographic scope Recent and affordable technological innovations have increased the access to tools that can be used in an instream flow assessment To demonstrate this renewed feasibility, we implemented five instream flow studies over a period of two years on the Savannah River These studies identified flow thresholds and relationships with oxbow-river connectivity, angler access, mussel habitat, salinity at key locations, and shoal spider lily inundation These studies were implemented at a small fraction of the cost had these studies been contracted with a private firm We identify start-up costs and methods required to implement basic instream flow studies, and provide general guidance for managers that wish to make fish and mussel collections useful to instream flow science

The Conservation Status of Cambarus bouchardi

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Cambarus bouchardi (Big South Fork Crayfish) is confined to the Roaring Paunch drainage of the Big South Fork Cumberland River in Scott Co, Tennessee and McCreary Co, Kentucky The species has been studied by The Tennessee Wildlife Resource Agency (Williams et al 2002) and documented at six sites in TN Tennessee classifies the species Endangered In Kentucky, Taylor and Schuster (2004) reported the species from two sites Thoma (2010) also reported the species from two KY sites In 2010 *C bouchardi* was petitioned for listing as Federal Endangered and has consequently been reexamined by the senior author for TWRA (summer 2014) Eleven sites in Scott County, TN were examined for the species This study has found *C bouchardi* at all nine sites sampled in Tennessee's Roaring Paunch system and none outside it From a genetic perspective, Fetzner (2012) has found the relationships of *C bouchardi* are not as clear as once thought The use of COI mitochondrial DNA has proven inconclusive in separating *C bouchardi* from closely related species and populations in adjacent areas Further study is needed to clarify taxonomic issues

Pelagic-Broadcast Spawning Cyprinids: Ecology and Conservation Opportunities

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The rivers and streams of the Great Plains ecoregion have experienced dramatic changes during the past century due to altered land cover patterns, reservoir construction, and climatic shifts Under natural conditions, these systems were characterized by extremes in flows and other biotic conditions that collectively drove the adaptation of a diverse endemic fish fauna However, anthropogenic activities have resulted in high levels of fragmentation, loss of channel complexity, reductions in stream discharge and high flow events, and elevated water temperatures One group of species notably impacted by these changing environmental conditions is the pelagic broadcast-spawning cyprinid reproductive guild This reproductive ecotype represents at least 20 species of small-bodied (< 5-6 cm total length) minnows that release semi-buoyant eggs which potentially require substantial lengths of free-flowing river to successfully complete development The majority of these species are considered of conservation concern, and little information is available on the status of remaining species The rapid decline of this reproductive ecotype is attributed to a range of factors including habitat fragmentation, altered flow regimes, and invasive species Conservation and management opportunities for pelagic broadcast-spawning cyprinids are limited by variability and deficiencies in basic ecological information available for some species To tackle this paucity of information, we undertook a systematic review of the available literature for each pelagic broadcast-spawning cyprinid species Latin and common name combinations including taxonomic synonyms were entered into Google Scholar The results were interrogated and studies published in peer-reviewed outlets included in a database To evaluate bias in publishing trends, publications were assessed for general bibliographic information (eg year of publication and journal type) Study location, methodology, and pelagic broadcast-spawning cyprinid species and life-stage examined were recorded The focus of study was categorized into several groups (eg genetics, habitat use, reproduction, feeding) and some studies belonged to multiple groups Through our systematic review, we identify common themes across pelagic broadcast-spawning cyprinid species (eg causes of decline, habitat use, and temperature tolerances) We synthesize the current understanding on the life history and ecological requirements of pelagic broadcast-spawning cyprinids and evaluate areas of uncertainty in relation to species biology The review also identifies knowledge gaps, thus providing a basis for further targeted investigations aimed at conservation of pelagic broadcast-spawning cyprinids

A Macroinvertebrate That Matters: The Asiatic Clam *Corbicula fluminea* in Lake Marion, SC, a Large Southeastern Impoundment

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The benthos of Lake Marion is dominated by mollusks, mainly the Asiatic clam *Corbicula fluminea* and the olive mystery snail *Viviparus subpurpureus* Total biomass of the benthos, sampled in spring and early summer, ranged from 80 g dry mass/m2 in the upper region of the main basin to 40 g/m2 in the middle region and 10 g/m2 in the lower region *Corbicula* contributed 60-80% of the total biomass We modeled phytoplankton dynamics In the upper main basin, which is shallow and rapidly flushed (mean depth of 34 m; mean retention time of 5 days) The model incorporated riverine import, production, and downlake export of phytoplankton, and a bioenergetics-based estimate of consumption by *Corbicula* *Corbicula* potentially transfers large quantities of material from pelagic to benthic habitats, substantially reducing the resource base for planktonic consumers Excess consumption by *Corbicula* may supplement diets of other benthic consumers

Monitoring of Temperature in Warmwater Streams: Challenges and Applications for Decision Making

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Instream thermal regimes are critical for defining and driving ecosystem diversity, structure and processes in lotic systems Various broad-scale drivers influence stream temperatures including climate change, impoundment, river regulation, and other point-source discharges A greater understanding of the impacts of thermal modification on stream ecosystem function is needed to inform conservation and management decisions For decades the technical tools and equipment to continuously monitor water temperature in streams have been available and affordable, yet long-term monitoring of temperature has rarely ensued in the Southeast United States Using a decade of monitoring data from multiple sites in the Tallapoosa River basin, I describe methods, associated costs and risks and various modeling techniques for monitoring and defining thermal regimes in warmwater streams These data have been applied to decisions regarding specific flow regimes from a hydropeaking dam Broader application of thermal data will require strategic monitoring programs such as proposed by the US Fish and Wildlife Service for the region

Prioritizing Streams for Hydrologic Reserves in the Eastern United States

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Stream classifications have been a fundamental concept in stream ecology, as they provide a convenient framework to understand fluvial processes at different scales However, stream classifications, especially those based on natural patterns in hydrology, have been underutilized as a tool to prioritize fluvial habitats for conservation purposes Stream classes represent divergent habitat types, which have varying levels of uniqueness in the landscape Thus, conservation measures should ensure that the variation of stream habitat types are protected from human disturbances, assuming that habitat variation is linked to biodiversity We applied this theory to the concept of Hydrologic Reserves, where protection should adequately and proportionally represent the diversity of unmodified hydrologic regimes Recently, a hydrologic classification for the US, based on reference-quality discharge data from >2600 USGS stream gauges, revealed 15 different types of predominant natural streamflow regimes Ten of the hydrologic classes were mapped to stream reaches (National Hydrography Dataset) in the Eastern US using climate and landscape predictors In addition, stream reaches were broken into size categories to create a 2-tier classification scheme We then evaluated protected status of all stream reaches using conservation land coverages and Wild and Scenic River designations Of the 15 million stream kilometers in the Eastern US, 11% fell under protection status, with 38% strictly managed for biodiversity protection Less than 05% of stream kilometers fell under Wild and Scenic River Designation Stream protection did not mirror the prevalence of predominant hydrologic regimes or predominant sizes of streams For example, although the majority of streams were classified as Perennial Runoff 1 type hydrology (34%), only 5% of these streams were protected In contrast, snowmelt streams, although only compromising 37% of total stream length, had relatively higher protection (27%) Intermittent and flashy type streams were less common and were typically not protected Headwater streams (<4 mi2), although making up 61% of total stream length, were moderately protected (10%) whereas small streams (39-200 mi2) showed the highest level of protection (15%) relative to their coverage (6%) This suggests that certain stream types are predisposed for protection, and the diversity of habitat types may not be adequate preserved in relation to their abundance We also explore other layers in stream classifications, such as temperature classes, patterns of disturbance, and biodiversity concerns among habitat types to broaden our assessment Finally, we provide a framework to prioritize stream reaches as hydrologic reserves in the Eastern US

City Cow, Country Cow: What Can Largescale Stonerollers Tell Us about Urban Streams?

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The Atlanta Metropolitan Area has experienced explosive growth over the last four decades and streams in the outlying areas and the fish communities that inhabit them have been significantly altered While many of the rare elements have been locally extirpated as urban land cover has increased, a select group of species have either maintained stable populations or increased in frequency or abundance Understanding the adaptations of tolerant species that maintain populations in altered systems can provide insight into factors contributing to the decline of other species In lower Etowah River Basin tributaries with increased urban landcover, Largescale Stoneroller (*Campostoma oligolepis*) maintain robust populations with high local abundance A series of studies over the last decade have revealed a number of morphologic, metabolic and life history differences between urban and non-urban stonerollers in these streams At the morphologic level, stonerollers in streams with high impervious surface (> 20%) had significantly shorter gut lengths than stonerollers from streams with moderate (2% - 6%) or low (<1%) impervious cover (ANCOVA; p < 001) Similarly, stoneroller otoliths from a stream with high impervious cover were shorter at a given fish length than those from streams with lower impervious cover (ANCOVA; p <001) At the physiological level, lipid content in non-visceral somatic tissues was significantly higher in stonerollers from urban streams than in non-urban streams (ANOVA; p = 0008) Finally, life history of stonerollers in urban streams differs from those in non-urban streams as they begin reproductive activity earlier in the year, reproductively active females are larger and young-of-year stonerollers are larger at the end of the summer than their non-urban counterparts The results from these studies suggest that stonerollers in urban streams are able to meet their energetic demands at a level that offsets the metabolic constraints presented by urban stream environments

Longterm Changes in the Fish Assemblage of the Upper Brazos River, Texas

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We sampled the Upper Brazos River, upstream from Possum Kingdom Reservoir, Texas, over a 25-year period During this period, average annual discharge has decreased several fold, an impoundment was constructed on one tributary, and the system experienced record drought in 2011 All fishes native to the Upper Brazos River, except Silver Chub *Macrhybopsis storeriana*, have persisted despite these changes Also, introduction of Sheepshead Minnow *Cyprinodon variegatus* in 2011 now threatens the local form of Red River pupfish *C rubrofluviatilis* through introgressive hybridization Otherwise, the fish assemblage is intact and superficially appears to be stable, except for reduced abundances of some species as a result of the drought of 2011 However, our data show there has been a longterm decrease in abundance of cyprinid species that reproduce by broadcast spawning ova into the current Conversely, there has been a general increase in abundance of substrate-spawning species This change likely is related to the observed decrease in discharge in the Upper Brazos River

Validating Stream Classifications Schemes for the Eastern US with Functional Composition of Fish Communities

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Characterizing spatial variation in stream habitat is an essential step in prioritizing biodiversity conservation Stream classifications based on hydrologic regimes are frequently used to characterize this variation, but their utility in conservation and management depends on how well they predict spatial patterns in biodiversity Recently, a hydrologic classification was developed for the contiguous US using reference-condition stream gauges to reflect variation in natural stream flow patterns The objective of the present study was to test the congruence between hydrologic regimes and the

functional composition of fish communities Random Forest models were used to predict hydrologic class membership (10 unique classes) for 986,157 confluence-to-confluence stream reaches in the eastern United States using climate and landscape variables summarized from the National Hydrology Dataset Next, 2,948 fish community samples were compiled for this area and functional composition was summarized for each sample based on fish life history characteristics (proportion of opportunistic, periodic, and equilibrium strategists) Lastly, Discriminant Function Analysis was used to predict the hydrologic class from which communities were sampled using proportions of each life history strategy as predictors Classification success was used to quantify congruence between hydrologic regimes and the functional composition of fish Preliminary results indicate that classification success was 51%, suggesting that hydrologic classification schemes generally reflect life history composition of fish communities at this spatial resolution Classification error may arise from (a) community changes in response to alteration of natural flow regimes, (b) abiotic drivers other than hydrology filtering functional characteristics of communities, or (c) historical biogeographic drivers of community composition Further evaluation of biotic-abiotic concordance will be evaluated using geomorphology and temperature regime classifications as well and other functional components of fish communities such as microhabitat preference and thermal tolerance Refined classification schemes that holistically reflect biodiversity patterns will be used with geospatial data describing existing and potential future hydropower facilities to prioritize stream preservation with the goal of maximizing the protection of regional biodiversity

Investigation of Invasive Silver Carp (*Hypopthalmicthys molitrix*) in Kentucky Lake: Utilizing Diet Analysis and 25 Years of Long-Term Data

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Asian Carp species, Silver Carp (*Hypopthalmicthys molitrix*) and Bighead Carp (H nobilis) have established populations throughout the midwestern US Populations of Asian Carp in Kentucky Lake have increased rapidly within the past decade This project aims to understand potential impacts of Asian Carp on reservoir primary productivity Understanding the diet of Asian Carp specific to Kentucky Lake is of primary importance for understanding long-term changes in primary production in Kentucky Lake A total of 126 Asian Carp were caught during the sampling period, only 3 of which were Bighead Carp This finding leads us to believe there is a disproportionate abundance of Silver to Bighead Carp in Kentucky Lake thus narrowing our focus to the Silver Carp Silver Carp (n=48) captured during summer sampling were used for this diet analysis Silver Carp diets consisted predominantly of phytoplankton (836% ± 04) and secondarily of zooplankton (164% ± 04) Diets were compared over sampling month: May (n=9), June (n=13), July (n=23), with a one way ANOVA, and showed few differences; however, the proportions of green algae (Family Volvocaceae) showed significant differences ($p<005$) between sampling month Diet analysis suggests that Silver Carp are feeding on the lowest trophic levels which could induce a trophic cascade or reduce reservoir primary production Diets also indicated selective feeding on smaller sized zooplankton such as *Keratella* sp and copepod nauplii which comprised over 70% of zooplankton observed in the diets Along with diet analysis, we began investigation of long term data of Kentucky Lake primary production Utilizing long term data collected by Hancock Biological Station's Kentucky Lake Long Term Monitoring Program (KLMP) we conducted analyses on 25 years of primary production data Seasonal values of primary production were compared before (1988-2004) and after (2005-2013) the Asian Carp population explosion with repeated measures ANOVA Primary production values after 2005 were significantly lower ($p<005$) than those before 2005 It is not yet clear whether this finding is due to invasive Silver Carp or other environmental variables Environmental covariates may help to explain changes in long term patterns of primary production However as Silver Carp continue to increase in density feeding habits may become more apparent in terms of phytoplankton cropping

Effects of Land Use, Habitat and Introduced Fishes on Stream Communities in the Upper New River Drainage, North Carolina

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The New River Drainage in northwestern North Carolina has undergone substantial changes in landuse during the last 100 y Historical land clearing led to a loss of primary forest cover in the early 20th century and subsequent conversion to agricultural land More recently, ex-urban development has transformed formerly agricultural and forested lands into residential communities These changes may have important implications for the New Drainage's endemic fishes Moreover, the upper New River Drainage supports populations of 50+ fish taxa including 9 taxa of conservation concern, an endemic crayfish (the New River crayfish *Cambarus chasmodactylus*), an isolated population of state endangered Green floater mussels (*Lasmigona subviridis*) and a large Eastern hellbender (*Cryptobranchus alleganiensis*) population along with a very high proportion of introduced fishes (~50% of total species richness) During 2014 we re-sampled 30 historically-sampled sites across the upper New River Drainage to examine how landuse changes at both the riparian and catchment scale influence 1) the distribution of endemic and introduced fishes, mussels, crayfish and hellbenders and 2) how in-stream habitat parameters affect fish and lotic community structure Preliminary data suggest that exotic fishes dominate headwater reaches whereas endemic and pollution-intolerant fishes are largely restricted to forested mainstem reaches of the South Fork New River and the lower reaches of larger tributaries Interestingly, we detected 28 fish taxa including 3 drainage endemics and a large population of hellbenders in the South Fork New River within a city park in Boone, NC suggesting that even localized patches of forested land may benefit native fishes and other sensitive taxa On-going analyses will model temporal and spatial changes in site occupancy by endemic and putatively introduced fishes across the New River Drainage and identify linkages between historic stream physicochemical parameters, landuse, habitat and fish community changes Data obtained from this study will be used in prioritizing management and conservation decisions by agency biologists to better protect and preserve the New River Drainage's numerous endemic aquatic species

Using Classification Trees to Model Habitat Partitioning Among Darter Species

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A classification tree is a flexible, easily interpreted multivariate statistical tool that can be used to predict categorical dependent variables Using the open-source statistical program R and the packages 'rpart' and 'party', we generated both classification and conditional inference trees These models used microhabitat characteristics of a darter to predict its species We used a data set that described the substrate composition and depth of the microhabitat of Rainbow Darters (*Etheostoma caeruleum*), Redline Darters (*Nothonotus ruffilineatum*), and Snubnose Darters (*Etheostoma simoterum*) (n=330) from two tributaries of the Clinch River, Tennessee To achieve a binary response variable, we classified the observations as either Rainbow Darter (n=180) or other species (n=150) We attempted to predict whether the darter was a Rainbow Darter or one of the other species based on the frequency of several substrate categories and depth measurements Our first classification tree made with 'rpart' had 14 terminal nodes and included six variables This tree grouped the darter species based on habitat characteristics with an accuracy of 60% To increase interpretability and reduce over-fitting, we pruned this tree to the node with the lowest prediction error rate The pruned tree used the percentage of boulder in the habitat to predict darter species with 66% accuracy We then used 'party' to create a conditional inference tree using a 70% training partition of the data This tree used percent of very coarse gravel and percent boulder in the substrate to predict darter species This tree had a training accuracy of 65% and a validation accuracy of 68% Both packages converged on presence of boulder substrate in the habitat as a

major factor separating Rainbow Darter habitat from the habitat associations of the other species These classification trees suggest that within this simplified system, the presence of boulder in the habitat of a darter means that it is likely to be a Rainbow Darter This type of analysis could be useful for assessing habitat characteristics and partitioning of darter species of conservation concern in this or other systems

Predation of White Perch in Sooner Reservoir: Is a Biological Control Possible?

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White perch, *Morone americana*, were first observed in the Oklahoma portion of the Arkansas River system in 2000 and in Sooner Reservoir in 2006 by the Oklahoma Department of Wildlife Conservation (ODWC) White perch have been deemed a nonindigenous aquatic species in the Arkansas River system due to the impact the species has on the established fishery Previous studies have shown that white perch impact sport fish age-0 year classes and recruitment through competition and predation The catch rate trends at Sooner Reservoir for largemouth bass, *Micropterus salmoides*; white bass, *Morone chrysops*; channel catfish, *Ictalurus punctatus*; and hybrid striped bass, *Morone saxatilis x Morone chrysops*, have decreased as the catch rates of white perch have increased since 2007 In 2011, ODWC began to stock saugeye, *Sander vitreus x Sander canadensis*, in Sooner Reservoir as a possible answer to the increasing abundance of white perch The first objective of this study is to quantify the level of predation on white perch within Sooner Reservoir by saugeye and other sport fish species The second objective is to evaluate the possibility of manipulate one or more of the sport fish species as a biological control for white perch through stocking rates and/or harvest recommendations

Revealing What Lies Beneath: Utilizing Environmental DNA (eDNA) to Detect Rare Fishes in Louisiana

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The relatively new environmental DNA (eDNA) technique has proven to be a valuable monitoring tool for the detection of invasive and imperiled aquatic organisms, but it has yet to be comprehensively utilized in the southern United States where the usefulness of this approach may be impacted by more rapid DNA degradation due to higher water temperatures and other chemical and physical characteristics of southern waters Southeastern Louisiana has a large number of imperiled aquatic species that are in need of study from a conservation perspective A cost-effective, non-invasive monitoring approach is needed to assess the conservation status of many aquatic species in the region In previous studies, there has yet to be standardization of the methodology for eDNA sampling This project had two objectives First, we conducted laboratory and field experiments on a locally abundant fish, the blacktail shiner, *Cyprinella venusta*, to test the efficiency of several common extraction and amplification methods in an effort to shed light on the most reliable protocols for eDNA sampling in this region Second, we used both eDNA and traditional field sampling techniques in a seasonal sampling approach to assess the conservation status of two imperiled taxa in the Lake Pontchartrain Basin, the gulf logperch, *Percina suttkusi*, and the flagfin shiner, *Pteronotropis signipinnis* Both species are known to occur historically in a limited number of localities in the basin making them ideal candidates for field-testing of the eDNA method Each species was detected at a greater number of sites based on eDNA samples in comparison to traditional sampling techniques, further supporting the usefulness of this technique

Contributions of Native and Non-Native Fishes to Nutrient Cycling in a Spring-Fed River

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Consumers can affect their environment through direct and indirect pathways Direct pathways include consumption of resources and indirect pathways include the excretion of nutrients that ultimately have the potential to alter microbial and primary producer biomass, productivity, and composition As large-bodied macro-consumers in aquatic ecosystems, fish have the ability to alter habitat structure and the abundance and distribution of food resources through their foraging activities In addition, fish may indirectly affect the fates and forms of nutrients within ecosystems through the consumption of food resources and their subsequent excretion Nutrient recycling by fish can be important for within-stream primary production and the quality of food items for other consumers in the food web Contemporary composition of many stream and river fish communities now include a variety of non-coevolved organisms introduced through human activities, which generally lead to the extirpation of native species and the proliferation of non-native species However, understanding the relative contributions of native versus non-native fishes to ecosystem function has only been more recently explored We examined the role fish communities play in the sequestration and recycling of nutrients in a spring-fed river system in central Texas, the San Marcos River We compiled historical and contemporaneous data on the abundance of fishes in the upper spring-influenced portion of the San Marcos River and determined that since 1990, 35 native and 12 non-native fish species have been identified in the river and non-native fishes now constitute ~39% of the total fish community biomass Measured excretion rates of nitrogen (as NH4+) and phosphorus (as PO43-) from fish in the river indicated the fish community excreted 220 µM N-NH4+/m2/h and 6 µMP-PO43-/m2/h, respectively Non-native fishes accounted for 46% and 50% of the fish community N and P excretion rates The aerial uptake of P by the river was determined with pulse-addition experiments and was estimated to be extremely high (119 µMP-PO43-/m2/h) Thus, P excretion by the fish community only met ~5% of hourly P demand However, non-native fish accounted for >50% of the P sequestered into fish biomass, indicating that although they may not play a critical role in the nutrient supply to riverine primary producers and microbes, non-natives are a relatively important nutrient pool within the biota Additionally, because P uptake dynamics are strongly influenced by benthic algal communities, the effects of fish on nutrient dynamics may be indirect rather than direct

Status Assessment Mapping for Imperiled Minnows and Suckers in the Southeast

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Information on the range and conservation status of large numbers of aquatic species is needed for state wildlife action plans, assessments of species petitioned for listing under the US Endangered Species Act, and other reviews carried out by groups such as NatureServe and the American Fisheries Society A major challenge for these assessments is the lack of comparable data across taxa, which is often presence-absence data or in some cases presence-only data with limited knowledge of areas that have been surveyed We developed a mapping method to assess the current range and survey needs of aquatic species using a combination of presence-only and presence-absence data Maps were initially developed for 193 aquatic species (fishes, crayfishes, mollusks, and selected aquatic insects) as part of the revision of Georgia's State Wildlife Action Plan We are currently expanding this project beyond state boundaries to produce range wide maps for 36 southeastern cyprinform fishes recognized as endangered, threatened, or vulnerable by the AFS Endangered Species Committee Our method uses a GIS algorithm to identify the most recent occurrence record for USGS Hydrologic Unit Code (HUC) 10 digit watersheds and then classifies watersheds by the number of years since last detection Occurrence records as well as locations of recent surveys where the target species was not detected are then overlayed to produce a

conservation status assessment map This map helps identify areas in need of additional sampling and can be updated to incorporate new survey results Maps also provide a consistent framework for assessing conservation status through metrics such as the number of occupied watersheds (index of range size), proportion of potential watersheds currently occupied (index of range stability) and watershed landcover (index of threat) While more detailed monitoring and assessments may be required for some species, our method has the potential to provide useful and consistent information for large numbers of aquatic species

Modeling Ecosystem Effects of Fishes Across Stream Network Gradients

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Grazing fishes affect stream ecosystem properties such as algal abundance and production rates through complex pathways that are subject to at least two governing principles First, the effects of grazing fishes such as minnows are greatest following disturbances (eg, drought, flooding) when fish biomass out-ranks algal biomass Second, the effects imposed by fishes are species-specific and density-dependent, so that effect magnitudes are dependent upon the dominant forces that control community composition for algae (light and nutrient availability) and fishes (dispersal and environmental selection) We modeled network-scale effects of two grazing minnows (Central Stoneroller, CS; and Southern Redbelly Dace, SRD) on algal abundance for stream networks using three treatments: stream type (forested vs prairie), nutrient loading (high vs low), and with varying habitat fragmentation caused by in-stream barriers (connected vs fragmented) Model input parameters included observed differences in fish distributions (CS = all stream segments, SRD = headwaters only), dispersal affinities (CS = low, SRD = high) and ecosystem effects (CS = strong, SRD = weak) as well as algal abundance across stream orders (highest in 1st and 2nd orders = prairie, highest in 3rd and 4th orders = forest) Disturbance frequency was calculated using estimated flow variability for individual stream segments based data from the National Hydrography Dataset for a prairie stream network (McDowell Creek, Kansas) and a forest stream network (Blackburn Fork, Tennessee) Habitat fragmentation scenarios included those imposed by road-crossing culverts (semi-permeable, low-order streams) and small dams (impermeable, high-order streams) Nutrient availability scenarios included high (1000 µg/L total nitrogen, 50 µg/L total phosphorus) and low (500 µg/L total nitrogen, 35 µg/L total phosphorus) water nutrient concentrations Results from this modeling framework revealed species-specific responses to fragmentation caused by road-crossing culverts with a general negative influence on dispersal For fragmented stream networks, “hotspots” of ecosystem effects were muted or shifted in space relative to unfragmented scenarios as fishes were “reflected” by barriers and left to exude their effects in either upstream or downstream segments High nutrient concentrations masked the effect of fishes in both ecosystems and higher flow variability in prairie streams resulted in potential for greater ecosystem effects by fishes in these streams Our findings highlight the potential for anthropogenic environmental disturbances (nutrient loading, habitat fragmentation) to create spatiotemporal shifts in the ecosystem effects of fishes that are otherwise mediated by naturally occurring disturbances (flood, drought)

A New Approach to Old Methods: Incorporating Species Detection into Timed Mussel Surveys

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Timed searches are frequently used to assess the status, distribution, and relative abundance of freshwater mussels These methods are generally accepted as being convenient and cost effective to implement for numerous study objectives across a wide array of sampling conditions However, data collected using these methods are frequently biased due to incomplete detection of species or individual mussels Hence, inferences drawn from these data may inaccurately represent the perceived status of species or their ecological relationships I present a simple approach to estimate and incorporate incomplete detection for data collected during timed searches My staff conducted

timed searches in the South Chickamauga Creek and Chattanooga Creek watersheds of the Tennessee River Basin of Georgia Sampling crew size ranged from 3-4 persons with 8 different searchers participating in sampling All mussels collected at each site were recorded separately by searcher to spatially replicate samples I fit single-season, single-species occupancy models to each species to estimate species detection and occupancy I also estimated the relative influence of several substrate and stream size characteristics on species occupancy One hundred eighty eight individual mussels representing four species were collected from 23 of the 40 sampling sites Mean species detection (95% CI) ranged from 024 (009–051) for the Tennessee Pigtoe (*Pleuronaia barnesiana*) to 044 (021-071) for the Tennessee Heelsplitter (*Lasmigona holstonia*) Estimated occupancy (95% CI) ranged from 014 (006-030) for the Tennessee Heelsplitter to 045 (028-063) for the Mountain Creekshell (*Villosa vanuxemensis*) Our best approximating occupancy models indicated that species detection was constant among searchers for Tennessee Heelsplitter, Tennessee Pigtoe, and Rainbow (*Villosa iris*) but varied among searchers for the Mountain Creekshell Occupancy of the Tennessee Heelsplitter was related to downstream link magnitude and percent run habitat whereas the Tennessee Pigtoe and Rainbow were both related to link magnitude but differed in that the Tennessee Pigtoe varied by percent edgewater and the Rainbow varied by percent gravel substrate Occupancy of the Mountain Creekshell was related to percent clay substrate Estimated cumulative detection for all species but the Tennessee Pigtoe exceeded 080 if 5 individuals searched a site This modification appears to be a useful approach to incorporate species detection into timed searches This approach may be particularly useful to quantitatively characterize the status or ecological relationships of rare mussel species which may have low species detection or occur at relatively few sites

"Restoring Habitats and Recovering Species One Shu at a Time"

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Alabama’s rivers are recognized for their freshwater biodiversity with more than 310 native fishes, 180 mussels, 160 snails, and 85 crayfishes, many of which are critically imperiled In an effort to conserve this unique fauna, preserve watershed health and integrity, improve water quality, and most importantly, build trust among the citizens of Alabama; the Alabama Rivers and Streams Network has identified 51 high priority watersheds known as Strategic Habitat Units (SHU) SHUs focus conservation activities on Alabama’s more than 225 listed and imperiled fishes, mussels, snails, and crayfishes SHUs are primarily based on the number and presence of federally listed and state priority species, but they also take into consideration the number and magnitude of threats, defined critical habitat(s), and key habitat components required for species survival Goals of the SHU process are habitat restoration and species recovery SHU habitat recovery efforts are implemented by working with landowners, agencies, NGOs, and industry to restore habitats and enhance opportunities for aquatic species conservation through collaborative watershed/habitat assessments, restoration of stream habitats, propagation and culture of imperiled species, and reintroductions of rare species into areas of their former range

A Quantitative Synthesis of Fish Effects on Temperate Stream Ecosystem Structure and Function

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A number of individual studies have demonstrated the ability of fishes to affect stream ecosystem structure and function However, a general consensus of the magnitude and direction of fish effects has not emerged Furthermore, changing biotic and abiotic conditions in streams make it difficult to predict when and where fish effects will be strongest In response to these information gaps, we conducted a quantitative synthesis (meta-analysis) of fish effects on structural (dissolved nutrient concentrations, periphyton biomass and composition) and functional (leaf decomposition and net

ecosystem metabolism) characteristics of temperate stream ecosystems In the analysis, we examined how fish effect sizes, or the magnitude of observed differences between the presence and absence of fishes, varied as a function of different biotic, abiotic, and methodological factors

Across 62 species included in the analysis, fishes had consistent positive effects on NH4, soluble reactive phosphorus, and chlorophyll-a The magnitude and direction of effect sizes differed among trophic guilds and taxonomic groups, whereas no significant differences were observed for abiotic and methodological covariates In some cases, effect size magnitudes were comparable with native Pacific salmon, a group of fishes long regarded for their extensive effects on the structure and function of freshwater habitats As one of the most conspicuous components of temperate stream ecosystems, fishes are likely to influence ecosystem structure and function given their trophic relationships, influence on nutrient dynamics, interactions with the benthic environment, and movement patterns Our results provide empirical support for this general idea and indicate the potential of a range of fishes – from small-bodied herbivores to large migratory species – to have substantial ecosystem-level effects in streams

Picking up the Pieces: Prioritizing Conservation of Fragmented Populations of Clinch Dace

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Since its discovery in 1998, 3 separate targeted range-wide surveys have been conducted for the Clinch Dace (*Chrosomus sp cf saylori*) These survey increase confidence in the putative distribution of this species being confined to 9 south-flowing tributaries of to the Upper Clinch River, Virginia Furthermore, the species occurs in fragmented populations at low densities in small headwater streams, supporting listing as a Federal Species of Concern and on Virginia's Wildlife Action Plan as Tier II- Very High Conservation Need Here we provide updated distribution records based on surveys conducted during the summer of 2014 that compare active and passive sampling methods in the detection of Clinch Dace We characterize the habitat associations and fish communities in these occupied streams and analyze a historical mining land cover data We use these findings to describe opportunities for conservation of existing populations and areas where population expansion or connectivity may be facilitated We failed to detect Clinch Dace at 4 streams where they had been detected in previous surveys Backpack electrofishing detected Clinch Dace at more sites than minnow traps Watersheds containing Clinch Dace are in private ownership and riparian land use, impassable culverts, and mining and gas development may pose threats to habitats Clinch Dace generally occur in runs and pools in 1st to 3rd order streams Clinch Dace occupied only 17% of stream reaches sampled in 2014; these were generally lower gradient with run or pool habitat Community richness in Clinch Dace streams averaged 66 species in our standardized sampling sites Common associates included Creek Chub (*Semotilus atromaculatus*), Blacknose Dace (*Rhinichthys atratulus*), Fantail Darter (*Etheostoma flabellare*), Central Stoneroller (*Campostoma anomalum*), and White Sucker (*Catostomus commersoni*); Clinch Dace rarely occurred with centrarchids or cottids We conclude with the recommendation of five priority populations for conservation and essential goals in conserving habitat for this species

The New Frontier of Midwestern River Trawling

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Trawling techniques have advanced rapidly in big rivers and their tributaries over the last decade Various types of trawls and boat rigging configurations have been developed by the US Fish and Wildlife Service's Columbia, Missouri Fisheries Office in concert with Innovative Net Systems to sample: small Ozark streams, large and small tributaries of big rivers, reservoirs, large rivers and their backwaters, Chicago shipping canal and agriculture ditches Our efforts have dramatically improved catches from traditional mid-western fisheries gears Specifically, the trawl gears we will

describe are: benthic stern trawling (sturgeon, catfish), floating mamou trawl (YOY carp, juvenile paddlefish, shad), mid-water scalene trawl (juvenile carp, juvenile paddlefish), Ozark benthic rock roller (darters, goby, shiners), electrified butterfly skimmer (Asian carp, paddlefish, shad, white/striped bass, fish community), electrified push trawl (YOY Asian carp, small bodied fishes), and ATV ditch trawl (snake heads) We will show videography of these gears in action and provide results of gear efficacy and efficiency throughout Midwest lakes, streams, backwaters, and big rivers

Measuring Success of a Long-Term Lake Sturgeon Restoration Program with a Standardized Stream Sampling Scheme

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We describe a technique for sampling large streams, targeting Lake Sturgeon in order to measure the success of a long-term restoration program Boat-mounted EF, employed by many agencies as a standard stream sampling technique, is not effective in large streams with great depth, especially for large benthic fishes We have refined and standardized a baited, longline for sampling Lake Sturgeon as a standard unit of effort Equipment consists of standard 50-hook trotline, with each hook attached to a 20 cm (12-inch) “trotline”, swiveled and spaced 12-15 m apart The resulting trotline is approximately 120 m in length, housed in a 05- x 05m wooden “jump box” for quick deployment with end rings and quick snaps on anchor lines Bait is primarily cut bait of buffalo or carp in small (1- x 1- x 1-cm) chunks Each line is readied before launching Our trotlines are deployed with a standard or homebrewed 10-20 lb anchor at each end of the line Trotlines are marked for retrieval with a single bullet buoy, usually rigged first, and deployed at the shallow end (5 – 12 m) outside of the commercial navigation channel; lines are set perpendicular or diagonal to flow in 5-30 m depth A crew of three can bait, deploy, check, and handle captured fish on 8 lines per day With a cooperative effort using 12 boats, we are able to coordinate and effectively sample >250 miles of large stream in a week Equipment and maintenance costs are low; each line can be constructed for ~$60 with terminal gear, and a crew outfitted for <$500 Lines are re-useable for many years with minor maintenance The success of targeted sampling is dependent on stream temperature that focuses on thermal conditions when Lake Sturgeon are most active (12-15 °C), while other species have reduced activity This technique captures a range of Lake Sturgeon size/ages, informing us about growth, dispersal, and habitat utilization of the stocked population Injury and mortality has been very limited Live capture and release allows us to collect data and mark individual fish, gather additional biopsy samples, and select fish for implant of acoustics transmitters We have captured >150 Lake Sturgeon since 2011, using this refined longline, trotline technique Bycatch ranges from blue catfish to logperch, hellbenders and mudpuppies

The Laurel Dace, Chrosomus saylori: Survey Results for an Endangered Species Endemic to Walden Ridge, Tennessee

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The Laurel Dace, *Chrosomus saylori*, is a federally endangered species endemic to small headwater streams along Walden Ridge in Bledsoe, Cumberland, and Rhea counties, Tennessee It is historically known from only eight streams in the Soddy (1), Sale (3), Piney (3), and Grassy Cove (1) creek systems within the Tennessee River drainage Preliminary genetic data suggests two genetically distinct groups, a southern population (Soddy and Sale Creek systems) and a northern population (Piney Creek system); Grassy Cove Creek genetics are unknown Two populations are likely extirpated (Laurel Branch and Grassy Cove Creek) and Laurel Dace have not been observed in the Soddy Creek or Cupp Creek systems since 2004 and 1996 respectively Known localities were sampled in 2013 and 2014 to assess population persistence and site occupancy Current distribution

of possibly introduced Tennessee Dace, *Chrosomus tennesseensis*, in the nearby Piney Creek system was also assessed during survey work because this closely related congener could compromise the viability of northern populations of Laurel Dace Results indicate that the southern population of Laurel Dace is restricted to two streams: a single pool in Horn Branch and only a single specimen has been collected in Cupp Creek Heavy siltation and poor water quality from agriculture (tomatoes) is the likely cause of extirpation in the Soddy Creek system The northern population of Laurel Dace (Piney Creek system) appears to be in relatively good shape, with high numbers of individuals in Bumbee and Moccasin creeks, but siltation and instream modifications for road crossings restrict distribution The third creek in this system, Youngs Creek, has few Laurel Dace and is impacted by heavy siltation and poor water quality from agriculture (tomatoes) Tennessee Dace are abundant in Duskin Creek, which is located downstream of Laurel Dace populations, but to date have not been observed in the Piney Creek mainstem upstream of Duskin Creek Laurel Dace have not been recorded from Grassy Cove Creek since 1954; current impacts are siltation and nutrification from unrestricted cattle use To assist us in uncovering potential new sites for Laurel Dace, the distributional model program MaxEnt was employed Using data from all known collections sites for Laurel Dace and 15 GIS environmental layers, MaxEnt predicted several other sites where this species may reside, but the vast majority have been already surveyed unsuccessfully for Laurel Dace

Application and Utility of a Low-Cost Unmanned Aerial System to Manage and Conserve Aquatic Resources in Four Texas Rivers

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Unmanned aerial systems (UAS) have recently gained increasing attention in natural resources management due to their versatility and demonstrated utility in collection of high-resolution, temporally-specific geospatial data The higher spatial resolution of images captured by these systems compared to historically used geospatial collection techniques (satellite or manned aerial surveys) often make them relatively low cost This study applied a low-cost UAS to support geospatial data needs of aquatic resource projects in four Texas rivers Specifically, a UAS was used to (1) map invasive salt cedar (multiple species in the genus Tamarix) that degraded instream habitat in the Pease River, (2) map mesohabitat and instream structural habitat features (eg, boulders, woody debris) in the South Llano River as a baseline prior to watershed-scale habitat improvements, (3) map enduring pools in the Blanco River during drought conditions to guide Smallmouth Bass removal efforts, and (4) quantify angling use in the Guadalupe River These four case studies represent an initial step toward assessing the full range of UAS applications in aquatic resources management, including their ability to offer potential cost savings, time efficiencies, and higher quality data over traditional survey methods

Is the Ironcolor Shiner a Vanishing Species in North Carolina?

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Currently, nearly 50% of 1,213 freshwater fish species in the US are imperiled, primarily due to habitat degradation In North Carolina, approximately 26% of our fishes are listed by the state or federal government as endangered, threatened, or meriting special concern Upon initiation of this status survey in 2010, distribution records for these priority fishes, such as the Ironcolor Shiner (*Notropis chalybaeus*) were sparse and dated Statewide surveys completed by the NC Wildlife Resources Commission (WRC) in the 1960's classified the Ironcolor Shiner as a 'ubiqutious forage species' across North Carolina's entire coastal plain ecoregion Five decades later, a targeted search in the lower Cape Fear, Lumber, and White Oak river basins failed to capture the species from many

previously recorded locations From 2010 to 2013, 110 sites were sampled and only three stream reaches yielded Ironcolor Shiners In 2010, this consisted of one site in Lumber River State Park near Wagram, NC, and one in the White Oak River No individuals were captured in 2011 or 2012, but a small number of individuals were collected from one additional site in the upper section of the New River, in the White Oak basin, in 2013

Reasons for this apparent disappearance are currently unknown Sources of historical and current stream impacts are numerous, including now-defunct textile mill effluents, a heavy concentration of hog farms, 50 years of development and agricultural impacts, as well as, most recently, hurricanes, extreme algae blooms and extended zero-DO conditions during 2011 and 2012 Sampling for small fishes in these coastal plain habitats is also very difficult, limiting the efficiency of available gear and techniques The WRC plans to continue investigation of the Ironcolor Shiner, including the exploration of new survey methods, such as the use of environmental DNA

Population Genetics of the Broadstripe Shiner

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The Broadstripe Shiner, *Pteronotropis euryzonus* (Suttkus, 1955), is a freshwater minnow endemic to the tributaries of the middle and lower Chattahoochee River in Alabama and Georgia Populations of P euryzonus appear fragmented because individuals have not been detected in the main channel This suggests limited dispersal potential and low gene flow between populations, and previous studies have suggested multiple forms of *P euryzonus* in the Chattahoochee Samples across twenty-two sites in eleven tributaries in the Chattahoochee River were collected for genetic analyses The mitochondrial genes cytochrome c oxidase I (COI) and cytochrome b (cytb) were used to assess genetic structure of *P euryzonus* throughout its range Results suggest the presence of three distinct populations: Northern, Pataula, and Southern These clusters support previous hypotheses of multiple forms of *P euryzonus* in the Chattahoochee River The presence of three genetically distinct populations has significant conservation implications for *P euryzonus* The Broadstripe Shiner is currently listed as imperiled in both Alabama and Georgia Three distinct populations, a restricted range, and recent disturbance to gene flow from local infrastructure may necessitate further protections to this species to prevent extirpation

Use of Trail Cameras to Assess Angler Use on Two Wild Trout Streams in Wilkes County, North Carolina

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Western North Carolina has thousands of miles of streams capable of providing angling opportunities for salmonids Many of these resources are managed by the North Carolina Wildlife Resources Commission (NCWRC) with an emphasis on maintenance and enhancement of self-sustaining wild trout populations Recent NCWRC trout angler opinion data indicated that a majority (68%) of trout anglers fish wild trout waters Given the popularity of wild trout angling, it would benefit managers to increase understanding of angler use levels and patterns on wild trout resources Angler use information from remote streams can be labor intensive and costly, and as a result, very little is known about angler usage of wild trout resources in North Carolina Data collection can also become increasingly difficult for waters that have multiple angler access points that make establishing angler contact a challenge In contrast, streams with limited access may be easier to obtain information by focusing data collection efforts at these restricted points of entry Recent advances in digital camera and motion detection technology provide a potential, low-manpower alternative to more intensive creel surveys In an effort to obtain angler use information for wild trout streams in North Carolina, two limited entry streams in Wilkes County were identified and angler use was determined via trail

cameras stationed along each stream This information will be useful when describing general trends about usage of wild trout resources These data may also aid in making future management decisions and attempts to obtain angler access to resources that are currently closed to public fishing

Population Structure and Genetic Diversity of Sicklefin Redhorse

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The sicklefin redhorse (*Moxostoma* sp) is an imperiled species endemic to the Tuckasegee, Little Tennessee, and Hiwassee River drainages of Georgia and North Carolina While still undescribed, it is believed that the sicklefin redhorse inhabited a larger range within these drainages than observed today; therefore, restoration and reintroduction efforts to expand the sicklefin's current range are ongoing In an effort to minimize genetic risks associated with hatchery-based reintroduction efforts, we estimated genetic diversity within and among samples collected from the known range of the species To this end, 382 individuals were sampled from the three drainages and genotyped for ten microsatellite loci Samples collected from each drainage were genetically distinct; although, there was evidence that individuals are straying between the Tuckasegee and Little Tennessee populations The Hiwassee population had the lowest genetic diversity of the three populations, with a lower effective population size, lower expected heterozygosity, and lower allelic richness The Tuckasegee and Little Tennessee populations had similar levels of genetic diversity for all three measures Each population was also modeled using Approximate Bayesian Computation to determine if any population had undergone a steady population decline or a more recent genetic bottleneck Future restoration efforts should attempt to preserve the three genetically distinct populations while attempting to expand the range of sicklefin redhorse within these drainages Efforts (eg, habitat restoration) should also be made to retain the remaining genetic diversity within the Hiwassee population

Sampling Crayfish Assemblages in Louisiana Coastal Plain Streams: Gear, Protocol, and Timing

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Quantitative and efficient sampling protocols are needed to estimate aquatic species richness and abundance in moderate to extremely heterogeneous habitats that are characteristic of southeastern US streams Within- and among-stream habitat differences can affect sampling efficiency, resulting in unquantified effects on catch-per-unit-effort Benthic and highly mobile species such as crayfishes are particularly difficult to sample quantitatively with consistently applied effort because they occupy a broad range of lotic habitats from fast-flowing streams with abundant woody debris to low gradient drainage canals We developed a quantitative and flexible sampling protocol for freshwater crayfishes in Louisiana streams that incorporated backpack electrofishing units and dipnets to determine crayfish catch-per-unit-effort (CPUE) For this study, we analyzed differences in relative abundance, diversity, and crayfish morphology between these two gear types from 20 Louisiana streams sampled in 2014, controlling for differences in specific conductance and woody debris density among streams In addition, we assessed gear-related diel differences in crayfish activity and capture vulnerability with species accumulation curves and examined potential effects of gear type and diel period on estimates of assemblage composition Preliminary results indicated greater crayfish CPUE and richness at night, although CPUE was influenced by the interaction of specific conductance and wood densities Although electrofishing gear yielded greater crayfish CPUEs regardless of habitat conditions, species accumulation curves suggested that combining gear types at night produced the highest species richness values However, if a single gear is employed, then nocturnal electrofishing would produce the greatest number, diversity, and size range of crayfish in these types of streams Our results suggest that gear type and time of day are both important

factors to consider in quantitative sampling of crayfish populations for assessment of abundance and diversity

Sampling Large-River Fish Communities – Challenges and Solutions

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Sampling fish communities in large rivers can present unique challenges I will discuss two case studies that illustrate these issues, and how I and colleagues were able to meet these challenges to reach management and conservation objectives Case Study 1: Sampling small benthic fishes in the Allegheny and Ohio Rivers, Pennsylvania These rivers are subject to numerous anthropogenic pressures, but standard sampling gears in use, such as electrofishing, gillnets, and beach seines, could only adequately sample near-shore and large-bodied species; thus basic ecology and populations of small-bodied benthic and channel dwelling species were largely unknown We therefore developed an electrified benthic trawl to sample these species, allowing us to identify effects of dams and gravel dredging that would have otherwise been undetected, as well as identifying significant range expansions of several species including a new species to Pennsylvania Case Study 2: Sampling fish communities and detection of invasive Asian Carp in the Illinois River Since their introduction in the 1970s, Bighead Carp and Silver Carp have spread throughout the Mississippi River drainage and now threated the Great Lakes While they can be caught in several gear types and are generally targeted using electrofishing by management agencies and trammel nets by commercial fishers, relative capture efficiencies of these and other gears are unknown It was suspected that these gears may have differential success for each species, for hybrids, and for different life stages We therefore tested a range of active and passive gears, including variable mesh sizes and configurations of gill nets, trammel nets, electrofishing, hoop nets, trap nets, mini-fyke nets, beach seines, trawls, and cast nets, at sites ranging from high to low Asian Carp densities We found that although Silver Carp are most efficiently captured by electrofishing, Bighead Carp are not very vulnerable to electrofishing and are best captured using entanglement gear; hybrid Asian Carp have intermediate vulnerability to both electrofishing and entanglement gears This comprehensive sampling also enabled us to evaluate large-river sampling gears for all species captured during this period, and to identify parsimony and redundancy in sampling these assemblages Through these case studies I will demonstrate the importance of identifying and using appropriate sampling gears in making conservation and management decisions

Demographic Processes Influence Genetic Patterns of Sicklefin Redhorse

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Members of Catostomidae and in particular *Moxostoma* (the redhorse suckers) comprise a large portion of ichthyofauna of the southeastern United States Unfortunately, the physical alteration of their habitat has adversely affected the persistence of numerous catostomid species and population Recently, there has been a number of newly discovered *Moxostoma* species in the southeast including the undescribed sicklefin redhorse Genetic data suggest three populations of sicklefin redhorse (Hiwassee, Tuckasegee, and Little Tennessee); however, evidence of straying between the Tuckasegee and Little Tennessee populations appears ongoing This finding is perplexing, given that migration between populations should homogenize the populations; yet, the two populations appear genetically distinct We used approximate Bayesian computation to compare competing models of demographic history to explain the observed level of genetic diversity within and among the Tuckasegee and Little Tennessee populations of sicklefin redhorse A model that simulated the migration out of the Tuckaseegee during the years when tannery operation were present was favored over models that included recent population reductions in the Tuckaseegee or continued migration between the Tuckaseegee and Little Tennessee rivers Our results suggest that tannery operations

during the 1900s may have influenced the behavior and observed genetic structure found presently in sicklefin redhorse

“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 (*Moxostoma robustum*) is a large, long-lived sucker species historically found in Atlantic slope 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 expand the repository to include males from the Pee Dee River in North Carolina The sicklefin redhorse (M sp) 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 and were undertaken in 2014 to develop a cryopreservation protocol for sicklefin redhorse sperm Sperm were collected from 5 males from the Little Tennessee River, NC Initial motility was 95% ± 0% The sperm were extended in the field with modified Hanks’ balanced salt solution (300 mOsmol/kg) at a ratio of 1:2 (v:v; sperm:extender) Dimethyl sulfoxide and methanol were evaluated as cryoprotectants at a concentration of 10% Extended sperm (1:2 or 1:5) were mixed with cryoprotectants and allowed to equilibrate for 12 minutes Equilibration motility ranged from 10 to 95%, with the methanol treatments being significantly higher (P < 005) than dimethyl sulfoxide as a cryoprotectant Five 05-mL straws per treatment were frozen in the bottom of a dry shipping dewar Cryopreserved sperm were stored for 190 days in liquid nitrogen, and then thawed in a 40°C water bath for 7 seconds Post-thaw motility ranged from 1 to 60% for the four treatments There were no significant differences of post-thaw motility within the four treatments (P > 005) The development of a successful protocol for sicklefin redhorse sperm cryopreservation will allow the establishment of a sperm repository for use in future restoration efforts

From Mussels to Sturgeon, Low-Cost Side Scan Sonar Helps Advance the Conservation Mission

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With access to low-cost, side imaging sonar and the development of tools and techniques for processing and analyzing data within a GIS framework, the opportunity to investigate and develop applications that address pressing conservation needs in navigable aquatic systems has never been greater Across the Florida Panhandle the US Fish and Wildlife Service is investigating the use of side scan sonar to detect and enumerate large sturgeons as an alternative approach for monitoring long-term trends in abundance as the species recovers Within a meandering portion of the Apalachicola River, we have demonstrated the use of this technology to define suitable mussel habitat and assess changes in habitat over time, and have used easily derived habitat metrics to model the distribution and abundance of an endangered species of mussel In these cases, side scan sonar provided highly detailed, meso-scale level information about the subsurface environment; such information is critical to advancing our aquatic conservation mission in the 21st century

Evaluating the Habitat Associations of a Stream Fish Assemblage at Multiple Spatial Scales Using Low-Cost Side Scan Sonar

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Understanding how environmental factors operating at different spatial scales within a watershed structure instream habitat is essential for accurately quantifying fish habitat associations and developing effective means for assessing stream conservation and restoration activities In this study, we used a combination of side scan sonar surveys, imagery collected by an unmanned aerial vehicle, and instream surveys of fishes and physicochemical conditions to evaluate the effect of physicochemical and habitat variables at various spatial scales (eg, micro-mesohabitat, mesohabitat, riffle-run-pool complex, stream reach) on fish assemblage habitat associations in the South Llano River, a spring-fed second order stream on the Edwards Plateau in central Texas We found that the micro-mesohabitat scale and the riffle-run-pool complex scale had the greatest explanatory power Many of the fishes endemic to the streams of the Edwards Plateau, such as Guadalupe Bass *Micropterus treculii* and Texas Logperch *Percina carbonaria*, exhibited associations with similar physicochemical and landscape variables Our results suggest that conservation and restoration efforts targeting single species, such as the Guadalupe Bass Restoration Initiative, has the potential to benefit a suite of species if these efforts are aimed at the appropriate scales Furthermore, side-scan sonar proved to be a cost-effective means of acquiring information on the habitat availability of the entire river length and allowed for the assessment of how a full suite of riverscape-level variables influenced local fish assemblage structure

From Rediscovery to Augmentation: Conservation of the Robust Redhorse in the Pee Dee River

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In 1985, an unidentified redhorse was collected in the Pee Dee River and it was not properly identified until 1991, when more specimens were collected in Georgia It was determined to be a Robust Redhorse (*Moxostoma robustum*), a species that was lost to science for over 120 years This rare sucker is now known to occur from the Pee Dee River drainage of North and South Carolina to the Altamaha drainage of Georgia Degraded water quality and the occurrence of hydropower dams have altered habitat and reduced its range and population densities To improve understanding and the status of this species, a cooperative, voluntary partnership (Robust Redhorse Conservation Committee) was formed between state and federal resource agencies, private industry, and the conservation community Efforts to determine population size, migratory patterns, and habitat ecology were completed in 2010 Negotiations during the Federal Energy Regulatory Commission (FERC) relicensing process resulted in higher minimum flows in the occupied Pee Dee River reach This action protects spawning redds and newly hatched larvae that were dewatered during previous minimum flows Microhabitat suitability analysis and flow modeling suggest that augmented flows increase suitable Robust Redhorse habitat during spawning and non-spawning periods Water quality has improved over time, but endocrine disrupting compounds are a newly discovered concern Due to the extremely small adult population size in the Pee Dee River (34 to 58 spawning adults), population augmentation was initiated with the release of 13,000 fingerling Robust Redhorse in fall 2014 The low number of spawning adults that can be propagated each spring dictates that the augmentation program should continue for the next 19 years to maintain the genetic diversity of the wild population Opportunities for reintroduction upstream are being considered and an option to move forward may include a Candidate Conservation Agreement with Assurances (CCAA)

Using Passive Acoustic Monitoring to Assess Diel Patterns and Temporal Trends in Spawning Rates of Robust Redhorse (*Moxostoma robustum*)

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Understanding reproduction and recruitment of imperiled species can help conservation efforts Recruitment failures, a problem in many imperiled riverine fishes, are caused by modifications of their riverine habitat, ie barriers to migration, and temperature, habitat, and flow changes) Conservation efforts for some imperiled species have failed because of limited knowledge of a species' life history requirements and alleviation of threats to the species We used visual observations and passive acoustic recorders to document spawning behavior and rates for a large-bodied catostomid, Robust Redhorse, *Moxostoma robustum*, in the Savannah and Broad rivers, Georgia We assessed spawning rates in relation to time of day, water temperature, discharge variation, moonlight, and weather Robust Redhorse spawning rates in the Savannah and Broad rivers were highest at night or in the early morning (0100-0400 h and 0800-1000 h, respectively) and lowest near mid-day (1300 h) Spawning rates increased over a 3-4 day period and then declined Moon illumination was positively associated with spawning rates for Robust Redhorse in the Savannah River Water temperature was negatively associated with spawning rate in the Savannah and Broad rivers, and spawning rate increased in association with cloud cover in the Savannah To our knowledge, this is the first study to document spawning rates for any *Moxostoma* species Although this study only documents spawning rates at two locations for one season, this could provide important information for management of these species downstream of hydropower facilities

Development of Edna Detection and Sampling Methods for the Invasive Apple Snail in Lake Seminole

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A recent technique in detecting the presence of cryptic, invasive or endangered aquatic organisms is environmental DNA (eDNA) eDNA has been useful in the tracking of Asian Carp in the Great Lakes region, and may also be helpful in tracking the spread of invasive Apple snails (*Pomacea maculata*) in Lake Seminole, a large, shallow reservoir on the Florida-Georgia border The first published sighting of *P maculata* on Lake Seminole was in 2008, and egg mass surveys have systematically mapped the distribution of *P maculata* around the lake in 2013 and 2014, which can be used as a proxy for presence of the snail These surveys are labor intensive, limited to mating season and highly objective due to cryptic egg masses For these reasons, eDNA is an attractive alternative method to survey the snail's invasion through the system In the current study we will develop eDNA sampling methods, test the detection limits, and finally compare this method to the direct survey method Monitoring the distribution of the snail is significant in that the snails are voracious grazers of submerged aquatic vegetation, which can cover up to 48% of the lake surface during the growing season In Lake Seminole, submerged aquatic vegetation acts as a nutrient sink for N and P, which results in reduced nutrient concentrations exported from the Lake into the Apalachicola River Increase in *Pomacea* grazing may act to reduce submerged aquatic vegetation nutrient uptake, and increase in nutrient release via excretion Efficiently monitoring Pomacea distribution around the lake will help predict where to expect increased grazing On a larger scale, using eDNA to monitor for *P maculata* in areas at risk to the spread of the snail can act as an early warning to managers, and lead to the development and/or implementation of management strategies for the snail

Presence/Absence Analysis of Historical Data on the Strawberry Darter

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Abstract-The Strawberry Darter (*Etheostoma fragi* Distler 1968) was identified as a species of greatest conservation need in the Arkansas Wildlife Action Plan The Strawberry Darter is endemic to the Strawberry River drainage and was recently elevated from the subspecies to the species level Abundance and distribution of this species has been studied, but the most recent survey occurred more than 16 years ago Prior to the initiation of a new survey, a retrospective analysis was conducted to examine historical patterns in the temporal and spatial distributions of the Strawberry Darter We acquired historical data from 35 studies covering a period of 46 years and analyzed the data using the program Presence Our analyses did not suggest a systematic decline in the occupancy rate of Strawberry Darter over the period examined The mean±SD occupancy rate was generally higher in tributaries (081±010) than the main stem (025 ± 038) Occupancy rate monotonically declined from the upper reach (055±052) to the middle (021±040) and lower (007±017) reaches of the main stem of the Strawberry River We found no correlation between mean annual flows, mean annual precipitation or mean annual air temperatures and annual occupancy rates The results from this retrospective analysis provide a foundation for designing and executing a new survey of the status and distribution of Strawberry Darter, based on a presence/absence sampling design

Two Years of 'Horse Play: Monitoring and Study of the Georgia Population of the Sicklefin Redhorse

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The Sicklefin Redhorse (SFR) *Moxostoma* spp is an undescribed, candidate species occurring in north Georgia within Brasstown Creek in the Hiwassee River watershed from mid-April to late May at water temperatures of 12-18°C We are currently developing a monitoring program for this population and have tested various sampling techniques for SFR Representative 100-meter reaches along Brasstown Creek (n=12) were sampled in spring 2013 and 2014 using three sampling techniques (eg visual surveys, seining, and snorkeling) Seining methods performed poorly in detecting sicklefin redhorse presence (~29% probability) whereas streamside visual surveys were most effective (>80% probability) Although visual survey methods are effective for detecting SFR, these surveys are not useful for collecting fisheries data such as length, weight, sex and aging structures SFR capture in seines is possible but difficult, with females likely being undersampled, and future research will address an improvement in seining techniques New upstream records for SFR were documented during sampling, and we plan to investigate possible occurrences upstream of reservoirs of the upper Hiwassee and Nottely Rivers in Georgia Recent work has investigated the utility of pectoral fin rays as an alternative to lethal aging techniques Whereas scales underage SFR in comparison to otoliths, pectoral fin rays display more annuli, which is comparable to otoliths Furthermore, we are comparing annual growth increments in aged SFR to stream discharge and temperature data to determine if significant annual variation in growth exists Lastly, sampled SFR are being implanted with PIT tags to collect data on annual growth, SFR movement within the watershed, and spawning site and stream fidelity Additional work has included removing fin clips for genetic analysis and collection of sperm for cryopreservation

Evaluation of Low Discharge Effects on Savannah River Mid-Channel Gravel Bars, with an Emphasis on Habitat Suitability for Spawning Robust Redhorse (*Moxostoma robustum*)

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Mid-channel gravel bars are an important yet limited habitat feature in the Savannah River We investigated the two bars near New Savannah Bluff Lock & Dam (NSBL&D) Savannah RM 1871 and RM 1774 These central gravel bars have been identified as spawning sites for the Candidate species, Robust Redhorse (*Moxostoma robustum*), as well as several other Catastomids Although these 2 gravel bars have been repeatedly studied throughout the past decade, quantitative relationships between river flows and habitat availability had not been developed, thereby limiting consideration

for flow management alternatives We measured habitat conditions at the gravel bars during lower, drought response flows, as well as higher flows We collected depth, current velocity, and substrate data at multiple flow levels, using multiple methods, including direct and acoustic measurements At lower flows, velocity and depth were not suitable for spawning Robust Redhorse At discharge levels below 7,000 cfs, depth and velocity were insufficient in much of the gravel bar habitat to overlap with the spawning substrate requirements of Catostomids Both gravel bars were fully inundated at flow levels of 5,680 cfs, although hourly river flow fluctuations, probably stemming from operation of the lock and dam caused frequent habitat emersion Low flows and habitat emersion likely limit reproduction and early life stages of Catastomids We demonstrate the utility of the flow-habitat relationships to inform flow management from Thurmond Dam

Swimming Ability of Sicklefin Redhorse Early Life Stages and Implications for Conservation of an Imperiled Species

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Effective management of rare or endangered fish species is dependent on a thorough understanding of ontogeny, ecology, and habitat requirements at all life stages Swimming ability is important in determining patterns of larval and juvenile fish dispersal, distribution, and nursery habitat selection, which may guide critical habitat protection The Sicklefin Redhorse *Moxostoma* sp is a sucker (family Catostomidae) that is geographically restricted to the southern Appalachian Mountains and is of particularly high conservation concern We designed a laboratory experiment to determine swimming ability of larval and juvenile Sicklefin Redhorse Sustained swimming abilities were assessed by subjecting captive-reared Sicklefin Redhorse (N=102) to fixed-velocity swim trials, wherein fish were subjected to a prescribed water velocity until they became exhausted and unable to maintain position Trials were performed in a 38-mm-diameter swim chamber capable of producing accurate velocities 005 – 025 m/s Fish were subjected to trials approximately 1, 2, 4, 6, and 10 weeks after they exhibited swim-up behavior; mean total lengths were 160, 161, 203, 263, and 333 mm, respectively Development classifications included early- and late-stage mesolarva, metalarva, and juvenile Within each developmental class of fish, there was a significant negative relationship between water velocity and swimming duration ($P < 005$) Swimming ability increased monotonically among classes; sustained swimming speeds (30-min) increased from 0099 m/s to 0166 m/s across the range of sizes observed Our estimates indicate that Sicklefin Redhorse larvae exhibit marginally better swimming ability than similarly sized Robust Redhorse *Moxostoma robustum* The information gained from our findings will be used to develop a more thorough mechanistic understanding of habitat associations observed in concurrent field research and to guide planning and implementation of conservation and recovery efforts

Poster Presentations

P-20 Otolith Chemistry and Genetics Reveal Scale of Ontogenetic Movement of Smallmouth Bass in the James River Basin, Virginia

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Understanding the dispersal of fish between connected habitats is important for the management of populations and fisheries We studied the movement of smallmouth bass (*Micropterus dolomieu*) between the middle James River, Virginia and its major tributaries using a combined approach of otolith chemistry and genetic analyses Isotopic differences between mainstem and tributary habitats provided reliable records of movement between rivers, which appeared common and widespread However, otolith chemistry could not provide any information on longitudinal (within-river)

movement or the impacts of movement upon population structure We used microsatellite DNA amplification fragment length data to characterize genetic structure of populations among mainstem and tributary habitats We included additional samples collected from the upper James River basin and outgroup populations to examine differentiation at both fine and coarse geographic resolution Our results showed that the mainstem and lower tributary reaches in the middle James River are an unstructured, well-mixed population, which corresponds with the high degree of individual movement shown by otolith microchemistry Genetic structure across the upper and middle basin reflected patterns of isolation by distance and the effects of barriers to movement, and suggested reduced exchange between mainstem and tributary habitats in the upper section compared to the middle James River watershed Different degrees of spatial structure between upper and middle basins may arise from physiographic variation across the region

P-46 Factors Associated with the Distributions and Densities of Three Native and One Non-Native Crayfish in Maryland

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We used an existing stream survey dataset generated by the Maryland Department of Natural Resources from 2007 to 2009 to quantify associations between three native (*Cambarus bartonii bartonii, Orconectes limosus,* and *Procambarus acutus*) and one non-native (*O virilis*) crayfish and eight water chemistry, physical habitat, and landscape variables Both reach and watershed scale factors were associated with crayfish densities in Maryland streams, while accounting for spatial autocorrelation of the dataset The density of *C b bartonii* was significantly correlated with stream gradient, and this species was also associated with higher forested land cover and cooler stream temperatures Density of *O limosus* was positively associated with upstream catchment area suggesting an affinity for larger streams *Procambarus acutus* density was positively correlated with total nitrogen concentrations and negatively associated with the quality of riffle and run habitats The density of the non-native *O virilis* was positively associated with urban land cover Counter to what has been reported from other states, syntopic occurrence of native species was rare in Maryland *Cambarus b bartonii* was syntopic with *O limosus* at only 5% of sites where the ranges of both species overlapped Similarly, syntopic occurrence of *P acutus* and *O limosus* was only 12% Recent surveys indicate the range of *O limosus* in the Piedmont region of Maryland has declined precipitously from historical levels, and the data suggest that the decline in the region appears to be more related to the concurrent spread of *O virilis* (ie, species replacement) than to other potential explanations (ie, urbanization) Our analyses suggest that the three native species are not particularly sensitive to urbanization, pH, or nitrogen eutrophication

P-4 The Effect of Sample Storage Time on Blood Gas and Electrolyte Readings for Channel Catfish, *Ictalurus punctatus*

Rachel Beecham*, Mississippi Valley State University

Storage of whole blood can lead to problems because the erythrocytes possess a high metabolic capacity, which can cause large fluctuations in blood gases and electrolytes This study was undertaken to determine the effects of sample storage time on blood parameters Blood samples were collected from 32 market sized pond raised channel catfish The whole blood was analyzed using a Stat Profile Critical Care Xpress Blood Gas Analyzer (Nova Biomedical) for osmolarity, blood urea nitrogen (BUN), lactate, glucose, magnesium (Mg), calcium (Ca), chloride (CL), sodium (Na), potassium (K), partial pressure of oxygen (pO2), partial pressure of carbon dioxide (pCO2), and pH Whole blood was stored on ice and each blood vial was sampled at 05, 1, 2, 3, 4, 5, and 6 hours post sampling Long-term cold storage of channel catfish whole blood caused significant increases in mean pO2 and significant decreases in mean pH only Further research should be conducted to determine the effects of blood storage on blue and hybrid channel x blue catfish as well

P-1 Implementing a Statewide Recreational Saltwater Angler Survey in Louisiana

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In 2014, the Louisiana Department of Wildlife and Fisheries began conducting a survey of recreational saltwater anglers known as LA Creel The primary goals of LA Creel are to provide precise fishery landings data at fine spatial and temporal scales, improve landings estimates of offshore species, and to expedite the availability of landings estimates LA Creel is a complemented survey consisting of a dockside survey to estimate landing rates (fish landed per trip) and e-mail/telephone surveys to estimate effort (number of trips) Total landings are simply the product of landing rate and effort estimates The dockside survey follows a stratified two-stage cluster sampling design using a proportional probability assignment selection process derived from various fishing activity pressures The dockside survey is brief and efficient, resulting in more completed interviews Field biologists utilize a tablet application that enables on-site dockside survey data entry and facilitates the data review process The angler telephone survey follows a simple stratified random (SSR) design where the recreational saltwater license database is stratified into four regions based on angler zip code to account for differences in angler density and fishing patterns In order to generate precise landings estimates of offshore species, anglers harvesting certain offshore species in Louisiana must possess a recreational offshore landing permit (ROLP) The ROLP database is incorporated into the effort survey as an additional stratum The charter captain effort survey also follows an SSR design and uses the charter captain license database, which is stratified by ROLP possession Anglers and captains are contacted weekly to minimize potential recall bias of effort estimates Effort estimates are expanded by the percentage of licensed anglers observed during the dockside survey Incorrect angler contact information in the license database is being addressed through a media campaign combined with a website tool that allows anglers to update their information The inclusion of an e-mail component into the effort survey and continuing improvement of contact information have resulted in a high rate of completed surveys Design elements of LA Creel can be modified on a weekly basis to improve precision as needed, for example during a short federal season for an offshore species Landings estimates can be available within two weeks of initial data collection, at drainage basin resolution for inshore species if needed Communication between field staff, data managers, and analysts has proven vital to the success of LA Creel

P-44 Temporal Influences on Estuarine Mesozooplankton and Fish in the Savannah River Estuary System

Kalynn Fitzgerald*, Savannah State University and Amanda Kaltenberg, Savannah State University

Fish exhibit a range of distribution patterns over daily, tidal, lunar, and seasonal cycles The coast of Georgia is home to many estuaries vital to fish, especially the juvenile period of their life In this project, the use of bio-acoustic sensors combined with plankton and fish net sampling allowed us to quantify the temporal patterns of fish behaviors and predator-prey interactions over a range of temporal scales in a tidal creek of the Savannah River estuary system An acoustic echosounder (Simrad Ek15) was used to monitor interactions among daily and tidal changes of the biota Understanding the temporal patterns of fish and mesozooplankton prey are necessary for monitoring the health of estuaries, which is vital to local economy that thrives on fisheries such as shrimping and crabbing

P-9 Mercury Bioaccumulation and Muscle Tissue Concentration in Six Reef Fish Species in the Snapper/Grouper Complex from the Atlantic Waters of the Southeastern United States

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Mercury (Hg) is found in fish species world-wide and since a large portion of the world depends on fish for protein, the concentrations and bioaccumulation of Hg in commonly consumed fishes is an important area of study The need to better understand Hg in the environment exists due to the vast amount of interspecific, intraspecific, temporal and spatial variation found in Hg concentrations and rates of Hg accumulation Reliable and up-to-date information on health concerns should be considered when choosing fish species and quantities to consume Consequently, care must be taken when issuing regional and national advisories to account for inconsistencies found between water bodies (eg the Gulf of Mexico and the Atlantic waters of the Southeastern US) and among similar species due to possible varying levels of tissue Hg concentrations The goal of this study is to provide a comprehensive understanding of Hg bioaccumulation in six species of the snapper/grouper complex from the Atlantic waters of the Southeastern US (*Mycteroperca microlepis, Mycteroperca phenax, Epinephelus morio, Lutjanus campechanus, Caulolatilus microps* and *Seriola dumerili*) These species were chosen as model species due to a combination of the following factors: their longevity, feeding habits, preferred habitat, and taxonomic relationships The study focuses on relationships between muscle tissue Hg concentrations and the independent variables length, weight, age, and carbon and nitrogen isotopic ratios (as proxies of trophic position and carbon source, respectively) Preliminary data suggest significant positive relationships between Hg concentrations and fish size, as well as, interspecific differences in Hg and accumulation rates The improved understanding of Hg in fishes from this study will provide insight into the biology and ecology of these fishes and enhance consumption guidelines for local and regional fishes

P-27 Using an Individual-Based Model to Assess the Impacts of Stocking Red Drum on Wild Population Genetic Diversity in South Carolina

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The South Carolina Department of Natural Resources (SCDNR) initiated an experimental stock enhancement program for red drum as a potential alternative to increasingly restrictive fishing regulations due to the overharvesting of red drum stocks throughout their range The SCDNR currently follows the ‘responsible approach’ to stock enhancement developed by Blankenship & Leber (1995) by incorporating the preservation of wild stock genetic diversity into the hatchery program The stocking approach, however, did not always focus on the maintenance of genetic diversity, and so this study aims to incorporate demographic and genetic components of cultured and wild red drum into an individual-based model to assess potential impacts of stocking on the genetic diversity of the wild population Heterozygosity and allelic richness will be used as accepted measures of genetic diversity Effective population size will also be calculated to inform potential effects of inbreeding often observed with stock enhancement The model will serve as a guide for future enhancement strategies through sensitivity analyses that examine various hatchery effective broodstock sizes, number of genetically distinct families, and number of fish to release in order to maintain an effective enhancement program while minimizing the genetic impacts to the wild population in South Carolina

P-23 Effectiveness of DNA Barcoding in Identifying Tidal Blue Catfish Stomach Contents Containing Fish

Zach Moran*, Virginia Tech

Effectiveness of DNA Barcoding in Identifying Tidal Blue Catfish Stomach Contents Containing Fish

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And

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Abstract- Understanding interactions between predators and prey creates many challenges for ecological studies One such challenge includes the proper identification of partially digested prey in the stomachs of piscivorous predators This pilot study investigated the molecular technique DNA Barcoding to examine its efficacy for identifying invasive tidal river Blue Catfish, Ictalurus furcatus, stomach samples containing fish Stomach samples were obtained and ranked on their varying stages of digestion to observe differences and determine success of DNA barcoding We used a cocktail of universal fish primers (FishF2_t1, FishR2_t1, VF2_t1, and FR1d_t1) for the mtDNA Cytochrome oxidase I (COI-3) region for polymerase chain reaction (PCR) on our digested samples Amplified mtDNA was then sent to Smithsonian Institute (SI) or Virginia Bioinformatics Institute (VBI) for Senger sequencing and analysis Sequenced results were then compared to the existing Barcode of Life (BOL) database for successful identification Raw sequences were edited with Sequencher and DNA sequences were compared against entries in GenBank using the Basic Local Alignment Search tool Results indicated that nearly 75 percent of samples sent to SI were successfully identified Samples sent to VBI have not yet returned from Senger sequencing Once we determine the success of DNA barcoding in identifying Blue Catfish stomach samples containing fish; we hope to conclude if DNA barcoding is an acceptable analytical tool for further study of Blue Catfish diets

P-63 Biochemical Reference Intervals for Farm Raised Channel Catfish (*Ictalurus punctatus*), Blue Catfish (Ictalurus furcatus), and Channel X Blue Hybrid Catfish Utilizing a Portable Bench Top Analyzer

Rachel Beecham*, Mississippi Valley State University and Michael Mauel, Mississippi State University

Catfish are the most aquacultured species in the United States but data regarding the normal blood chemistry values are highly limited The development of a normal blood value database will be valuable in determining the health status of the catfish, which will aid producers in managing their stock Blood was collected from pond raised channel, blue, and blue x channel hybrid catfish for the purpose of establishing normal plasma biochemical reference intervals The plasma was analyzed with portable bench top analyzer using two different rotor kits (comprehensive and an avian/reptile) and the following values were determined: albumin (ALB), alkaline phosphatase (ALP), alanine aminotransferase (ALT), amylase (AMY), total bilirubin (TB), blood urea nitrogen (BUN), calcium (Ca), glucose (GLU), sodium (Na), potassium (K), total protein (TP), globulin (GLOB), aspartate transferase (AST), bile acids (BA), creatine phosphokinase (CK), uric acid (UA), sodium/ potassium ratio (NA/K), albumin/globulin ratio (ALB/Glob), and blood urea nitrogen/creatine ratio (BUN/CRE) Values were compared within each group for statistical differences between the rotors, and between groups for each individual rotor Significant differences were found between the comprehensive and avian/reptile rotors within each group for albumin, globulin and the albumin/globulin ratio Comparisons of the three groups demonstrated significant differences for albumin, calcium, glucose, and potassium on both the comprehensive and the avian/reptile rotors The data indicates that normal ranges need to be established for each catfish species and the hybrids The reference intervals determined in this study will be useful in health management decisions for catfish producers

P-32 "An Investigation into Sexual Segregation in the Tiger Shark, in the Gulf of Mexico and the Atlantic Ocean, Using GIS Analysis"

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In some species of sharks, males and females occupy different areas, called sexual segregation The Tiger shark (*Galeocerdo cuvieri*) is one of the widest ranging large coastal species in the waters of the southeastern USA Our goal was to compare the distribution of male and female Tiger sharks, in the Atlantic Ocean and the Gulf of Mexico, to see if they exhibited sexual segregation GIS analysis was used to map areas of male and female population densities based of longline surveys conducted from 1995-2003 The results indicated that males and females occupy the same areas, so sexual segregation in tiger sharks does not occur in these regions

P-28 Louisiana Crappie: Population Dynamics, Fishery Characteristics, and Evaluation of Size Regulation Effectiveness

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Given the popularity of black crappie (*Pomoxis nigromaculatus*) and white crappie (*P annularis*) fisheries throughout Louisiana, continual evaluation of management strategies is essential and require baseline information on crappie population and fishery characteristics Crappie were collected on eight waterbodies for a three to four year period using lead nets An access point creel survey was conducted during one of these years on five waterbodies Since black and white crappie are not independently managed, analysis was conducted on the combined population The von Bertalanffy growth function was used to model length-at-age and catch curves were used to estimate total mortality Growth and mortality rates and recruitment variability indicated the presence of several crappie population types within Louisiana Proportional size distribution indices and mean relative weights were mostly within recommended ranges An age and sex structured population model was constructed to simulate the effects of minimum length limits on crappie fishery performance across a range of potential natural mortalities Simulations indicated that the same size regulation can affect populations differently For most waterbodies, implementation of a ten inch minimum length limit (MLL) was predicted to increase crappie catch, but decrease the number of harvested fish and overall yield For two waterbodies, a ten inch MLL was predicted to produce higher yields Increased yield is attributed to low natural mortality and fast growth, which supports similar research from other states Despite projected yield improvements with a 10 inch MLL on two waterbodies, the large number of crappie that would need to be released may be considered unacceptable to the angling community

P-2 Local Ecological Knowledge about Climate Change Among Anglers in the Southeastern United States

Liz Brown-Pickren*, East Carolina University

Resource users often amass local ecological knowledge about the resource Anglers who fish in the same spot over time have knowledge of the fluctuations of types and sizes of species they target and environmental conditions where they fish, including water temperature, storm activity, anthropogenic inputs and changes in the area A series of intercept surveys of anglers actively fishing along the coast in Georgia, South Carolina and North Carolina revealed that climate change is not perceived as the cause of changes in catch at a local level

P-24 Mercury Accumulation and Effects in the Brain of Atlantic Sharpnose Sharks

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As demonstrated in a number of previous studies, sharks often bioaccumulate the non-essential toxic metal mercury to levels that threaten the health of human seafood consumers However, there have been no published studies that have examined if high mercury levels also occur in the central nervous system of sharks, the main site of mercury toxicity in most vertebrates, or whether accumulation of this metal affects shark neurophysiology Therefore, to address this question, the goal of this study is to determine if the elevated levels of mercury often found in shark muscle also occur in the brain of these animals, and if mercury accumulation is associated with damage to the shark's nervous system This will be accomplished by measuring and comparing muscle and brain mercury concentrations in the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), and comparing these measurements with levels of S100, a protein marker of mercury-induced neurodegeneration, in shark cerebrospinal fluid To date, sharks have been captured from multiple locations in South Carolina, Georgia, Florida, and Alabama Total mercury concentrations in dried muscle and brain samples are being measured using a direct mercury analyzer, and levels of S100 in cerebrospinal fluid are being measured using ELISA Correlation analysis will be used to determine if significant relationships occur between mercury accumulation and biomarkers of neuron damage This study will be one of the first to examine the direct impacts of high mercury uptake in sharks and their relatives, and will therefore contribute significantly to the field of shark ecotoxicology

P-64 Effects of Graded Levels of Dietary Soybean Meal Inclusion on Intestinal Morphology and Growth of Red Drum

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The aquaculture industry relies heavily on fishmeal and fish oil as key ingredients in fish feed production Over the past 20 years, reduction fisheries populations have plateaued while global seafood consumption has steadily increased As a result, the future sustainability of reduction fisheries' products may not keep pace with the demands of the growing aquaculture industry Additional protein sources, including vegetable-based plant proteins, are currently being evaluated as possible substitutes for fishmeal Soybean meal (SBM) has been used as a sustainable alternative to fishmeal but has been shown to cause intestinal enteritis in certain teleost species With the continued expansion of the soy industry into aquaculture feeds, additional testing of soybean meal and its potential impacts on growth and health in fish species needs further evaluation

Red drum, *Sciaenops ocellatus*, was used as a model for warm-water, marine species in determining soybean meal tolerance through graded fishmeal substitution A 12-week feeding study was conducted on juvenile (initial mean weight, 469 g) red drum utilizing five experimental diets: a 0% SBM control diet, a 15% SBM, a 30% SBM, a 45% SBM, and a 60% SBM Fish were held in twenty-four 1,500 L recirculating tanks, four randomly assigned replicate tanks per diet at a concentration of twenty fish per tank, and fed twice daily to satiation By the end of the experiment, no statistical differences in final weight (g) or condition factor per treatment were detected (ANOVA, $\alpha = 005$: $p = 034022$ and 0355995, respectively) Measurements of intestinal morphology (villi area, lamina propria area, and goblet cell density), taken from the distal section of the small intestine, were compared in a subset of fish from each treatment Determining the maximum amount of soybean meal red drum can tolerate without negatively affecting growth and physiological functions will offer feed manufactures a more sustainable, cost-effective alternative to fish byproducts Initial results suggest the increased concentrations of soybean meal used in this study to feed red drum did not negatively affect growth or intestinal morphology

P-33 Genetic Assessment of the Atlantic Horseshoe Crab in South Carolina

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The Atlantic horseshoe crab, *Limulus polyphemus*, is an important species environmentally, commercially, and biomedically Horseshoe crabs migrate onto beaches each spring to spawn where, in some locations, they are non-lethally harvested for their blood, which can lead to post-bleeding mortality (10%-30%) and may reduce fitness during the spawning season Limited genetic information was available regarding horseshoe crab populations in South Carolina, and the combination of direct mortality and sublethal effects of harvest raised concerns about the genetic diversity of these organisms The objectives of this project were to (1) evaluate the genetic structure of horseshoe crabs collected at two proximal spawning beaches in South Carolina and (2) generate measurements of genetic variation for these locations A total of 200 horseshoe crab samples were collected at Coffin Point and Harbor Island beaches in South Carolina DNA was isolated and amplified using 13 microsatellite primers The two locations were compared using several different measures of genetic differentiation; no significant genetic structure was found between Harbor Island and Coffin Point, indicating that these locations represent a single population Thereafter, samples were combined to generate estimates of genetic diversity, which showed moderately high levels of heterozygosity, very little inbreeding, and relatively large effective population sizes These are all positive indicators for the adaptive potential of the population This study addresses the deficiency of genetic data for the horseshoe crab in this region and establishes an important baseline for future monitoring and management of the horseshoe crab in South Carolina

P-47 Life History and Distribution of the Oconee Burrowing Crayfish, *Cambarus truncatus*

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The Oconee Burrowing Crayfish, *Cambarus (Depressicambarus) truncatus* Hobbs, is endemic to the lower Oconee River watershed in Georgia The ICUN lists *C truncatus* as “near threatened” and the State of Georgia lists it as “threatened” This is due in part to the limited life history information known about this primary burrowing species To gather life history data, a non-invasive study was conducted using Norrocky tube traps and avian mist nets at Balls Ferry State Park near Toomsboro, Wilkinson County, Georgia Bi-weekly trapping began in March 2014 and is ongoing Captured crayfish were measured, tagged with Visible Implant Alpha Tags (Northwest Marine Technology, Inc), and released into the burrow from which they were captured A total of 109 burrows have been trapped yielding 29 *C truncatus* individuals, 23 of which were tagged Five individuals were caught in burrows previously occupied by another crayfish and 10 individuals have been recaptured at least once All recaptured individuals were collected in the same burrow from which they were initially trapped Form I males were collected in March, May, and October Glair gland activity was evident from March through May, and during October Four ovigerous females were captured in May, each of which carried approximately 30 eggs; egg diameter averaged 196 mm Adult *Cambarus truncatus* exhibit a growth rate of about 1 mm in total carapace length (TCL) per molt until plateauing at about 34 mm TCL The largest specimen collected was a female measuring 3458 mm TCL The known distribution of *C truncatus* has been expanded from four locations in 1981 to 18 locations as of October 2014

P-21 Insights into Movement and Hybridization Patterns of Striped Bass *Morone saxatilis* in North and South Carolina Via Use of Genetic Tagging in Stock Enhancement Programs

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Genetic tags are unique permanent marks used in stock enhancement programs to detect wild or stocked fish Striped bass *Morone saxatilis* stock enhancement has been evaluated using microsatellite markers in South Carolina since 2006 and North Carolina since 2010 The long-term genetic evaluation of striped bass field samples has allowed for further insight into population aspects that would otherwise not be feasible As a surrogate to documenting movements of striped bass between North and South Carolina, we analyzed all 2006-2011 SC broodstock and field collections (Lake Marion and Lake Moultrie), 2010-2011 NC broodstock (Roanoke River source), and one Lake Wylie (border of NC/SC) sample to estimate genetic signatures of the populations An admixture analysis for assignment indicated that there are definite aspects of Roanoke ancestry within the Santee Cooper System striped bass population in multiple year classes, which suggests low levels of ongoing 'migration' The Lake Wylie sample was a pure Roanoke strain fish, indicating that downstream movement of fish from North Carolina reservoirs into the Santee system in South Carolina does occur, though coastal movements between systems remain a possibility

Additionally, genetic evaluation of field samples from NC resulted in the identification of a number of hybrid striped bass samples in recent collections (36% of 2012-2013 samples) These hybrids may be the product of intentional NC stocked groups, escapement from hybrid striped bass production facilities, or natural hybridization occurring in the wild Genetic parentage analyses will allow us to determine the source of hybrid occurrence, which will provide important information for management of striped bass populations

These findings will help guide further management of striped bass across state lines The 'migration' of striped bass between North and South Carolina indicates that stocking programs could affect each state's populations and the states should work together to stock fish appropriate for the strain within those drainages Both states should consider these potential interactions as part of a responsible approach to their future stock enhancement programs

P-5 Detection of an Invasive Parasite, Anguillicoloides Crassus, of American Eels Using qPCR

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Abstract *Anguillicoloides crassus* is a nematode parasite of Asian origin that infects the swim bladder of its native host, the Japanese eel *Anguilla japonica* The parasite was unintentionally introduced to the US and Europe, with the earliest detections of the species in US waters occurring during the mid-1990s In the introduced range, *A crassus* now infects both the American eel, Anguilla rostrata, and the European eel, *Anguilla anguilla* The parasite may be associated with declining populations of both eel species because it causes more extensive host pathology and mortality compared with infected native Japanese eels Methods of preventing introductions and/or the spread of such invasive species are a priority in the early detection and rapid response to aquatic invasions

The ultimate goal of this project is to develop a molecular tool that will accurately detect and quantify *A crassus* To achieve this, *A crassus*-specific regions of the Cox I gene were identified and used to develop and optimize species-specific primers appropriate for qPCR The primers were tested against closely related nematode species and *A rostrata* DNA to verify their specificity To establish limits of detection, gravid *A crassus* worms were removed from infected eels to obtain eggs

harboring L2 larvae (the free-living stage that infects crustacean intermediate hosts) L2 larvae were allowed to hatch from the eggs and triplicate qPCR assays were performed using 1, 5, 20, 50 and 100 L2 larvae to generate standard curves for quantification Once developed, the molecular tool should enable *A crassus* to be detected in water, sediments, potential vectors, and both intermediate and definitive hosts

P-10 Spawning Observations of Clinch Dace in a Mountain Stream

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The Clinch Dace (*Chrosomus sp cf saylori*), discovered in 1998, is a Species of fine-scaled dace currently believed to be confined to just 9 tributaries on the Northern side of the Upper Clinch River watershed Only one previous study documented spawning behavior, habitat, and timing of Clinch Dace During the Summer of 2014 a study of stream occupancy of Clinch Dace was conducted On two separate days, June 4th and June 6th, we observed Clinch Dace exhibiting spawning behavior over a Central Stoneroller (*Campostoma anomalum*) nest, and underwater and above-water video recordings were made In total, we recorded five video clips totaling one hour and five minutes We broke the footage into 10 second intervals and recorded counts for various behaviors Behaviors observed included: male-male territorial chases, male-female nest chases, benthic feeding, females over the nest not being chased, nest construction, number of clinch dace on screen at given intervals, and numerous others We calculated the average number of behaviors per interval for a given video, as well as the average per interval for each of the two days We documented increases in the number of males chasing females, decreases in the number of males chasing males, increases in the number of females over the nest not being pursued, increases in benthic feeding among both Clinch Dace and other Species (Blacknose Dace (*Rhinichthys atratulus*) and Creek Chub (*Semotilus atromaculatus*)), and an increase in the number of Clinch Dace over the nest over the two days Distinguishing between sexes simply based on visual observation can be difficult in Clinch Dace, and for the purposes of this study females were distinguished as individuals with less vibrant coloration Average behavior counts from June 4th as compared to those from June 6th appear to suggest that the behaviors on June 4th were territorial pre-spawn behaviors and the behaviors on June 6th were mid-spawn/post-spawn behaviors Little research has been done into the spawning of *Chrosomus* species, especially one as rare as the Clinch Dace Further research into spawning behavior could indicate trends in habitat and environmental conditions which may aid in future conservation efforts

P-45 Application of the Index of Biotic Integrity for Assessing Biological Condition of Streams in Alabama

Heath Haley*, ADCNR

The Wildlife and Freshwater Fisheries Division of the Alabama Department of Conservation and Natural Resources initiated stream sampling in 2009 and has continued sampling annually through 2014 A total of 343 biological assessments have been made statewide using Alabama's Index of Biotic Integrity (IBI) 30 + 2 method This IBI method and protocol was developed by O'Neil and Shepard of the Geological Survey of Alabama (GSA) Calculations are calibrated for Alabama's five ichthyoregions Sampling at all sites is conducted over four habitat types: riffles, runs, pools, and shorelines Thirty-two efforts are completed at each site, including 10 efforts for riffles, runs, and pools and two 50m shoreline efforts For sites missing one or more habitat types, the effort potentially expended on the missing habitat is proportioned to habitat types that are present A standard seine and a Smith-Root backpack electrofisher are used to collect fishes at all sites Sampling within riffles and runs consists of setting the seine and shocking fish downstream into the net Pools and shorelines are sampled by backpack electrofishing with crew members following to collect stunned fishes with dip nets In 2014, 61 waded stream sites across various watershed sizes were targeted throughout the state in the following major river drainages: Tennessee, Coosa, Little

Tallapoosa, Tallapoosa, Warrior, Chattahoochee, Choctawhatchee, Alabama, and Sepulga IBI scores within these watersheds ranged from very poor to excellent A total of 12,845 fishes representing 114 species were collected and identified Two notable species of conservation concern were collected in 2014 including *Notropis cahabae* (Cahaba Shiner; n=26) and *Percina brevicauda* (Coal Darter; n=3) The Alabama Department of Conservation and Natural Resources will continue to monitor the condition of streams in the state by utilizing this IBI method and will apply the data toward the development of a comprehensive water management plan

P-3 "a Look at Oklahoma's State Wildlife Grant Program: A Snapshot of Recent Aquatic Projects"

Curtis Tackett*, Oklahoma Department of Wildlife Conservation

The State Wildlife Grants Program provides federal grant funds for developing and implementing programs that benefit wildlife and their habitats, including species not hunted or fished Priority is placed on projects that benefit particularly species of greatest conservation need Grant funds must be used to address conservation needs such as research, surveys, species and habitat management, and monitoring, identified within a State's Comprehensive Wildlife Conservation Strategy (CWCS) Oklahoma's CWCS identifies species of greatest conservation need and guides the future of wildlife conservation and associated funding Oklahoma's plan was approved by the US Fish and Wildlife Service on October 12, 2005 Since the birth of this program, Oklahoma has funded numerous conservation projects ranging from species specific research, habitat mapping and restoration, land aquisition, baseline surveys of flora and fauna, the development of publications as well as coordination amongst natural resource professionals This poster will provide more detailed information about the State Wildlife Grant Program in Oklahoma and will highlight several aquatic projects that have both recently been accomplished and are currently ongoing

P-48 Effects of Residence, Size, and Habitat Complexity on the Aggressive Interactions Between the Invasive *Orconectes palmeri* and the Native *Procambarus gibbus* in Georgia

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Orconectes palmeri is an invasive crayfish that has occupied parts of the Flint River since 1999 Already, native crayfish populations in the Flint are decreasing in numbers *Procambarus gibbus* is an endemic to tributaries of the Flint River and may be interacting with *O palmeri* if it moves upstream into these tributaries Interspecific behavioral trials were run in laboratory aquaria to observe levels of aggression when different sizes of invasive *O palmeri* were introduced to native *P gibbus* When the crayfish were matched in size, they spent more time fighting, and *O palmeri* were more aggressive with more chases and time by cover When *O palmeri* were smaller, *P gibbus* spent more time by the cover and chased more often When *O palmeri* was the resident, *P gibbus* spent much less time by cover compared to *O palmeri* Intraspecific aggression matches had less fighting and more time spent by cover for the resident for both species When O palmeri was the resident, P gibbus spent much less time by cover compared to *O palmeri* Habitat complexity caused less fighting between resident *P gibbus* and invading *O palmeri* These results indicate *O palmeri* may be successfully invading the flint river because of aggressive eviction of native crayfish for cover It also indicates the possibility that *O palmeri* could threaten *P gibbus* with extinction

P-25 Using DNA Adducts to Examine Polycyclic Aromatic Hydrocarbon Exposure in Shark Populations Impacted By the Deepwater Horizon Oil Spill

John Whalen*, University of North Florida, Jim Gelsleichter, University of North Florida and Dean Grubbs, Florida State University

The Deepwater Horizon oil spill (DWH) released approximately 5 million barrels of petroleum into the Gulf of Mexico between April and July of 2010 The Gulf is home to hundreds of natural oil seeps, but the DWH created an atypical environment for localized demersal shark species because of the high concentration of oil and its most toxic components, polycyclic aromatic hydrocarbons (PAHs) Exposure to PAHs generally results in increased expression of metabolic enzymes necessary for biotransforming and excreting these compounds Occasionally, metabolites resulting from this process can bind to DNA, forming adducts and creating the potential for mutagenic effects The objective of this study is to investigate if increased PAH–DNA adduct formation occurred in four abundant and ecologically important Gulf of Mexico shark species: *Squalus cf mitsukurii, Squalus cubensis, Centrophorus cf niaukang,* and *Centrophorus cf granulosus* Animals were collected using demersal long lines from the Northeast Gulf at varying distances from the origin of the DWH The presence of DNA adducts was determined by immunocytochemical analysis of blood samples collected from 2011 to 2014 Cell counts were made using a confocal microscope to determine an adduct damage index for each species Adduct formation was compared to reference sites located off the West Florida Shelf

P-65 Prey Selectivity and Ontogenetic Shifts Related to Gape Size in Larval and Juvenile Spotted Seatrout in Hatchery Ponds of South Carolina

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Feeding success and resource availability in the early stages of life are paramount for the survival of larval and juvenile fish in hatchery ponds Currently, little is known of the prey selection of juvenile spotted seatrout This study investigated prey taxa selectivity and ontogenetic shifts related to fish gape height in larval and juvenile spotted sea trout from hatchery ponds at the Waddell Mariculture Center

A total of 290 juvenile spotted sea trout ranging from 4 to 67 mm TL were collected from nine hatchery ponds between May 28, 2014 and September 16, 2014 Whole fish were preserved in 10% buffered formalin solution for 14 days and subsequently transferred to 70% ethanol Fish were measured to the nearest 025 mm and the entire gastronomical tracts were removed Prey items were removed and identified to the lowest practical taxonomic group A minimum of 20 prey individuals, when available, per taxa were measured to the nearest 01 µm Fish gape height was measured by fully opening the mouth with a forceps, photographing with Q Capture and measuring the maximum dorsoventral gape using Image J Co-occurring zooplankton samples were collected using a 3 L vertical sampler filtered through a 100 µm mesh sieve The sample was diluted up to 50 ml and thoroughly mixed before withdrawing a 1 ml sub-sample Ivlev's electivity index (E) was calculated for each prey taxa using stomach content and corresponding pond zooplankton data

Regression analysis indicated a significant positive relationship between spotted seatrout gape height and fish total length ($R^2=0986$, $p<0001$) Ivlev's electivity index results indicate that spotted seatrout exhibit an ontogenetic shift of prey selectivity based on gape size The general chronological feeding pattern in this study went as followed: rotifers (*Brachionus* sp), copepod nauplii (*Calanoid* sp), trochophore larvae (Polychaete), copepod adults, fish and water boatmen (Corixa sp) However, certain taxa were consistently selected over others, indicating prey selection that may outweigh size-specific characteristics in some gape height ranges For instance, spotted seatrout displayed a high electivity index for copepod adults in a wide range of gape heights (1000-5500 µm), but consistent high selectivity only occurred when gape height was above 2000 µm Pond production could be improved by closely monitoring zooplankton populations and effectively timing stocking with appropriate sized prey and abundance Results indicate that supplemental feeding with artemia could be done at an earlier stage than previously thought, when fish are most vulnerable to mortality

P-29 Hindcasting and Forecasting the Effects of Angler Harvest, Land Use and Climate Change on Smallmouth Bass Abundance at the Southern Edge of Their Range

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Climate change and altered land use threaten aquatic systems across the United States In Arkansas, climate change is expected to alter precipitation patterns and increase air temperatures over the course of the 21st century Discharge and temperature are two of the most important variables structuring lotic ecosystems and deviations from historic patterns of these variables due to climate change will affect lotic fish populations In addition, many lotic systems are threatened by altered land use associated with increasing development in the coming century Smallmouth Bass *Micropterus dolomieu* are ecologically important as top predators in stream ecosystems and are susceptible to detrimental effects of both climate change and altered land use Additionally, Smallmouth Bass provide a popular recreational fishery in many systems and are vulnerable to harvest mortality We have created a model examining the relative effects of climate change, land use, and angler harvest on smallmouth bass populations in two of the most popular Smallmouth Bass fisheries in Arkansas, the Buffalo River and Crooked Creek We parameterized the model for three time periods, historic, present, and future in order to compare land use and climate change over time

P-6 Estimating Discard Mortality in Gray Triggerfish Using Surface and Bottom Tagging: Preliminary Results

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Annual recreational landings of gray triggerfish (*Balistes capriscus*) in the US south Atlantic have increased dramatically over the past 13 years From 2001 to 2013, average annual landings were ~240,000 fish/yr, while landings for the previous 20 years (1981 to 2000) were ~145,000 fish/yr Moreover, in 9 of the past 14 years (2000 to 2013), the number of discarded (released alive) gray triggerfish in the south Atlantic recreational fishery has exceeded the number of gray triggerfish harvested Given the large numbers of discarded fish, estimates of delayed mortality from hook trauma, barotrauma, and water column predators are critical to refine estimates of fishing mortality for this recreationally- and commercially-important species We used fish traps and hook and line to capture gray triggerfish A subset of gray triggerfish in the best condition served as a “control” Other tagged triggerfish were binned into two different compromised conditions upon release: barotrauma and floating The tag return rate in each compromised group relative to the tag return rate in the control group was used to estimate discard mortality Our preliminary estimate of survival rates of gray triggerfish released with barotrauma was ~70%, while for floating fish we estimate 0% survival In addition to our preliminary results, we provide seasonal information on gray triggerfish discard levels to aid in designing future research; future work includes fishery-dependent sampling to obtain numbers of released gray triggerfish in each compromised category and using SCUBA to develop a better “control” group Our estimates of discard mortality and numbers and condition of discarded fish will be valuable in estimating the number of dead discards used in future gray triggerfish stock assessments

P-34 Comparison of Nektonic Communities Utilizing Artificial and Natural Oyster (*Crassostrea virginica*) Reefs in Coastal Georgia

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Oyster reef enhancement efforts in coastal Georgia include many methods to establish substrate for new oyster recruitment and provide habitat for nekton In 2012, GA DNR constructed artificial oyster reefs in the intertidal zone comprised of bagged oyster shell and oak bundles in Jointer Creek, near Brunswick, GA Two artificial reefs were sampled along with adjacent natural reefs using a 5m x 3m bottomless lift net Sites were sampled at high tide for three days consecutively each season (spring, summer, fall, winter) to determine nekton associated with artificial and natural oyster reefs Thirty-five species of fish and seven species of crustaceans of different age classes have been identified Analysis of similarity (ANOSIM) will be used to determine if nektonic communities over artificial reefs are similar to that of natural reefs

P-11 Brook Trout Selection of Aquatic Versus Terrestrial Origin Prey in Four Head Water Streams

Erin Thayer*, West Virginia University and Kyle Hartman, West Virginia University

Brook trout selection of aquatic versus terrestrial origin prey in four head water streams

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Eastern brook trout (*Salvelinus fontinalis*) are, for most of their life cycle, restricted to headwater streams in central Appalachia In many of these systems the autochthonous production and energy contribution is much lower than what is required to sustain a population of brook trout The allochthonous input from the surrounding terrestrial ecosystem contributes this remaining energy debt in the form of arthropods, specifically hexapods and arachnids and some vertebrates Current poor land management such as the reduction in riparian corridor from logging and creation of forest roads has the potential to further affect brook trout population by reducing the amount of large wood, increasing light penetration, and increased sedimentation which will ultimately change the amount and type of prey available Brook trout seemingly operate in violation of optimal foraging theory in that previous research has indicated that even with the high energy content of terrestrial invertebrates, brook trout still seem to feed upon aquatic benthic invertebrates The goals of this study are to investigate the prey preferences and feeding behavior of brook trout and to specifically test the hypothesis that brook trout prefer aquatic invertebrates to terrestrial invertebrates when ample amounts of both prey types are present; when aquatic production is low, brook trout will switch to a more opportunistic feeding behavior resulting in a higher amount of terrestrial invertebrates present in their diets I will be presenting preliminary results based on a data comparison of invertebrate kick net samples and stomach contents of brook trout across two seasons and four head-water streams The outcome of whether this hypothesis is supported or refuted can give insight to the persistence of brook trout populations in the face of an ever-changing immediate environment and changing subsidies from the adjacent terrestrial ecosystem

P-22 Current Northern Snakehead Distribution in Virginia

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Northern Snakehead *Channa argus* were first discovered in the Potomac River system in 2004 and have spread into nearly the entire tidal Potomac system and several additional coastal tributaries in Virginia Ecosystem-level impacts of this non-native species are uncertain, and effective management has proven difficult as the species continues to spread A centralized statewide database containing all Northern Snakehead observations was used to develop distribution maps Most fish were collected during standard electrofishing surveys while other data sources included verified reports from anglers and commercial fishers To date, the species has been collected in the Potomac River, Rappahannock River, and as far south as the Piankatank River Anglers have also illegally introduced the fish into at least five impoundments Northern Snakehead have shown a propensity to survive relatively high salinities during migration, as river mouths entering the Chesapeake Bay have elevated salinity relative to upper river sections and tributaries Movement likely occurs during seasonal spring freshets and other periods of high freshwater inflow to the Bay system Continued monitoring is needed to document future spread and distribution

P-49 A Test of DNA Barcoding in Crayfish

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Crayfish populations in North America face many conservation threats, including habitat loss, habitat degradation, and the introduction of non-native species To compound these basic conservation issues, many species are difficult to identify using standard morphological approaches Most available morphological keys work only for breeding (Form I) males, making identification of females and many males problematic; many keys also are tailored to specific geographic areas, which may cause problems in identification of introduced species We investigated DNA barcoding using cytochrome oxidase I (COI) gene sequences to determine if this widely used method is useful in the identification of crayfish As a test case, we sampled crayfish from the middle and upper James River basin in Virginia This area had been surveyed recently by experienced crayfish biologists, and hosts a moderate number of species We collected more than 300 COI sequences, which clustered clearly into seven groups, mirroring the seven species reported for this watershed Despite the unambiguous clustering, the range of sequence variation within species overlapped the range of variation between species; we detected no clear “barcode gap” Although this method holds promise as an aid to crayfish identification, current sequence databases (GenBank, BOLD) do not contain enough appropriate COI sequences to allow unequivocal identification

P-30 Post Fish-Kill Monitoring on the Ogeechee River

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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 These factors result in a set of distinct challenges to a fixed monitoring protocol that will be discussed 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 above a textile processing plant discharging treated waste into the river and three below the textile plant Fishes are sampled at each site in single-pass boat and backpack electrofishing transects We will report fish assemblage metrics (richness, diversity, IBI) from the first quarterly samples

P-66 Determining the Optimal and Most Cost Effective Food for Bluegill

Greg Grimes*, Aquatic Environmental Services

A study was designed to evaluate the effects of four dry pellet food diets containing various protein levels on the growth efficiency versus cost of food for bluegill (*Lepomis macrochirus*) Average weight was calculated per phase to measure growth rates Fish were held in 33ft3 plastic mesh cages to isolate feeding; there were 8 cages in total, 2 per food type Over the five month period, Purina Aquamax 500 and Cargill Aquafeed 40-10 gains were close in total weight gain, protein content, and price per pound Purina Aquamax 500 had a feed conversion ratio of 186:1 and Cargill Aquafeed 40-10 had a ratio of 208:1 A Chi Square Test was done to provide a p value of p=28, >05, so the feed conversion ratios are not significant These values far exceeded the fed conversion of the lowest protein level food tested Purina Game Fish Chow with 327:1 This data demonstrates that protein and crude fat content give evidence to be an important factor when choosing the most efficient dry pellet food source for bluegill The cost to grow a bluegill was significantly lower to gain a pound of weight ($137) for the food with higher fat and protein content than a cheaper priced lower protein feed ($170) This study was not intended for scientific scrutiny rather to be used as a reference for private lake owners to determine best means to grow bluegill economically

P-7 A Method for Extracting Moray (Muraenidae) Otoliths

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Scientists have used otoliths for over a century to aid their investigations into the biology and ecology of fish Historically, most work involving otoliths has focused on the age and growth of commercially and/or recreationally important species in order to better manage and maintain those populations More recently, new and improved technological resources have allowed scientists to uncover more detailed aspects of life history based on otolith analysis Certain analyses such as mercury, stable isotopes, and Sr:Ca ratios have expanded the utility of otoliths by allowing them to serve as proxy records of climate and habitat conditions As such, scientist are looking at an increasingly wide variety of fish species otoliths Generally accepted methods for removal of otoliths are readily accessible, as are methods and examples for specific species, especially gamefish However, there is a little to no information on how to remove otoliths from less common species Here we present a simple method for removing otoliths from moray eels

P-12 The Phenology of Larval Fish in Kentucky Lake during Early Summer

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A working knowledge of larval fish communities within aquatic ecosystems can be useful in understanding system dynamics as a whole The timing and ecology of larval fishes in reservoir systems is important for determining components for successful fish reproduction and potential species interactions The objectives of this study are to better understand larval fish phenology by conducting larval sampling in Kentucky Lake Kentucky Lake is the largest reservoir of the eastern United States, and understanding larval fish ecology in this system may be useful for determining recruitment patterns of specific fish taxa, especially during current rapid population growths of Asian Carp In addition, understanding larval fish phenology will help provide biologists and managers with information about the timing of sensitive life stages in large reservoirs We sampled larval fish in embayments and channel sites along the lower 30 km of Kentucky Lake from April through May of 2014 Using larval pushnets (net opening =1X5m, mesh size =1mm), samples were collected on transects ranging in length from 335m to 1341m Volume of water sampled was calculated based on average speed traveled over a known time and corrected by multiplying by an estimated net efficiency (70%) Larval fish collected were enumerated in the lab and larval densities were calculated as fish/m3 Fish were identified to the lowest taxonomic level, and identification is ongoing

Over 6 sampling events, we collected a total of 30 samples during which lake surface temperature ranged from 1662 (April 19) to 2221ºC (May 14) During our sampling period, larval fish densities ranged from 0 – 7145 fish/m3 Densities were compared across sampling days using a one-way ANOVA We found significant differences (p = 00001) in larval fish densities between sampling day Using pairwise comparisons (Tukey Kramer), we determined that larval densities from May 15 were significantly greater than the densities from all other sampling dates During the sampling period, water temperatures increased 559ºC, and larval fish densities increased by 7145 fish/m3 Understanding larval phenology is useful for determining the interactions of larval fish in reservoir systems, including the establishment and ecological dynamics associated with Asian Carp

P-35 Low Temperature Tolerance of Overwintering White Shrimp in South Carolina

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White shrimp are an important local fishery in South Carolina, as well as a critical link in local estuarine food webs Subadult white shrimp not large enough to migrate offshore overwinter in estuarine waters These overwintering white shrimp are known to be vulnerable to cold kills in severe winters when water temperature decreases rapidly This has both direct impacts on the opening and duration of the spring shrimp fishery and ecological implications While previous studies have contributed to a better understanding of how severe winters and low water temperatures impact white shrimp populations, there have been no studies that have empirically determined the low temperature limits of white shrimp It is hypothesized that shrimp experience loss of equilibrium at water temperatures below 85○ C and mortality at temperatures below 6○C Low temperature limits of white shrimp at a size found overwintering (80-110mm) collected in Charleston Harbor will be determined using four experimental methods: the critical thermal method (CTM), the chronic lethal method (CLM), the acclimated chronic exposure (ACE) method with static temperatures, and the ACE method with fluctuating temperatures These methods were chosen because they use rates of temperature decline and duration of exposure to cold water temperatures that mimic conditions experienced by overwintering white shrimp in Charleston Harbor during severe winters, and allow the determination of the temperatures that lead to loss of equilibrium and mortality in white shrimp Shrimp will be collected December 2014 and experimental trials will begin late December in temperature-controlled environmental chambers at the Marine Resources Research Institute (MMRI) The anticipated results of this research will be an empirical determination of low temperature tolerance of overwintering white shrimp, which will quantify both direct and indirect effects of cold water temperatures on white shrimp mortality in South Carolina In years with severe winters, the South Carolina Department of Natural Resources (SCDNR) may delay opening the spring fishery, or close it altogether, in state waters in an effort to protect the remaining spring spawning stock; however, they must petition the South Atlantic Fishery Management Council (SAFMC) to close the fishery in adjacent Federal waters to protect the surviving shrimp that will become the broodstock for the year's production A thorough understanding of the cold tolerance of white shrimp could give fishery managers a predictive tool so that winter mortalities could be better anticipated and more preventative measures taken to delay opening or close the fishery early

P-26 The Effects of Food Web Complexity on Mercury Bioaccumulation in Upper Trophic Level Fish

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Mercury (Hg) is one of the most widespread contaminants in the United States In contrast to virtually all other metals, Hg, particularly the organic form methylmercury (MeHg), biomagnifies as it

is transferred through aquatic food chains to higher trophic levels This biomagnification results in Hg concentrations which are much higher in fish than they are in the aquatic environment, leading to increased human and ecological risks Mercury is predominantly accumulated in fish through the food chain rather than aqueous exposure, so food web complexity and the lengths of food chains play important roles in controlling mercury bioaccumulation in fish East Fork Poplar Creek (EFPC) is a Hg-contaminated stream in east Tennessee where the water and fish Hg concentrations have been well studied for over 30 years Throughout this stream, fish tissue Hg concentrations, a benchmark of human and ecological risk, remain well above the National Recommended Water Quality Criterion of 03 mg/kg In order to mitigate Hg bioaccumulation in fish, we must first understand the biomagnification and trophic transfer at each step of the food chain Uptake at the base of the aquatic food chain (algae/periphyton, invertebrates) is the most important concentration step, with mercury concentrating over 10,000-fold between water and algae However, the transfer pathways from the base of the food chain to fish remain largely unknown In the present study, we examine the relationship between Hg concentrations in the most abundant upper trophic level fish (rock bass: *Ambloplites rupestris*) and food web complexity/pathway at different sites within EFPC We sampled water, invertebrates (the Asiatic clam *Corbicula fluminea*, Pleurocera and Elimia snails, *Cambarus* and *Orconectes* crayfish, Heptagenaiidae mayflies and Hydropsychidae caddisflies) and rock bass We utilized stable isotope ratios (δ13C and δ15N) to infer trophic levels and historical fish and benthic macroinvertebrate survey data to recognize community structures Mercury and MeHg concentrations in animals throughout the food chain were used to identify the critical linkages for Hg transfer to fish and to quantify the trophic transfer efficiency of Hg through the EFPC food chain We found that Hg concentrations in upper trophic level fish were more directly related to food web complexity than to aqueous Hg concentrations Our results indicate that strategies to mitigate Hg bioaccumulation in fish should account for food web transfer in addition to aqueous exposure

P-8 Genetic Identification of Longnose Gar Populations Using Microsatellites in Estuarine Versus Freshwater Environments

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Longnose gars have recently been caught within the tidal creeks of St Catherine's island This privately owned island is located off the coast of Georgia in the South Atlantic bight far away from any freshwater input streams and estuaries These species are primarily lake dwelling; living within the middle to upper water column of freshwater ecosystems The purpose of this study is to determine if the specimens collected along St Catharine's island are genetically related to the freshwater specimens collected from two reservoirs, Clarks Hill Lake and Goat Rock Lake Each fish was caught using a suspension gill net They were then brought back to the lab and deep tissue samples were taken for analysis Microsatellite primers have been designed to determine if each of the specimens are genetically the same fish or if genetic differences have appeared within each of the populations based on specific loci located within each gars genome

P-50 Populations of the Vernal Crayfish (*Procambarus viaeviridis*) in Alabama

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Alabama is home to more crayfish species than any other state and is considered a hotspot of crayfish biodiversity Of the more than 88 species of crayfish (Decapoda:Cambaridae) found in Alabama, 12 are considered priority 1 species (at risk for extinction/extirpation) A more thorough understanding of population statuses and life histories of these at risk species is necessary for proper management and maintenance of the crayfish biodiversity in Alabama The vernal crayfish (*Procambarus viaeviridis* Faxon 1914) is currently a priority 1 species in Alabama and inhabits lentic

and slow-moving lotic habitats, including vernal pools and roadside ditches Despite previous collecting attempts, only two historic records are currently documented for this species from the state of Alabama These include one record along the Tennessee River near Muscle Shoals, AL from 1978 and a second near the Black Warrior River in Tuscaloosa, AL from 1954 In this study, we sampled a variety of temporary aquatic habitats throughout the state of Alabama (eg vernal pools and temporary roadside ditches) to locate extant populations of this species First, we verify the previously documented population along the Tennessee River at Muscle Shoals, Alabama Second, we document 3 populations within a 07 mile radius along the west bank of the Black Warrior River near Fosters Alabama These results demonstrate the importance of historically under-sampled vernal pool habitats to the aquatic biodiversity of Alabama crayfish

P-13 Comparison of Abundance, Body Condition, and Growth of Juvenile Green Sunfish and Redbreast Sunfish in an Urban Tributary of the Chattahoochee River

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We aimed to compare the abundance, body condition, and growth of young-of-the-year and juvenile green sunfish, *Lepomis cyanellus*, and redbreast sunfish, *L auritus*, in the highly impaired Rottenwood Creek, an urban tributary of the Chattahoochee River From 17 February to 9 May 2014, sunfishes were sampled using minnow traps at six sampling stations along the creek These sampling stations were located from the headwaters to a downstream segment near Rottenwood Creek's confluence with the Chattahoochee River At each location, 10 to 11 minnow traps were distributed among four different pools to account for local variation in fish distributions Each station was sampled on three occasions, with minnow traps set to soak overnight for approximately 24 hours All fish caught in the minnow traps were identified, weighed (g) and measured (mm TL) Fifty individuals of each species were collected for age and growth analyses We sampled a total of 165 green sunfish (33 - 92 mm TL, 08 - 132 g) and 213 redbreast sunfish (29 - 87 mm TL, 03 - 102 g) Regressions between log10 (WT) and log10 (TL) were highly significant for both species Analysis of covariance indicated that the slopes of these regressions were significantly different, with the regressions converging at the upper end of the TL range Green sunfish were significantly heavier at a given length than redbreast sunfish, suggesting that green sunfish exhibited better condition A two-factor ANOVA revealed a significant effect of site, but not time, on the condition of green sunfish Condition of green sunfish increased from upstream to downstream sites For redbreast sunfish, a two-factor ANOVA revealed significant effects of site and time on body condition Condition of redbreast sunfish during the third round of sampling was significantly greater than the condition of fish during the first round Condition of redbreast sunfish was lowest at the two, highly degraded upstream sites A multi-factorial ANOVA also revealed a significant species*time interaction on fish abundance, with redbreast sunfish abundance decreasing and green sunfish abundance increasing over time This result likely reflected the increased activity of green sunfish with elevated water temperatures, and, consequently, a potential increase in competition for space between the species Age and growth analyses are ongoing; thus far, mean total lengths at ages 2 and 3 are similar between the species Overall, both species appear to be very resilient in the highly degraded habitat conditions of Rottenwood Creek

P-36 Influence of Salinity on Thermal Preferences and Growth of Mummichogs

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Mummichogs (*Fundulus heteroclitus*) are a common prey for estuarine piscivores along the east coast of the United States Any reduction in production of mummichogs due to changes in temperature and salinity associated with climate change may, therefore, have negative repercussions for estuarine food webs Using mummichogs from a population in the southern Chesapeake Bay, this study determined the thermal preferences of mummichogs at four salinities (2, 12, 22, and 32 ppt) Despite previous evidence that mummichogs prefer cooler temperatures in

freshwater than in saltwater, the final temperature preferendum of mummichogs in this study (264-269ºC) were similar across the salinities tested, suggesting that changes in salinity due to climate change will be unlikely to affect temperatures occupied by mummichog based on habitat selection alone Mummichog growth rates were then measured for 12 weeks at seven temperatures (range ±7ºC of the preferred temperature) at each salinity There was a significant interaction between temperature and salinity on mummichog growth At lower salinities, growth was greater at cooler temperatures, whereas at higher salinities, growth was greater at temperatures close to and just greater than the preferred temperature Overall, growth was greatest at 22 ppt from 266-306ºC These results suggest that mummichog growth will be most negatively impacted at sites that experience a reduction in salinity and increase in temperature due to climate change, although sites that experience an increase in salinity beyond 22 ppt along with an increase in temperature may also see reductions in mummichog growth

P-31 Evaluation of the Effect of Stocking Rates and Nursery Habitat on Early Survival of Gulf-Strain Striped Bass in the Apalachicola-Chattahoochee-Flint River System

Elise Irwin, US Geological Survey and Alexander Aspinwall*, Alabama Cooperative Fish and Wildlife Research Unit

Interstate management of Gulf-strain striped bass (*Morone saxatilis*) has involved a thirty year cooperative effort involving 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 (ACF) Apalachicola-Chattahoochee-Flint River system To better understand the consequences of management activities, population models are being constructed to inform management decisions We initially constructed two population models to examine 1) density dependent mortality of age 0 striped bass and 2) effects of presence of Hydrilla, (an aquatic weed),on abundance (catch-per-unit-effort; CPUE) in the ACF Logistic and log linear models were used to evaluate the number of fish stocked and their correlating fall CPUE each year Hydrilla was incorporated into both models to evaluate its impact on age-0 striped bass survival Results suggested that density dependence was not a limiting factor and carrying capacity for the stocked striped bass was not met; the population grew exponentially and was positively related to the number of fish stocked The impact of Hydrilla did not appear to influence the survival of Gulf-strain striped bass in the ACF; however abundance was lower in dense vegetation Low levels of natural reproduction occur in the system indicating that other factors may be influencing the population viability of the stock Our initial findings suggest that multiple management actions including habitat enhancement (Hydrilla control) or increased stocking, could be beneficial to obtaining population objectives identified by the management team

P-37 A Preliminary Investigation into Fish Community Dynamics of Three Barrier Islands in the South Atlantic Bight

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Current research suggests that estuaries are subject to anthropogenic degradation Many of the fish species that live in and use these estuaries are ecologically and economically important An essential consideration within these estuarine environments is being able to compare these fish populations to gain insight into the dynamics of these valuable ecosystems The purpose this study was to compare fish diversity among the three islands In addition, the dynamics of possible seasonal changes was investigated Size comparisons among the most ubiquitous fishes were also conducted Our study sites include three barrier islands with varying human impacts Both Hunting Island (SC) and Tybee Island (GA) are accessible by vehicle and open to the public St Catherine's Island (GA) is only accessible by boat and not open to the public Current sampling occurred on Hunting and Tybee

islands and historical through present day data was used for comparison from ongoing research at St Catherine's Island We sampled using two types of beach seines Our preliminary findings suggest some differences in species collected, seasonal ubiquity, and size difference s may indicate anthropogenic impacts may be a factor These differences may be indication of possible habitat degradation which could negatively affect these economically essential estuaries and the dependent fish populations These findings could help set better regional management practices and potentially influence better global management practices

P-51 Life History of the Obey Crayfish, *Cambarus obeyensis*, an Endemic Crayfish of the Cumberland Plateau

Thomas Boersig III*, Tennessee Technological University, Hayden Mattingly, Tennessee Technological University and John Johansen, Austin Peay State University

The Obey Crayfish (*Cambarus obeyensis*) is a narrowly endemic species of the Cumberland Plateau, found only within the Hurricane Creek watershed of the East Fork Obey River in Tennessee We conducted monthly sampling from March to October 2014 at two Hurricane Creek sites to characterize morphological and life-history traits that may be important in protection of the species *Cambarus obeyensis* was the most abundant crayfish species collected from both sites each month Mean carapace length (CL) of Form I males averaged 298 mm CL at the upstream site and 317 mm CL at the downstream site Reproductively active females (exhibiting active glair glands or carrying egg clutches) averaged 311 mm CL at the upstream site and 329 mm CL at the downstream site Form I males were collected every month at both sites, and reproductively active females were collected every month except July Females with egg clutches were encountered during March, April, and May Mean clutch size averaged 114 eggs, and clutch size was weakly correlated with carapace length We plan to continue monthly life-history sampling through June 2015 to obtain data for a full annual cycle

P-14 Evaluating the Effects of Drought and Anthropogenic Alterations on the Growth of Stream Fishes on the Edwards Plateau, Central Texas

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Both drought and landscape-level anthropogenic alterations, such as alterations of stream channel morphology and flow regime, have the potential to affect fish growth However, it is not clear how drought and anthropogenic alterations interact Our objectives were to evaluate the influence of this interaction between drought and anthropogenic factors influence on the growth rates of a suite of stream fishes within a pair of adjacent river systems in Texas The North Llano River (NLR) and South Llano River (SLR) both recently experienced a historic drought However, the flow regime of the NLR was heavily altered while the SLR was not because of stronger spring contributions to base flows We collected otoliths from eleven species common to both the NLR and the SLR and back calculated estimated lengths at age We will be presenting growth data analyzed using several different models that will 1) identify if there are differences or similarities between the NLR and SLR and their individual species, and 2) if an overall difference is present among individual species we will test for differences between several covariates (age class and species) that will be allowed to vary over all specimens We will present the preliminary results evaluating the effects of drought and altered flow regime on the growth of eleven species Results from this study will provide biologists with a better understanding of how drought coupled with anthropogenic alterations affects the overall growth rate of stream fishes and will help improve decisions made for the management and conservation of stream fishes found within similar river systems

P-15 Biotic Responses to Urbanization: Differences in Fish Assemblages Between Burwell Creek, an Urban Stream As Compared to Armuchee Creek, a Forested Stream in Floyd County Georgia USA

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Urbanization has led to biotic homogenization, or the replacement of endemic and diverse, regionally distinct faunas with a few common and ubiquitous, often nonnative and sometimes invasive species that are tolerant of human disturbance (McKinney and Lockwood, 1999)The purpose of our study was to determine if homogenization, which has been documented in the Etowah River system (Walters, et al, 2003) is also occurring in the Oostanaula River system We tested the hypothesis that urbanization alters streams and fish assemblages in the Oostanaula River system in North West Georgia

We compared relationships between fish assemblage and land use in two North West Georgia streams: Burwell Creek, which is urbanized, and Armuchee Creek, which is forested, between August and October 2014 We quantified and identified fish, measured habitat parameters including stream depth and width, velocity, temperature, dissolved oxygen and pH, at three positions: both banks and the center of the stream, every 20 meters along a 100 meter reach on each stream We noted riparian vegetation and bank stability

We caught a greater diversity and a higher number of fish at Armuchee Creek, as compared to Burwell Creek Forested streams can maintain a greater diversity of fish compared to urbanized streams Contributing factors are most likely the increased velocity, depth, width, pH and lower temperature of Armuchee Creek This could be due to the increased overhead cover and riparian buffer at Armuchee Creek compared to the steep banks and lack of vegetated riparian buffer at Burwell Creek Our results support our hypothesis that large scale human disturbance homogenizes regional faunas and agree with the results of a previous study on the Etowah River (Walters et al, 2003) Urbanization alters stream habitats making them more favorable to cosmopolitan species (Walters et al, 2003)

P-38 Production and Contribution of Cultured Spotted Seatrout (*Cynoscion nebulosus*) to Charleston Harbor, South Carolina

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Spotted seatrout, a recreationally important fish in SC, has recently suffered substantial population declines during the cold winters of 2000, 2009, and 2010 when water temperatures dropped substantially below long term averages In response to these winter kills, which appear to result in population bottlenecks, the South Carolina Department of Natural Resources (SCDNR) began a three year pilot scale stock enhancement study in 2011 to determine the feasibility of using hatchery-reared fish to supplement natural populations following substantial population declines in South Carolina Spotted seatrout production and stocking for the Charleston Harbor system (Charleston Harbor, Ashley River, and Wando River) began in 2012 with 520,291 fingerlings released and continued in 2013 with 236,072 fingerlings released Spotted seatrout in the Charleston Harbor system were monitored using trammel net sampling and fin clips were taken for genetic analysis from all individuals collected, with a subset sacrificed for otolith aging Spotted seatrout collected from June 2012 to December 2013 were assigned to a year class based on otolith ages or standard lengths using ordinal regression, and thirteen microsatellite markers were genotyped and used in parentage analysis to determine if each individual was of wild or cultured origin Seventeen cultured spotted seatrout were collected in a drop net at a small size soon after initial stocking in 2012,

showing evidence of fingerling survival beyond the initial stocking Additional cultured recaptures of the 2012 year class were collected in trammel net sampling in the second and fourth quarter of 2013, amounting to an annual 24% cultured contribution to the 2012 year class A 24% annual hatchery contribution during 2013 for the 2012 year class for the Charleston Harbor system is a sign of success for the spotted seatrout stock enhancement program given that only ~500,000 fingerlings were stocked throughout the Charleston Harbor system An established stock enhancement program for the species has the potential to be a powerful management tool If spotted seatrout population abundances show evidence of rapid declines in the near future, stocking cultured individuals could help sustain populations facing continual recreational fishing pressure in the midst of adverse environmental conditions

P-52 Replacement of the Sharp-Nosed Crayfish (*Procambarus acutissimus*) By the Non-Indigenous Red Swamp Crayfish (*P clarkii*) in a Disturbed Wetland

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Of the nearly 600 crayfish species worldwide, more than half are native to North America, and the southeastern US is the epicenter of global crayfish species richness There is concern about the current conservation status of many crayfish species and the viability of their populations *Procambarus acutissimus* is a surface dwelling crayfish that is native in Mississippi and Alabama and has isolated populations in west Georgia Its limited distribution in Georgia prompted this re-assessment of a previously surveyed population in a burrow pond-wetland complex near Columbus, Georgia To assess the population status of *P acutissimus*, we use baited Gee minnow traps to survey crayfish in the spring of 2014 following protocols similar to those used in a 1994 survey Trap catches shifted from 100% *P acutissimus* (1994) to less than 6% in 2014 *Procambarus clarkii* (a non-indigenous species) accounted for 94% of the 2014 catch *P acutissimus* was captured in a single woodland depression but not in any of the other 4 woodland depressions or 5 burrow pond sample locations Woodland depressions had significantly greater ammonium and phosphate concentrations than burrow ponds, however these differences do not explain the species replacement observed over the last 20 years Our results suggest that *P clarkii* is replacing *P acutissimus* in this wetland complex Given that *P clarkii* has been widely introduced across the world, there is reason to be concerned that it could influence the viability of other crayfishes, particularly those such as *P acutissimus* that share its wetland habitat preferences

P-39 Evolution of Sexual Dimorphism and Trophic Traits in *Fundulus diaphanus* and Its Descendant Lake Waccamaw Endemic, *Fundulus waccamensis*, and Significance in Speciation and Conservation

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The purpose of this project is to collect Banded Killifish, *Fundulus diaphanus* and its Carolina bay forms as well as the Waccamaw form*, Fundulus waccamensis*, for a Master's thesis to be completed at East Carolina University by Zach Harrison The Carolina bay forms will be compared to the riverine forms as well as to one another in test for body shape divergence in sexual dimorphism and test for convergence amongst populations The populations will also be tested for possible convergence in trophic traits, mainly gill structure but also dentary, pre-maxillary and maxillary structure The hypothesis being tested is that habitat type encourages convergent evolution of sexual dimorphism Results showing body shape divergence in sexual dimorphism between riverine and lacustrine forms that is statistically significant will promote one of two conclusions The first would be in the situation that the research shows convergence between the forms of each species from similar environments The opposite result would show show that body shape divergence in sexual dimorphism is not encouraged by the habitat in a similar direction A significant difference in aforementioned trophic traits would suggest that selection for convergence has not been confined to traits responding to

predation In addition, because the Waccamaw form is confined to Lake Waccamaw and all Carolina Bay populations have very limited distributions, insights into the evolutionary ecology of this species complex may be important for conservation and management purposes

P-53 Effects of Simulated Drought on the Burrowing Behavior of the Piedmont Blue Burrower Crayfish (*Cambarus [Depressicambarus] harti*)

Katherine Gilbert*, Columbus State University and Troy Keller, Columbus State University

The Southeastern US is the center of global species richness for crayfishes Within Georgia alone there are nearly 70 species of crayfishes, making it the state with the 3rd highest crayfish diversity It is also home to several endemic species, including the state-listed endangered Piedmont Blue Burrower crayfish (*Cambarus harti*) Because this primary-burrower depends on access to groundwater, severe droughts, expansion of impervious surfaces, and increased well water withdrawals threaten its viability To help preserve this endangered species, we designed a 6-week long experiment to test the hypothesis that *C harti* will burrow to maintain contact with declining water levels (ie, simulated drought) We compared the burrowing behavior of *C harti* in experimental chambers with constant (control group, n=2) and declining water levels (experimental group, n=2) Only one crayfish tracked the changes in water levels, digging 265 cm below the soil surface Three other crayfish (ie, 2 controls and 1 experimental animal) maintained burrows within 105 cm of the surface Our results indicate that crayfish can respond to changes in water level by excavating soils to maintain contact with declining groundwater levels, however greater replication is needed to more fully understand this species' behavioral response Factors influencing groundwater level, which are often overlooked, may need to be considered when developing conservation strategies to protect burrowing crayfishes

P-16 An Assessment of Blue Catfish Weight-Length Relationships in the Coosa River, Georgia

Dalton Robinson*, Shorter University, daltonrobinson@hawksshorteredu and Michael Crosby, Shorter University

An Assessment of Blue Catfish Weight-Length Relationships in the Coosa River, Georgia

Dalton A Robinson and Michael K Crosby

Abstract

To effectively manage catfish populations for recreational anglers, accurate base-level information must be obtained The Coosa River is a favored location among anglers seeking catfish for trophy or food resource Three sections of the Upper Coosa River in Georgia, between the headwaters in Rome and Weiss Lake in Alabama were sampled with trot lines from April 2014 to November 2014 Here, weight-length relationships for blue catfish (*Ictalurus furcatus*) are reported for each section sampled There is a significant difference between weight-length relationships at Site 1 near the headwaters in Rome, GA and Site 3 south of a power generation facility Additionally, the largest fish (length and weight) caught thus far were at Site 1 and the smallest weight at Site 3 Managers could use this information to concentrate efforts to develop locations with poor weight-length relationship into fisheries with the potential for trophy catfish

P-54 The Conservation Status of *Cambarus eeseeohensis*

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Thoma (2012) reported on the life history and conservation status of *Cambarus eeseeohensis* for the North Carolina Wildlife Resource Commission A total of 39 sites were sampled in the Linville River

basin (19 sites) and its surrounding streams (20 sites) *Cambarus eeseeohensis* was recorded at all but one of the 19 sites sampled in the Linville basin An additional population, discovered by Jesse Pope of Grandfather Mountain Stewardship Foundation, was documented at five sites in the upper reaches of the Watauga River *Cambarus eeseeohensis* was found to coexist with *Cambarus robustus cf, Cambarus acuminatus cf, Cambarus asperimanus,* and *Orconectes virilis cf* but not with *Cambarus bartonii cf* Food and habitat preferences, life span, and fecundity were investigated The species is best considered an insectivore It likely lives four to five years Some may live longer Though genetic material was collected, no analysis has been conducted

P-17 Rapid Recovery of a Fish Assemblage in Response to a 100-Yr Flood in an Urban Tributary of the Chattahoochee River

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Our primary goal was to monitor the response of a fish assemblage after the major floods of Fall 2009 In particular, we sought to determine if a fish community in an urban system would exhibit resiliency and/or resistance to a 100-year flood We selected Nickajack Creek, a tributary of the Chattahoochee River, as our study system (Georgia, USA) Nickajack Creek can be characterized as an urban system, with approximately 557% Medium-Density Residential, 114% Commercial, and 4% High-Density Residential land cover in its watershed (based on 2001 land cover data) In addition, the Georgia Environmental Protection Division (GA-EPD) currently lists Nickajack Creek as violating criteria for fecal coliform bacteria and having impacted fish community biota (Draft 2014 Integrated 305(b)/303(d) List) On 21-22 September 2009, the mean daily discharge peaked at 4,600 ft3/s and mean gauge height increased to 1819 ft After the flood receded and flow conditions were deemed safe for sampling, we sampled Nickajack Creek on four occasions (ie, 10/1, 10/8, 10/16, and 10/22) We randomly selected one of each mesohabitat (riffle, run and pool) for sampling, and each mesohabitat was revisited on subsequent trips Each mesohabitat was sampled by backpack electrofishing for five minutes At the riffle and run, a minnow seine was stretched at the downstream end to collect any shocked fish that drifted downstream Fish were identified to the species level, measured (mm TL) and then released at their capture locations On 1 October 2009, we documented 12 different fishes from seven different families (N=98), with the most dominant species being the Redbreast Sunfish (N=42), Alabama Hogsucker (N=20), Bluefin Stoneroller (N=11), and Bluegill Sunfish (N=9) On 8 October 2009, seven different fishes representing six different families were documented (N=48), with the most dominant species being the Redbreast Sunfish (N=12), Alabama Hogsucker (N=11), Snail Bullhead Catfish (N=10), and Bluefin Stoneroller (N=6) On 16 October 2009, seven different fishes were documented representing six different families (N=42), with the most dominant fishes being Redbreast Sunfish (N=19), Alabama Hogsucker (N=8), Snail Bullhead Catfish (N=5), and the Blackbanded Darter (N=5) On 22 October 2009, we documented eight species from five different families (N=53), with the most dominant species being the Redbreast Sunfish (N=33), Alabama Hogsucker (N=9), and Bluegill Sunfish (N=4) Overall, we documented 14 species representing seven different families within a month after a 100-year flood, revealing a fish assemblage with the capacity for great resistance to a major environmental disturbance

P-40 Quantifying the Relationship of Juvenile Nekton to Salt Marsh and the Effects of Sea Level Rise

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Current models predict sea level rise to significantly reduce and fragment salt marsh over the next century on the Georgia (USA) coast Studies have demonstrated the importance of salt marsh habitat as essential to juvenile fishes and crustaceans, though broad scale quantitative models of these relationships have been lacking Knowing these relationships at a landscape level is paramount to

forecasting the long term stability of a system challenged by sea level rise Using a five-year fisheries independent dataset from the Georgia coast provided by the Georgia Department of Natural Resources, we developed negative binomial linear mixed models at three scales (500m, 1000m, and 5000m) for juvenile blue crab (Callinectes sapidus) Environmental variables were derived from land cover datasets based on the 2007 National Wetlands Inventory Our results quantify a positive relationship of juvenile crab abundance with marsh metrics, and specifically the importance of brackish marsh and the proportion of salt marsh-to-water to juvenile crabs, though these relationships strengthen or weaken with the scale of consideration Using model coefficients in conjunction with sea level rise forecast models of salt marsh loss (Sea Level Affecting Marsh Model; SLAMM 6) we anticipate an overall reduction and fragmentation of juvenile crab habitat under future sea level rise conditions Anticipated changes to essential salt march habitat are likely to have implications for future fishery success

P-41 An Evaluation of Culturing Carolina Diamondback Terrapins for Responsible Stock Enhancement

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Terrapins exclusively inhabit brackish tidal zones from Cape Cod, MA south to the Florida peninsula and west around the Gulf of Mexico to Texas Throughout the species' range, diamondback terrapin populations are in decline Vehicular mortality, habitat loss and degradation, and drowning in crab traps have been widely documented as the primary causes of adult terrapin mortality In addition to these negative anthropogenic impacts to diamondback terrapin populations, predation rates of terrapin nests by native (raccoons and mink) and non-native species (fire ants) can be extremely high, exceeding 92% in some isolated populations Combined these sources of mortality have the potential to limit the persistence and recruitment of the species for future generations While terrapin excluder devices may effectively reduce mortality of male terrapins in crab pots, mortality of mature females from vehicles and nest predation are more difficult to control In order to ensure recruitment of new year classes of terrapins, relying only on attempts to reduce mortality may not be sufficient; population enhancement may be necessary to sustain and recover diamondback terrapins in depleted regions In the Spring of 2014, we collected 62 gravid female diamondback terrapins with trammel nets and induced them with Oxytocin, a hormone used to accelerate the egg laying process We collected 444 eggs and incubated half to be males and half females Incubation time averaged 60 days for males and 47 days for females Overall hatching success was 71% resulting in 311 individuals, which consisted of 162 females and 149 males Hatchling size averaged 314 mm carapace length, 277 mm plastron length and 826 grams Of the 311 individuals, we selected 180 for a feeding study in which we provide individuals with one of three diets over a 5 month period and record individual growth over that time This study will continue through April 2015 In addition, we will be tracking the movements of a subset of individuals in the spring and summer 2015 to document behavior and survival after being held in captivity for the first year of their life

P-55 Crayfish in Education: Giving Alabama Students Context for Studying Biology

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The teaching of many life science concepts such as classification and ecological interactions can be enhanced through understanding the basic biology and ecology of model organisms Alabama crayfish biodiversity is the highest in the nation, making this state an ideal location for using crayfish as model organisms in the classroom Many students in Alabama are interested in learning about these organisms because they have significant cultural and economic ties to the state Also, due to their abundance in the environment, rural students are often familiar with these organisms This foundation of familiar information can enhance student learning of biological concepts In my classroom, these concepts are brought to life through basic field investigation centered on the

crayfish we find on school property For two years, beginning in January, my students and I sample for young of the year crayfish Each week the students use nets to capture crayfish and measure their lengths The students take these data and create spreadsheets where they can calculate growth rates Throughout the spring semester, I use these data as well as live and preserved specimens to create activities and initiate discussions in science club and in my Biology classes about the scientific method, ecology and classification of organisms After our sampling season concludes, my science club students teach a two hour lesson to first grade students at a nearby elementary school The lesson incorporates life histories of crayfish collected and the basic ecology of the aquatic ecosystems associated with the crayfish of Alabama These activities provide the basis for a better understanding of biological and ecological principles

P-18 Hypoxia in Shas: Formation, Duration, and Habitat for Age 0 Striped Bass and River Herring

Ryan MacKenzie*, East Carolina University, Shelby White, East Carolina University, Roger Rulifson, East Carolina University and Eban Bean, East Carolina University

This study will use field observations to monitor hypoxic conditions (<2 mg O2/L) developing during summer and fall, while conducting in situ experiments determining how Ago 0 striped bass (*Morone saxatilis*) and river herring (*Alosa* sp) respond to hypoxia These species were chosen based on recreational, commercial, and cultural importance; importance to the food web at Age 0; and use of Strategic Habitat Areas (SHAs) in Albemarle Sound as primary nursery habitat Previous Rulifson lab investigations identified potential of these species to use hypoxic areas as refuge from predators Our concern is to find whether these young *Morone saxatilis* and *Alosa* sp can reside in Ablemarle watersheds for extended periods under hypoxic conditions and display normal growth and eventual recruitment to the forming year classes or whether these hypoxic zones, including large areas of SHAs, excluded as nursery habitat because sub-lethal conditions overwhelm their ability to survive and grow Hypoxia can be identified by the trace manganese in ambient waters Manganese is released from the sediment during changes in water chemistry via reduction of insoluble Mn (III/IV) within sediments forming soluble Mn (II) If fish use hypoxic zones as refuge, Mn should appear on their otoliths Two sampling platforms will be placed in Albemarle Sound tributaries: Perquimans River (summertime hypoxia) and Pasquotank River (normoxic) Platforms will have two automated water samplers collecting samples for analyses from upper (~1m) and lower (~3m) portions of the water column at 12-hour intervals Water quality sondes will measure (every 15 minutes) dissolved oxygen, temperature, pH, oxidation reduction potential, conductivity, salinity, nitrate, ammonium, and turbidity, deployed within upper and lower water columns to determine the vertical structure, stability, and duration of hypoxia Cages containing either Age 0 striped bass or river herring will be suspended below the platform in upper and lower water columns Fish will be forced to reside under the ambient conditions, determining long-term hypoxia effects Vertically elongated (3m deep) control nets will also hang from the platform, allowing fish to select their position in the water column We hypothesize the control fish will choose non-hypoxic waters during hypoxic events Fish will be measured for growth changes related to the ambient conditions Otoliths will be extracted and examined for manganese We hypothesize that manganese will only occur in the bottom dwelling fish, exposed to extended hypoxic conditions Possible causes of hypoxia will be identified through water chemistry, isotopic analyses, and GIS mapping layers

P-19 Spatio-Temporal Distributions of the Zooplankton Community in a Puerto Rican Reservoir

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Zooplankton provide an essential forage base for the development and maintenance of a balanced recreational fishery As the second tier in the aquatic food web, their importance cannot be overlooked Little scrutiny has been given to zooplankton dynamics in tropical systems in general and particularly those in Puerto Rico This study attempts to assess the movements of the zooplankton

community within Carite reservoir, Puerto Rico Data collection began in June 2011 and was conducted for a period of one year Comparisons evaluated within the study include habitat preference, by comparing littoral and limnetic zones; diel movement, by sampling at 12-hour intervals; and seasonal trends within the system All zooplankton studied revealed their highest abundances in the fall, though the number of rotifers dwarfed copepods and cladocerans and consistently represented the largest abundances throughout the study Diel period showed no effect on rotifers, however they were found in greatest abundance in limnetic habitats Copepods, the next most abundant order, also showed a slight bias toward limnetic sites and were found in higher densities at dusk Cladocera represented the least captured group and like the others were found in highest abundance during dusk samples They showed no significant difference between habitat types

P-42 Monitoring Movement of Southern Flounder to Elucidate Residency Time and Migration Patterns in a North Carolina Estuary

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Monitoring movement of southern flounder to elucidate residency time and migration patterns in a North Carolina estuary

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Southern flounder movements were monitored during fall of 2012 and 2013 in the New River Estuary, NC using acoustic telemetry Fish were surgically implanted with VEMCO model V9 transmitters, which communicated with an array of 38 VEMCO model VR2W receivers moored throughout the system The purpose of the study was to monitor residency time within the estuary, assess broad-scale habitat use, observe seasonal migration patterns, and identify emigration corridors Eighty-one flounder were tagged across the two sampling seasons (2012 n = 41; 2013 n = 40) During the first year, about half (n = 21) of fish emigrated and most of those fish (76%) exited via the New River Inlet The remaining emigrants left the system through the intracoastal water way (ICWW) to the north of the inlet The vast majority (90%) of emigrating fish left during October and November, and fish that left the system were significantly (t-test: t = -303, df = 32, P = 0004) larger than those fish which overwintered in the estuary Similarly, about half (18 individuals) of the study fish in 2013 were observed to emigrate from the estuary During the second year, all fish emigrated during the months of October and November, with more fish (61%) exiting via the inlet compared to using the ICWW corridor Differences in body size between emigrants and resident fish were not as strong in 2013 (t-test: t = 131, df = 33, P = 019), but still contributed to an overall difference in body size between the two behaviors for the entire study period (t-test: t = 329, df = 61, P = 002) Our findings to date indicate a relatively punctuated estuarine emigration period for southern flounder and that emigration behavior is more likely for larger, putatively mature, individuals Ongoing work will identify specific emigration behaviors and use of specific estuarine habitats

P-56 Seasonal Dietary Changes of the New River Crayfish in Anthony Creek, WV

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New River Crayfish (*Cambarus chasmodactylus*) are restricted to the New River drainage of the Central Appalachians Seasonal dietary habits were investigated in Anthony Creek, West Virginia via

dissection of stomachs Crayfish were collected monthly from May through October 2011 Animals were weighed prior to dissection and following removal of their stomachs to determine stomach mass Total carapace length was measured and used to place animals in respective demographic groups Stomach content frequencies were obtained for the following broad categories: organic detritus, inorganic detritus, vegetal, and animal Food items were identified to the lowest taxonomic level applicable Additionally, the presence and weight of gastroliths was noted Analysis of proportional stomach content mass indicated that elevated foraging occurred across the population in May and October, with reduced foraging during mid-summer months Organic detritus was consumed during all sampled months, and was the only item consumed by juveniles Inorganic detritus was ingested sparingly, with the highest frequency of occurrence in August Vegetation was primarily consumed by non-reproductive females in the months of June and July Snails were the predominate animal ingested; benthic macroinvertebrates were rarely consumed Increased ingestion of exuviae was observed during two mass molting events occurring in the population in both June and October Furthermore, the presence of snails increased after known juvenile release, suggesting that the ingestion may possibly represent a source of supplement to the depletion of chitin during juvenile development When present, exuviae usually occurred alongside gastroliths Results indicate New River Crayfish are feeding generalists, and food items vary largely according to season, reproductive state, and molt stage

P-57 Development of a Captive Rearing Protocol for *Cambarus* Crayfish

Nicole Sadecky*, West Liberty University and Luke Sadecky, West Liberty University

Though crayfish are considered one of the most imperiled animal groups in North America, they have received little active conservation attention outside of regional inventories and isolated life history studies Captive rearing of endangered species is a potential avenue for recovery, especially for species occurring in regions where stream degradation is actively occurring if stream recovery is a possibility post disturbance To determine whether it is conceivable to rear *Cambarus* species from egg to adult, a pilot study was initiated with New River Crayfish (*Cambarus chasmodactylus*) as surrogates for endangered *Cambarus* species Ten ovigerous female *C chasmodactylus* were captured in Anthony Creek, West Virginia and relocated to 40 gallon rearing tanks, with two females placed in each tank Two treatment groups, natural habitat and artificial habitat, were tested to determine if natural conditions were needed for successful rearing of neonates Natural habitat tanks included small slab rocks as hides; artificial tanks included 30 cm terra cotta disks as hides All eggs hatched and successfully underwent development to stage four instars Differences were observed between artificial and natural habitat tanks with neonates in artificial tanks progressing slower than those within natural tanks Instars were then segregated into two additional treatments following stage four development to determine the influence of the female on the development of instars “With mother” instars were allowed to remain with their mothers, and “without mother” neonates were separated from their mothers Growth and survival between groups were similar, but the largest reared instars were associated with the “with mother” groups Previous life history studies involving *C chasmodactylus* allowed us to compare development of instars in the wild to their development in captivity

P-43 Population Genetic Structure of Southern Flounder Inferred from Multilocus DNA Profiles

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Assessment of stock structure is an important component of fisheries management, and incorporation of molecular genetic data is an effective approach for evaluating differentiation among putative populations We examined genetic variation in southern flounder (*Paralichthys lethostigma*) within and between the US South Atlantic and Gulf of Mexico basins in order to improve our

understanding of the scale of population structure and connectivity in this widely distributed species with a complex life history and the capacity for long range migration and larval dispersal We analyzed amplified fragment length polymorphisms (AFLPs), which are a high resolution molecular tool capable of rapidly generating a genetic fingerprint, composed of hundreds of reproducible DNA fragments which can be compared across individuals and populations We found clear evidence of genetic divergence between the two ocean basins using AFLP fingerprint data, but southern flounder population structure within the US South Atlantic, where we examined genetic differentiation at both broad (among states: North Carolina, South Carolina, Georgia, Florida) and finer (among regions within North Carolina) spatial scales, was less conspicuous In pairwise comparisons, we found significant subdivision between nearly all southern flounder populations within the US South Atlantic, suggesting that finer scale population structure may be present However, AFLP genetic cluster analysis also revealed evidence for a high degree of mixing within the Atlantic basin The patterns of variation observed in the cluster analysis were not aligned closely with geography, and included a genetic similarity among populations in South Carolina and the Gulf of Mexico When examining the partitioning of genetic variation among groups with analysis of molecular variance (AMOVA), we found no evidence that the North Carolina southern flounder populations, which are managed on the state level as a unit stock, are significantly differentiated from the remainder of the populations in the US South Atlantic Our findings indicate only weak population structure and the potential for basin-wide mixing among Atlantic southern flounder populations, suggesting that cooperation among US South Atlantic states will be essential for effective assessment of stock dynamics and future management plans

P-58 Life History of *Orconectes obscurus* (Allegheny Crayfish) in West Virginia

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Orconectes obscurus is a common species of crayfish in parts of West Virginia but populations in Maryland, New York, Ohio, and Virginia are imperiled due to invasive species For proper conservation of *O obscurus* the species' life history under normal circumstances must be known In order to establish this base line life history, populations in the northern panhandle of West Virginia were sampled monthly over a one year period For all collected crayfish sex was determined, male reproductive form was determined, morphological measures were taken, and female reproductive attributes were noted Collected data was compared to representative specimens from all watersheds *O obscurus* is native to in West Virginia After comparisons were made *O obscurus* was found to exhibit a monotypic life history across West Virginia West Virginia contains over 50% of *O obscurus'* range with West Virginia populations contiguous with Maryland, Ohio, and Virginia populations This means that life history data collected in West Virginia can be used to aid in conservation efforts throughout *O obscurus'* range

P-59 Epigean Crayfishes of the North, Middle, and South Forks of the Kentucky River: Life History and Ecology

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The Headwaters of the Kentucky River Basin's (HKRB) epigean crayfish fauna were surveyed during the summer of 2014 Goals of this project included determining the native fauna of the basin, as well as identification of basic life history parameters Sixty random sites were chosen for sampling through use of GIS Site coverage accounted for all stream orders conducive to crayfishes Physiochemical and biotic data were collected at each site, as well as crayfish vouchers for identification in the laboratory The native epigean crayfish fauna of the HKRB consists of six species: *Cambarus (cf) robustus A, Cambarus (cf) robustus B, Cambarus distans, Cambarus jezerinaci, Cambarus sphenoides,* and *Orconectes cristavarius Cambarus (cf) robustus B* was only found in the Middle Fork of the Kentucky

River while its ecological equivalent, *Cambarus (cf) robustus A*, possessed a broader distribution, and was found in the North and South fork of the Kentucky River Sites with high density of *O cristavarius* on average had lower density of *C robustus A* and *C robustus B Cambarus distans* was limited to the headwaters of the Middle Fork of the Kentucky River, where it occurred primarily in smaller streams Both *C jezerinaci* and *C sphenoides* were limited to the headwaters of the South Fork basin *Orconectes cristavarius* was the only species that occurred in all three watersheds, and was the most common species encountered in the study Crayfish populations reached their highest densities in the South Fork, where environmental degradation was limited Results of this study indicate that the forks of the Kentucky River harbor a rich crayfish assemblage, with several species relegated to small subbasins within the greater watershed

P-60 Ecology of *Cambarus carinirostris* (Rock Crayfish) in Northern West Virginia

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The primary goal of this study is to better understand the ecology of a common Appalachian secondary burrowing crayfish, *Cambarus carinirostris*, the Rock Crayfish, by achieving the first complete life history study of this species Understanding *C carinirostris* ecology will help aid in conservation and protection of closely related imperiled taxa by discovering unknown biological behaviors of secondary burrowing crayfish By collecting physiochemical and climatic data at a single site and recording one population's responses to changes in the environment, we can determine multiple behavioral strategies that correlate with those environmental changes In addition, we can determine important life history variables, such as growth rates, fecundity, and required age and size to reach sexual maturity So far, this study has consisted of catching, measuring, sexing, and determining how old each crayfish are, and noting their preferred habitat within a reach (a 20 meter stretch of stream) This process was repeated in various locations along the stream During the summer months, 384 crayfish were captured and Total Carapace Lengths (TCL) were measured We now know that the dominant carapace length during the summer months is roughly 11 millimeters There were 149 crayfish with this carapace length, 87 of which were female During the month of June, the habitat preference was equally distributed between the run and riffle However during July, 69% of the crayfish were found in the runs

P-61 Phylogenetic Analysis of *Cambarus robustus* (Big Water Crayfish) Complex in the North, Middle, and South Forks of the Kentucky River

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Cambarus robustus is a wide spread species complex with a global range extending from Tennessee to southern Ontario This species has been assessed as Least Concern (LC) by the IUCN due to this large geographic range Southern populations may ultimately constitute undescribed species and require heightened conservation efforts A protocol using modern phylogenetic analysis was developed to determine if *C (cf) robustus* in the headwater Kentucky River watersheds were undescribed taxa or nominate *C robustus Cambarus robustus* were collected from the north, middle, and south forks of the Kentucky River watershed DNA was collected from leg tissue and prepared using a Quiagen DNEasy Kits Genetic sequences were analyzed using Clustal with bootstrap analysis with 2000 iterations using program MEGAv6 *Cambarus (cf) robustus* display extreme phenotypic plasticity in this watershed, with distinct phenotypes allied to specific basins Morphological analysis has already proven consistent differences exist between basins Ultimately, Middle Fork *C (cf) robustus* claded separately from all other basins genetically, and are both morphologically and genetically divergent from the rest of the Kentucky River system Additional sequences are needed from the Middle Fork to officially declare it unique taxonomically Crayfish in the North and South Forks of the KY River appear to be the same morphologically, differ genetically, but maintain a highly

divergent paraphyletic clade with Upper and Lower Kentucky River *C (cf) robustus* populations Future work is planned to further attempt to resolve taxonomic issues with *C (cf) robustus* complex in eastern Kentucky

P-62 Geospatial Analysis of *Cambarus monongalensis* Across a Habitat Gradient

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Cambarus monongalensis (Blue Crayfish) are burrowing crayfish that are found throughout the mountains and hills of West Virginia and Pennsylvania This study was conducted in order to determine *C monongalensis* habitat preferences Transects were set up around a crayfish colony and data concerning burrow entrances and burrow numbers was collected Collected data was interpreted using geostatistical analysis techniques which created maps that reveal *C monongalensis* preferred habitat In addition to discerning habitat preference, the geostatistical analysis also reveals that *C monongalensis* behave differently depending on their microhabitat This can be inferred by differences which were identified in burrow entrances across multiple microhabitats It was determined that *C monongalensis* prefer to inhabit “seep” microhabitats These areas are typically found adjacent to waterways and have high water tables and moisture levels, yet experience no water flow Specimens inhabiting burrows outside of seep microhabitats employ specific burrow architecture in responses to deeper water tables Identified behavioral differences across microhabitats included creating open burrow entrances where water levels were highest and utilizing burrow plugs and chimneys where water tables are lowest This is believed to be a behavior adapted in order to inhibit and decrease evaporation rates where water is relatively scarce These revelations are important aspects of *C monongalensis* ecology that were previously unknown

Oral Presentations

Need for Empirical Estimates of Fishing Effort Dynamics in Recreational Fisheries

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Substantial evidence now shows that recruitment overfishing can occur via recreational fisheries However, the risk of overfishing is strongly influenced by recreational angler effort dynamics Fisheries where fishing effort remains high regardless of stock abundance create a high risk of overfishing, whereas systems where anglers respond to reductions in fish abundance by directing effort to other systems allows self regulation Surprisingly, there are very few evaluations of how anglers respond to changes in fishing quality and fish abundance Here, we outline critical research needs and identify experimental designs that could be used to improve our understanding of fishing effort dynamics in recreational fisheries Results of this study could be used to improve future management of recreational fisheries, and may substantially contribute to predicting where and when overfishing is likely to occur

Seasonal Weather Patterns Drive Brook Trout Population Dynamics: Implications for Climate Change

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Summer temperature and flow are known to affect brook trout populations negatively, but little is known about the relative importance of seasonal weather patterns on population vital rates and persistence We investigated effects of seasonal air temperature and precipitation (fall, winter and spring) on survival and recruitment of brook trout (*Salvelinus fontinalis*) in Shenandoah National

Park, Virginia, using a novel Bayesian stage-structured population model The data were a 15-year record of brook trout abundance from 72 sites distributed across a 100-km long mountain range Population vital rates responded differently to weather and site-specific conditions Specifically, young-of-year survival was most strongly affected by spring temperature, adult survival by elevation, and per-capita recruitment by winter precipitation Low fall precipitation and high winter precipitation, the latter of which is predicted to increase under climate change for the study region, had the strongest negative effects on trout populations Simulations show that trout abundance could be greatly reduced under constant high winter precipitation, consistent with the expected effects of gravel-scouring flows on eggs and newly hatched individuals However, high-elevation sites were less vulnerable to local extinction because they supported higher adult survival Furthermore, the majority of brook trout populations are projected to persist if high winter precipitation occur only intermittently (≤ 3 out of 5 years) due to density-dependent recruitment Strong recruitment years appear to drive population dynamics, but there was no positive spawner-recruit relationships Stage-specific effects of seasonal weather patterns may increase population persistence to changing climate by not affecting all population segments (vital rates) simultaneously Yet, our results also demonstrate that weather patterns during seemingly less consequential seasons (eg winter precipitation) can have major impacts on brook trout population dynamics

Maturation and Fecundity of the North Carolina Neuse and Tar-Pamlico River Striped Bass Population

Evan Knight*, East Carolina University and Roger Rulifson, East Carolina University

The largest stock of striped bass (*Morone saxatilis*) in North Carolina is the Albemarle/Roanoke stock; however, other populations inhabit North Carolina's coastal and riverine waters The Central Southern Management Area (CSMA) consists of the waters of the Tar/Pamlico River, Neuse River, Cape Fear River, and Pamlico Sound Striped bass populations have been sustained in the CSMA by stocking (Roanoke River broodstock) from the North Carolina Wildlife Resources Commission (NCWRC), but the goal from the fishery management plan is to establish self-sustaining spawning populations of striped bass in these coastal rivers The NCWRC instituted an endemic stocking program in 2011 using fish collected on the spawning grounds in the Tar/Pamlico and Neuse River for broodstock in hopes that endemic broodfish will produce offspring that are genetically suited for each individual river system A maturation and fecundity schedule is needed for stock assessment models and effective management of the CSMA striped bass population Striped bass were sampled (n=174) on and near the spawning grounds in the Neuse and Tar/Pamlico River by electroshocking during the pre-spawn, spawning, and post-spawn period (March-May 2013 and February-June 2014) Each fish was measured (fork length and total length, mm) and weighed (g) Otoliths were removed for ageing and otolith chemistry Sex was determined, and gonads were removed and weighed to determine the GSI and stage of reproduction Ovaries were preserved in cold formalin for histological examination Livers were weighed to determine the liver somatic index (LSI) and K factor, two indicators of fish condition or well-being A maturation and fecundity schedule was determined based on results from analyzing otoliths, gonads, and histological samples of individual fish

Cooling Water Intake Structure Regulations: Summary of the New 316(b) Regulations

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In August 2014 US EPA finalized regulations dealing with cooling water intake structures under §316(b) of the Clean Water Act These rules differ significantly from those last promulgated back in the 1970s We summarize key points of the regulation that are likely of interest to fisheries scientists In particular we discuss regulatory requirements and compliance strategies to these regulations

Integration of a Multi-Metric Index for Informing Instream Flow Criteria Decisions in Warm Water Streams

Katie Kennedy, Alabama Cooperative Fish and Wildlife Research Unit and Elise Irwin*, US Geological Survey, eirwin@usgsgov

The index of biotic integrity (IBI) is a multi-metric index used extensively in warmwater streams to characterize the effects of anthropogenic impacts on the biological condition of water resources Justification for development and use of an IBI by natural resources agencies often include a stipulation that the index will help improve management decision making However, use of the index in decision making has been primarily restricted to independent decisions based on IBI site classification; it has not been widely used to make decisions concerning direct management actions To facilitate broader use, we provide a general framework to incorporate an IBI into aquatic resource management decision making using an example from Alabama's Valley and Ridge/Piedmont ichthyoregion This framework takes a structured decision making approach, equating established IBI metrics to resource objectives, and linking these objectives to management actions with hypotheses of system response We further demonstrate use of the framework for a specific decision context in the state of Alabama, where the IBI provides the basis for a statewide aquatic biomonitoring protocol Data collected through this protocol is intended to improve resource management decisions, including those for managing instream flows Using the outlined framework, we illustrate integration of the IBI into instream flow criteria decisions that may be applied to the development of Alabama's statewide water management plan Within the described structured decision making framework, the IBI provides a basis for informing the selection of management actions that directly meet defined agency resource objectives

Undergraduates and Fish: Working with Flagler College Student Volunteers to Measure Biodiversity in a Northeast Florida Estuary

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A monthly beach seine survey was established May 2013 in the Intracoastal Waterway in St Augustine, Florida Undergraduate students from Flagler College helped initiate this project as part of their Independent Study research course and the project continues with the help of student volunteers The first purpose of this project was to produce a documented record of fish species in the area and evaluate how the community changes from month to month The second purpose of this project was to provide undergraduate students with an opportunity to perform field work and acquire hands-on experience conducting research Beach seining was performed at 10 sites, which included sites within the Guana Tolomato Matanzas National Estuarine Research Reserve as well as sites near downtown St Augustine that are not within the reserve A fifty foot seine net with ¼ inch diameter mesh was pulled twice at each site and all fish, along with select crabs, were identified and measured (mm) Measurements of salinity, dissolved oxygen, and temperature were also recorded A total of 29,000 individuals and 79 species have been collected over 15 months Overall species richness and abundance decreased in the colder winter months, while distinct seasonal patterns of certain species, ie spot (*Leiostomus xanthurus*) and permit (*Trachinotus falcatus*) have been also observed, specifically relating to spawning These data represent the baseline results of a long-term monitoring project that will be able to document potential future changes in fish biodiversity in the region as well as providing a source of research questions for students

The Effects of a Newly-Established Marine Protected Area on Commercially Targeted Snapper-Grouper Species Off the Southeast Coast of the United States

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Large, economically important species such as those in the snapper-grouper complex are long-lived and slow growing which contributes to their vulnerability to fishing pressure Size and bag limits are sometimes ineffective due to the complex community composition on live bottom habitat where the

snapper-grouper species are found This is also true of temporal or spatial closures that are imposed for a single species Marine Protected Areas (MPAs) are the only management mechanism that protects the habitat and all the organisms in an ecosystem Nine type-II MPAs were established off the coast of the Southeast United States (SEUS) in 2009 These MPAs are closed to all bottom fishing, which protects entire deep water communities and prevents discard and by-catch mortality of deep water species This type of protection also compensates for data-poor stock assessments and little-understood ecosystem functionality

Using fishery independent data gathered by the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) at SC Department of Natural Resources from 1997-2013, we have investigated the abundance of commercially targeted snapper-grouper species before and after MPA establishment for the Northern South Carolina MPA (NSC MPA) Biomass of both targeted and non-targeted species was analyzed to reveal any trends in trophic level effects For spatial comparison, two areas near the NSC MPA with similar habitat and consistent sampling were also analyzed Together, these analyses give a preliminary evaluation of the effects of this relatively new MPA

Southeast Aquatic Resources Partnership As a Vehicle for Aquatic Conservation: A Decade of Success

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The Southeast Aquatic Resources Partnership (SARP) has been a leader in aquatic habitat conservation for more than 10 years SARP is comprised of 14 state agencies, multiple federal agencies, non-governmental organizations, and private industries, each sharing an interest in conservation of fish habitat The conservation landscape has become more complex over the past decade There has been an increase in the number of organizations competing for increasingly limited dollars Consequently, the need to build partnerships and share resources has increased To that end, SARP has initiated the Native Black Bass Initiative, an effort designed to study and conserve native black basses SARP has capitalized on the formation of the Landscape Conservation Cooperatives, and helped to ensure that aquatic resource needs are represented in landscape-level conservation planning Over the past decade, SARP has been a proven leader and regional catalyst for aquatic habitat protection and enhancement, including management of many local restoration projects representing millions of dollars in leveraged partner investments Along the way, SARP has continued to build effective working partnerships with national, regional, state, and local organizations, businesses, and agencies to increase local implementation of projects, and its outreach and communication efforts are building new constituencies for aquatic habitat protection and enhancing a long term stewardship ethic in the region During this session, we will share recent conservation initiatives, newly created datasets intended to aid in our collective conservation efforts, habitat restoration success stories, and opportunities to work with SARP

Protection of Downstream Migrating Adult American Eel at Hydropower Projects

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American eel is among the many diadromous species that must contend with hydropower projects during migration between freshwater and marine habitats Provision of upstream passage for juveniles is relatively straightforward and effective for this species; however, downstream passage of pre-reproductive adults presents a significant challenge, especially at large facilities on rivers with heavy debris loads The Electric Power Research Institute (EPRI) organized and leads the Eel Passage Research Center (EPRC), a bi-national, long-term, collaboratively-funded research program to address this challenge The research focus is on identifying and developing behavioral stimulus technologies to guide downstream migrating adult eels to collection points for capture and transfer around operating hydropower projects Research is guided by a 15-member technical committee

comprising eel experts from hydropower companies and federal (US and Canadian), state, and provincial resource management agencies The Center was formed in 2013, with initial funding through 2017 This presentation describes the scope and structure of the EPRC, our collaborative process for research funding and management, and our activities to date

Associations Between Fish Assemblages and Agricultural Land Use in the Nolichucky River Watershed,Tennessee

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The Nolichucky River watershed in east Tennessee is one of the most critically important “hot spots” for North American biodiversity in the US However, agricultural land use has intensified since 2006 with vegetable “truck crops”, primarily tomatoes, flourishing in the region Pesticide treatments during the warm growing season have caused runoff-related fish kills The goal of our study is to explore relationships between agricultural landscapes and the structure of fish assemblage and biotic integrity in the watershed During July-October 2014, we surveyed 10 sites (4 tributaries, 6 main stem) using Tennessee Valley Authority (TVA) sampling protocols, specifically backpack electrofishing at riffle-run habitats and seine hauls in pools Fish sampling and water quality assessments were conducted at sites we considered to be least impacted (n=4), moderately impacted (n=2), and most impacted (n=4) by agricultural fields Thus far, 43 species (5,279) have been documented from 199 riffle-run habitats, while 39 species (1,206 individuals) were sampled from 106 pools Cluster analysis and Sum F tests revealed that fish assemblages were statistically different based on our site impairment classifications Results of indicator species analysis (ISA) suggested that, for riffle-run habitats, *Nothonotus acuticeps, Nothonotus camurum, Etheostoma blennioides* and *Etheostoma simoterum* were strong indicators (Indicator values > 25; P < 001) of the least impacted condition from the warmer, main stem sites *Cottus bairdi* and *Notropis rubricroceus* were strong indicators of the least impacted condition in cooler, higher-elevation tributary sites For moderately impacted sites, *Nocomis micropogon* and *Notropis volucellus* were adequate indicators species Meanwhile, species indicative of heavily impacted sites were *Nothonotus rufilineatus* and *Cottus carolinae* For pool habitats, least impacted indicator species included only *Notropis telescopus,* while *Moxostoma breviceps* was an indicator of moderately impacted sites *Luxilus coccogenis* was indicative of most impacted sites We continue to assess impacts of agricultural landscapes on health and condition of aquatic biota, including benthic macroinvertebrate assemblages and fish physiology (eg, intersex condition, parasite load, sensory system development)

The Relationship Between Habitat Metrics, Land Use, and Index of Biotic Integrity for Georgia Streams

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The influence of physical habitat and land use on biotic condition of fish assemblages was investigated for stream reaches throughout Georgia Biotic condition (IBI) and physical habitat assessment scores were obtained from data collected by the Georgia DNR Stream Survey Team Upstream land use for each stream reach was characterized as forest, agricultural or developed Streams were sorted by basin and by physiographic region Scores for individual habitat metrics were evaluated to determine which contributed most to overall physical habitat assessment scores In riffle-run streams epifaunal cover was the metric contributing most to overall habitat assessment scores In glide-pool streams bottom substrate and available cover contributed most to overall physical habitat assessment scores In riffle-run streams epifaunal substrate and instream cover contributed most to overall physical habitat assessment scores Linear mixed effects models were constructed to predict IBI scores from all habitat metrics Backward stepwise elimination was used to

identify the most important habitat metrics for each model In glide-pool streams three metrics were kept (bottom substrate and available cover, bank stability and riparian vegetation zone) In riffle-run streams five metrics were kept (epifaunal substrate and instream cover, velocity and depth combinations, frequency of riffles, channel alteration and bank stability) Habitat metrics were negatively correlated with urban and agricultural land use, and positively correlated with forested land use

Functional Connectivity of Fishes in a Modified Hydroscape

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A major goal of Florida Everglades restoration is to recreate more natural hydrological patterns, including reconnecting regions where flow is currently blocked by canals and levees Increased connectivity can have both desirable and unwanted consequences, and yet the processes underlying connectivity are not well known In particular, the manner in which behavioral responses to landscape structure, such as habitat edges, area, and configuration, shape connectivity is mostly known from terrestrial systems Telemetry studies of three species are used to illustrate how habitat borders, spatial gradients, and habitat configuration within the submerged, physical environment affects the movement of native and nonnative fishes in the Florida Everglades In the first study, we quantified the influence of position in the landscape on seasonal movement of Florida Gar Florida Gar moved further and in more directed fashion when ecosystem size was contracting during seasonal drought versus expanding during the wet season Dry-season movement by Florida Gar was shaped by the distance and direction they needed to move to reach creeks, sloughs, and canals used as drought refuge In the second study, fish movement between marshes and canals was compared between native Florida Largemouth Bass and nonnative Mayan Cichlids Scale, timing, and direction of functional connectivity between marshes and canals was influenced by landscape structure bordering each canal Permeability of habitat borders to fish movement and the scale of landscape structure affecting movement distance and direction were both greater for the invasive Mayan Cichlid than Florida Largemouth Bass Empirical relationships between submerged landscape structure, the hydroscape, and fish movement strengthen our ability to predict ecosystem responses to climatic and human changes to hydrology

Field Validation of a Bioenergetics Model for Coastal Striped Bass in the Southeastern United States

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Striped bass (*Morone saxatilis*) is a long-lived species native to the east coast of North America and northeastern Gulf of Mexico with commercial, recreational, and ecological importance In contrast to northeastern striped bass, southern populations are typically non-migratory and reside in coastal rivers and adjacent estuaries year-round These habitats have been extensively modified in recent decades, and declines in striped bass abundance have been observed in many southern coastal systems Consequently, stocking is used to support some southern coastal striped bass populations An understanding of habitat suitability is essential for the success of a stocking program A bioenergetics model can be used to evaluate habitat suitability by interpreting growth rate potential under specified environmental conditions as an indicator of relative habitat quality Although a bioenergetics model has been developed for northeastern striped bass, due to regional life history differences it is unknown whether the model accurately predicts environmentally-based growth in southeastern populations Therefore, we validated a bioenergetics model developed for Chesapeake Bay striped bass using weight data from four year-classes of striped bass captured in South Carolina's Ashley River Striped bass have been stocked annually into the Ashley River by the South Carolina Department of Natural Resources since 2006, and are monitored by monthly electrofish sampling Environmental data have been collected in the Ashley River using sondes since 2009

Cumulative model-predicted growth from 2009-2014 was compared to field weights In general, there was a satisfactory fit between model predictions and field measurements, although the model consistently overestimated growth in late fall and early winter Our cool season overestimation could be due to physiological differences between Chesapeake Bay and Ashley River striped bass populations, or to seasonal fluctuations in prey abundance The possibility of improving model fit by incorporating prey abundance is being explored In addition to guiding striped bass stocking efforts, potential applications of the model include predicting impacts of dam removal and climate change scenarios on population sustainability

Potential Morphological Response of Guadalupe Bass Populations to Hydrologic Alteration and Urbanization within the Colorado River Basin, Texas

Jessica Pease*, Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University, Timothy B Grabowski, US Geological Survey, Allison Pease, Texas Tech University and Preston Bean, Texas Parks and Wildlife Department

The Colorado River Basin in Texas has experienced major alterations to the hydrologic regime due to changing land and water use patterns These anthropogenic influences on hydrologic variability have had major implications for riparian and aquatic ecosystems and the species dependent upon them, such as Guadalupe Bass *Micropterus treculii* Our objective was to evaluate the relationship between the degree of hydrologic and landscape alteration changes in Guadalupe Bass morphology in portions of the Colorado River Basin that were previously or are currently inhabited by Guadalupe Bass Hydrologic data were obtained from the US Geological Survey stream gauge stations and US Geological Survey National Hydrography Dataset The Indicators of Hydrologic Alteration (IHA) method was then used to calculate flow metrics for select streams for two periods, pre-1979 and post-1979 US Geological Survey North American Landscape Characterization data and Texas Parks and Wildlife ecoregion data were used to characterize land use and land cover changes within the watersheds of the selected streams Relationships between hydrologic alteration and landscape changes were compared to landmark-based morphometrics for Guadalupe Bass in the late 1970's and present Discriminant function analysis results show that present-day individuals have deeper bodies and shorter head lengths than those individuals collected 35 years ago from the same locations These locations vary in the degree of alteration to flow regime and anthropogenic disturbance across the landscape that they have experienced since the late 1970's We will present the effects of landscape and flow regime alterations on the morphology of Guadalupe Bass within Colorado River Basin below Austin, Texas Comparison of the present flow regime and ecomorphological traits to historical collections and hydrologic data will facilitate the assessment of future hydrologic alterations due to increases in urbanization and water withdrawals on Guadalupe Bass populations

Southeast Connectivity Assessment Project (SEACAP)

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Fragmentation of river habitats by dams is one of the primary threats to aquatic species in the United States Barriers limit the ability of sea-run fish species to reach preferred freshwater spawning habitats and prevent resident fish populations from moving among habitats critical to their life requirements

To help address this problem, The Nature Conservancy (TNC) and the Southeast Aquatic Resources Partnership (SARP) have completed an assessment of dams in the Southeast US The project with funding from the South Atlantic Landscape Conservation Cooperative (SALCC) helps support

planners and managers in their efforts to target fish passage and other aquatic connectivity projects where they have the most benefit

The Southeast Aquatic Connectivity Project (SEACAP) will identify opportunities to improve aquatic connectivity by prioritizing dams based on their potential ecological benefits if removed or bypassed within watersheds that intersect the SALCC area The project area is approximately 250,000 square miles with over 350,000 miles of mapped streams Approximately 14,000 dams were snapped to streams in the GIS Dams are evaluated on a suite of metrics in a Geographic Information System including the number of river miles that opened, number of downstream dams, presence of diadromous or resident fish species and metrics which assess watershed and stream ecological conditions Biological richness and species presence were developed from the Multistate Aquatic Resource Information System (MARIS), Biodiversity Information Serving Our Nation (BISON) and Nature Serve Metrics are combined to produce a relative prioritization and displayed in an interactive web map with a custom analysis tool for running user-defined scenarios

Swimming Performance of Coastal and Inland Largemouth Bass at Varying Salinities

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Swimming performance of coastal and inland Largemouth Bass at varying salinities

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Coastal estuaries are exposed to seasonal and annual fluctuations in salinity and the freshwater fishes that live there must adapt, emigrate, or endure these variations Previously we have found that largemouth bass *Micropterus salmoides* living in coastal estuaries do not move to avoid seasonal increases in salinity, but instead, they remain in these areas and, exhibit different growth rates, condition factors, and diet composition when compared to inland populations In addition, they exhibit life history strategies that differ from those of inland populations These differences suggest adaptations to the estuarine environment that may also include different physiological mechanisms for tolerating/thriving in brackish waters In this study we compare swimming performance of largemouth bass from the Mobile-Tensaw Delta estuary (Bay Minette, Mobile, AL) and inland bass (Yates Reservoir, Tallassee Alabama) at 0,4,8 and 12 ppt salinities at 25°C to test for physiological adaptation to tolerate elevated salinities We measured the Critical Swimming Speed (CSS) of largemouth bass (279-432 mm) to determine swimming performance in a custom built swim tank After measuring their CSS we also recorded length, weight, and HSI (heptosomatic index) CSS did not differ between source populations at either 0 or 4 ppt salinity, but at 8 ppt CSS was higher for fish from Bay Minette versus from Yates Reservoir (although the difference was not statistically significant further replication at 8 ppt is ongoing to increase the power of the test) Yates Reservoir fish tested at 8 ppt had CSS values that were significantly lower than those for fish from either Yates or Bay Minette when tested at 0 ppt Largemouth bass from Bay Minette had significantly higher HSI values than bass from Yates Reservoir further supporting the idea that these two populations exhibit physiological differences Swim performance tests at 12 ppt are not yet complete, although previous work has suggested that largemouth bass from inland populations may be unable to tolerate salinity of this level; we will acclimate them carefully in an effort to make this comparison In addition to previous documented life history differences between coastal and inland Largemouth Bass, our results suggest that their performance abilities at higher salinity may differ as well, likely as a result of their adaptation to this coastal ecosystem

Estimation of the Number Artificial Reefs in the Northern Gulf of Mexico with Side Scan Sonar

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An EdgeTech 4125 400/900 kHz dual frequency side-scan sonar was towed off the Alabama coast both within and outside the Alabama artificial reef zones The low (400 kHz) frequency range covered 150 m per side and the high (900 kHz) frequency covered 75 m per side Sonar transect tows were made from 9 Apr 2012 to 4 Sep 2014 (n = 17 d) We completed a total of 37 transects, both within (n=31) and outside (n=6) the artificial reef zones The total distance covered = 731 km, and area = 2157 km2 with low frequency scans Side-scan data were analyzed using Sonar Wiz 5 software The positions of sonar images were marked, measured and assigned a rank based on the quality of the image A rank of 5 was the highest and showed a clear reef image along with resident fish A rank of 1 indicated a poor image where it was difficult to confirm a reef structure The estimated total number of reefs were based on sonar images that identified reef structures with ranks ≥ 3 and areas ≥ 3 m2 A total of 691 sonar images were identified as reef structures within the side-scan area covered, with 246 assigned rank ≥ 3 and an area ≥ 3 m2 To validate sonar images SCUBA divers visually confirmed the identification of 75 reefs, which included artificial reef structures such as bridge rubble, steel cages, concrete pyramids, concrete culverts, scrap metal, tires, and natural rock reef habitat Preliminary estimates indicate a total of 2,737 unpublished reef structures on the Alabama shelf out to 40 m depths Further SCUBA diver identification of sonar images that were ranked 1 and 2 is in progress, ie, were structures present and capable of supporting adult reef fish The reef densities obtained from this study will be used to estimate the total number of artificial reefs present off portions of Alabama's coast, and will be combined with reef fish abundance estimates from fishery independent and hydroacoustic surveys to provide an estimate of total reef fish abundance and biomass off Alabama's coast

Inputs and Fate of Large Woody Debris in Headwater Streams of the Central Appalachians

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Large wood debris (LW) are important components of headwater stream channels with various functions ranging from biotic habitat to structural stabilization Therefore, changes of in-channel LW quantity may offer benefits and/or detriments to both stream habitat and fluvial morphology We studied the effects of a large hurricane with respect to LWD addition in 25 headwater streams of West Virginia, USA We first quantified the inputs of LW and found varying levels (0-195% change from previous annual data; 0-820 LW pieces km-1) of new wood additions When compared to years prior to Sandy, the rate of LW deposition was significant across all size classes and streams ($p < 00001$) We also found a significantly ($p < 001$) negative pattern of LW impact based upon elevation, with higher elevations receiving lower levels of LW deposition We also tracked the movement of LW in 14 of the 25 streams in the years following the initial input period We used individual numbered tags on 484 pieces of LW (pieces ≥ 10m x 005m) to determine the movement and positioning of both old and newly added LW pieces We then compared LW movement across drainage area, underlying geologic conditions, and other stream variables We found a significantly positive linear relationship between movement of LW and stream drainage area ($p < 001$, $r^2 = 040$) We also investigated differences in LW movement rates between channel units, relative age of pieces, and orientation of pieces within the stream channel Qualitative information about the fate of LW was also collected in order to assess the retention of newly added LWD within a stream reach and the recruitment of LWD into functional roles within the channel This study provides a detailed assessment of the amount and function of LW addition following disturbance in headwater streams and can provide empirical evidence to support both biological and morphological roles of LW in these systems at a brief temporal scale

European Eel Passage Survival and Injury through Three Propeller Type Turbines in France

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European Eel Passage Survival and Injury Through Three Propeller Type Turbines in France

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Abstract

Survival (direct effects) and injury rates of European eel, *Anguilla anguilla* (600-1,040 mm) in passage through three propeller type turbines (two located on the Rhine River and one on the lower Rhone River in France) were estimated via controlled releases of HI-Z tagged specimens at multiple entrainment depths within each turbine Survival rates differed between turbine types The number of runner blades, eel length, and entrainment location individually or in combination affected survival and injury rates The direct 48h survival was substantially higher for the 4 bladed Kaplan units at Fessenheim (924%) and Beaucaire (923%) than the five bladed Kaplan unit at Ottmarsheim (786%) The Kaplan unit at Beaucaire is a horizontal bulb turbine; the other units are vertically oriented Generally, eels released near the tip of the turbine blades incurred diminished survival rates and higher injury rates as compared to other release points High recapture rates enabled injury rates, types and mechanisms to be determined with greater certainty Most observed injuries were mechanically induced, with the primary injuries observed being severed or nearly severed bodies, bruising and or scraped bodies Injury rates at the four bladed Beaucaire and Fessenheim stations were 65 and 115%, respectively The injury rate at Ottmarsheim was 265%

Spatial and Temporal Distribution of Fishes at the River – Reservoir Ecosystem Scale

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Maintaining a healthy diversity of aquatic organisms and quality sport fisheries in public reservoirs, rivers, and streams is a primary goal of Texas Parks and Wildlife Department (TPWD) Currently TPWD manages rivers and reservoirs independently As a result, management objectives and target species often differ among reservoirs and their upstream tributaries even though they are segments of a larger continuous, interconnected river-reservoir ecosystem To improve our understanding of the fish assemblage dynamics and seasonal connectivity across the river-reservoir ecosystem, we sampled three macro-habitats (river, reservoir, and river-reservoir interface [RRI]) in Lake Livingston and the Trinity River, Texas with multiple types of gears during four seasons from summer 2013 to spring 2014 Cluster analyses showed a gradient of similarity across the macrohabitats that clearly demonstrates a spatial connectivity of the fish assemblage The overall fish assemblage structure of the three macrohabitats was not completely unique, with a gradual overlap on the spatially adjacent macrohabitat type A total of 55 fish species were collected during the study, with 82% represented in the river, 65% represented in the reservoir, and 67% represented in the RRI Of the total 55 fish species, 28 species were commonly shared across the macrohabitat types Some of the commonly abundant species are white and yellow bass, smallmouth

buffalo, threadfin and gizzard shad, inland silverside, and channel catfish Seasonal shift in the assemblages across the macro-habitat scale was not observed in the general assemblage, although some of the above mentioned species did show significant seasonal differences in abundance Our results indicate a functional connectivity across a longitudinal scale and hence, may benefit from combined management across the entire river-reservoir ecosystem

The Use of Original Music Videos As Innovative Instructional Resources for Fisheries and Ecology

Gary Grossman*, University Georgia

I teach Natural History of Georgia, a large (100-200 student) lower division course that satisfies both environmental literacy and life science general education requirements at University of Georgia The class is deals with conceptual topics in natural resource management, ecology, evolution, habitats, identification and biology of species Examples include: speciation, natural selection, competition, the Coastal Plain and the black rat snake To provide an innovative instructional approach, I have developed several music videos on these topics which cover lecture materials in song format In 2012 and 2013, student responses to questionnaires indicate that the videos improved the class environment and study habits The link to the videos is http://wwwyoutubecom/user/AssortedPieces , although four songs are hidden for a study in progress In addition, student in the 2014 course are compiling their own karaoke music videos as a group project in class It is likely that innovative multimedia techniques that involve active learning will increase student interest and participation in natural resource and ecology/biology courses This research complied with all UGA IRB human subjects requirements

Minimum Length Limit Evaluation on Largemouth Bass in the Ocmulgee River, Georgia

Brandon Baker*, Wildlife Resources Division and Timothy Bonvechio, Wildlife Resources Division

Black bass *Micropterus* spp are a popular sportfish In Georgia, black bass are the preferred freshwater species with 45% of freshwater anglers targeting these species All of the rivers in Georgia are currently managed with a 305-mm minimum length limit (MLL) after the recent reduction in MLL on the Ocmulgee River We conducted a population assessment of largemouth bass (*Micropterus salmoides*) in the Ocmulgee River to analyze effects of various size limits Georgia resident license holders were surveyed to gain public perception and comments about various size regulations Using population metrics derived from the assessment, responses of the largemouth bass fishery to a 305-mm or 356-mm MLL were simulated using the Fishery Analysis and Modeling Simulator (FAMS) model Largemouth bass ages ranged from 0–12, with 98% of the largemouth bass ≤ age-6 Total annual mortality was 039, and conditional natural mortality averaged (SD) 022 (006), thus exploitation was estimated to be 017 Mean total length (TL) was described by the von Bertalanffy growth curves as TL = 610 (1-e-0189[age - 2214]) Implementation of a 305-mm MLL had potential to increase the number of fish harvested by 24%-64%, but decrease the average weight of harvested fish by 16%-29% Change in yield ranged from -8% to 25%, but the benefits began when exploitation was modeled <018 at the lowest natural mortality (020) Similarly, when natural mortality was modeled at 030 and 040, yield was always higher across all levels of exploitation The Ocmulgee River largemouth bass population was characterized as having moderate natural mortality and growth with an estimated low exploitation Minimal changes in yield will likely occur by reducing the MLL, but the benefits from increased harvest exceed the subtle changes in yield

Waivers and Exemptions of the Final Clean Water Act 316(b) Rule

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The final regulations implementing the Clean Water Act Section 316(b) recently promulgated by EPA are designed to reduce the impacts of large volume (greater than 2 million gallons per day) cooling water intakes on the fisheries of their source waters The regulations focus on reducing impingement, the trapping of adult or juvenile fish against intake screens, and entrainment, the intake of eggs and early life stages into the cooling water system But not all large volume cooling water intakes would lead to significant adverse impacts on the source water fisheries, particularly under certain conditions and features The final rule identifies cooling water system features such as cooling towers and traveling screens that when operated properly already minimizes impingement and entrainment to acceptable levels The final rule goes further and includes several provisions that allow industry to apply for a waiver from impingement and/or entrainment requirements These provisions include such waiver and exemption options as a waiver of impingement requirements for plants demonstrating a de minimis rate of impingement, waiver of impingement and entrainment requirements for plants whose cooling water intakes are located in manmade lakes or reservoirs that are stocked and managed by a State or Federal natural resource agency, and waiver of entrainment requirements for plant's demonstrating actual flow volumes of less than 125 million gallons per day This presentation will explore waiver and exemption provisions and provide examples of their application in the American Fisheries Society Southern Division territory

The Value of Long-Term Data Sets: Seasonal Flatfish Abundance Patterns in a Shallow Estuarine Creek in Georgia

Mary Carla Curran*, Savannah State University, curranc@savannahstateedu and Katherine Doyle, Savannah State University

Temperature and seasonal changes may play crucial roles in the selection of nursery habitats by flatfishes The purpose of the present study was to investigate the patterns in use of a shallow estuarine creek by flatfishes to determine the effect of season on species composition and abundance over multiple years Monthly samples were collected during ebb tide in Wylly Creek (31°59'52"N, 81°03'18"W) in Savannah, Georgia beginning in January 2004 Three replicate tows were conducted for 2 minutes each using a 1 m-wide beam trawl with a 3 mm mesh net Means were calculated as the number of individuals per sample date by season Six species were collected throughout the study: the Blackcheek Tonguefish *Symphurus plagiusa*, the Bay Whiff *Citharichthys spilopterus*, the Fringed Flounder *Etropus crossotus*, the Summer Flounder *Paralichthys dentatus*, the Southern Flounder *Paralichthys lethostigma*, and the Ocellated Flounder *Ancylopsetta quadrocellata* The flatfish species used the creek at different times of the year The most abundant species was *Symphurus plagiusa* (660 ± 077 individuals d-1), with peak abundance during summer (1196 ± 214 individuals d-1) *Citharichthys spilopterus* was most abundant during winter (1228 ± 454 individuals d-1) when mean size was shortest (181 ± 04 mm) and least abundant during fall (110 ± 051 individuals d-1) when mean size was longest (819 ± 53 mm) The major finding of this study was that recently settled *Citharichthys spilopterus* used Wylly Creek as a nursery in early winter while the other species utilized this creek in later juvenile stages

Quantified Population Assessment of Shortnose Sturgeon in the Savannah River, Georgia

Derek L Bahr*, University of Georgia and Douglas L Peterson, University of Georgia

Federally endangered shortnose sturgeon have historically experienced declines from overexploitation, habitat loss, and pollution throughout their range, from the Saint John River, Canada to the St Johns River, Florida Although the species was a charter member of the Endangered Species Act, quantified population assessments are still lacking for many river systems throughout the range Because river specific assessments are critical for evaluating species recovery, the primary objective of this study was to quantify abundance and annual recruitment of shortnose sturgeon in the Savannah River, Georgia During the summers of 2013 and 2014, we sampled juvenile and adult shortnose sturgeon throughout the lower Savannah estuary by using variable

mesh gill nets and trammel nets Mark-recapture data were then analyzed with Huggins closed-capture models in RMark to derive abundance estimates for both juveniles and adults The best fitting models estimated that the Savannah River contained 548 (95% CI, 224–1,427) juveniles in 2013 and 393 (95% CI, 242–663) in 2014 as well as 1,855 (95% CI, 780–4,670) adults in 2013 and 1,564 (95% CI, 1,005–2,513) in 2014 The results of this study suggest that the Savannah is likely the 2nd largest population of shortnose sturgeon in Georgia Future studies are needed in other South Atlantic River systems to better understand current recovery status of the species within the South Atlantic Bight

Using Spawning Design to Increase the Genetic Effective Population Size of Hatchery-Produced Spotted Seatrout (*Cynoscion nebulosus*) in South Carolina

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Spotted seatrout (*Cynoscion nebulosus*) are a popular recreational fish species in the southeastern United States In 2011, the South Carolina Department of Natural Resources (SCDNR) began a three year pilot scale stock enhancement study to determine the feasibility of using hatchery-reared fish to augment natural populations following significant winter kill events in South Carolina When beginning a stock enhancement program, it is important to understand and evaluate the potential negative impacts of stocking on the genetic diversity of the wild population It is incumbent upon hatchery managers to develop spawning designs which seek to maximize the genetic diversity of the release population Of critical importance to maximizing genetic diversity in hatchery-produced fish is maximizing individual broodstock contribution to spawning events Broodstock spawning trials conducted in South Carolina between 2012-2014 were intended to identify hatchery protocols that would increase individual broodstock participation and thus improve the genetic effective population size (Ne) of hatchery-produced spotted seatrout In 2012, the spawning hormone hCG was administered to 3-4 females with oocyte diameters greater than 400 µm in each of 3 spawning systems in order to initiate spawning In 2013, all spawning events were volitional and no spawning aids were utilized, while in 2014, hCG was administered to all broodstock in the spawning systems, both males and females, regardless of oocyte diameter Genetic parentage analysis conducted on approximately 50 seatrout larvae following both volitional and hormone induced spawning events revealed broadly distributed male contribution, however, early season spawns were typically less diverse and dominated by a single male Female participation in spawning events was limited to 1 or 2 females per spawn in both 2012 and 2013, but increased to as many as 4 females per spawn in 2014 These results indicate that hatchery managers seeking to increase the genetic diversity of hatchery produced spotted seatrout should avoid using the first spawns of the year in order to maximize male contribution and should also use spawning aids on all females in a spawning system in order to improve female participation

What Fishing Tournaments Can Teach Us about Measuring Impingement Mortality

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Abstract The new 316(b) regulations published by EPA in the Federal Register August 15, 2014 require industries that use >2MDG of cooling water to reduce impingement mortality of fish associated with their water intake While collecting fish impinged on traveling screens is a relatively simple task, assessing delayed mortality of these fish requires additional handling and retention in a suitable confined environment This handling and retention adds stress to that incurred by impingement and, as a result of the cumulative effect of sublethal stressors, may result in elevated estimates of mortality compared to impinged fish immediately released to natural conditions There

is no true control for the effects of additional handling and confinement because control fish, usually collected from the wild, are subjected to the stress of capture and further handling This additional stress may or may not be sufficient to result in mortality of “control” fish; therefore, the absence of mortality cannot be interpreted as “no additional stress” from handling and confinement on treatment (impinged) fish Further, there is no consensus on how to interpret “control” mortality if it does occur This situation is identical to assessing mortality of tournament-caught fish Measurement of mortality of fish exposed to known stressors under controlled laboratory conditions has provided meaningful and less ambiguous estimates of control mortality that can be used to assess mortality of tournament-caught fish We suggest replacement of expensive and imperfect estimates of mortality of control fish (ie, mortality due to handling and confinement) with standardized species- and temperature-specific mortality responses of fish to fixed stressors that are determined under controlled laboratory conditions may be useful for assessing impingement mortality The 316(b) rule allows that the results of this proposed standardization of mortality can be used across a fleet of plants or even as an industrial standard for assessing impingement mortality Establishing useful standardized mortality estimates will require consensus among regulatory agencies and water users of appropriate stressors and relevant covariables The potential benefits of standardized mortality rates are likely to be far-reaching for regulatory agencies and water users

Assessing Angler Effort and Fish Abundance Couplings in Multi-Species Fisheries

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Coupling between angler effort and fish abundance has critical implications for the resilience of recreational fisheries, and while a tightly coupled relationship has often been assumed, this relationship has rarely been assessed We evaluated how fishing effort might be predicted by fish abundance, socioeconomic and demographic variables within four popular marine recreational fisheries in Florida, USA The results suggest that while recreational fishing effort can be well predicted by fish abundance, particularly when accounting for human populations and temporal correlation, there is little evidence of a strong causal between effort and abundance In fact, modeling effort as a function of calendar year instead of fish abundance produced similar fits to observed data, but very different predictions for the future This implies fishing effort could increase in the future unrelated to fish abundance, a decoupling that could threaten the viability of fish populations in the absence of unpopular recreational effort limitation Further, the inability to disentangle alternative drivers of effort (fish abundance vs exogenous factors) using currently available observations should motivate a future focus towards natural or scientifically-planned experiments that may provide more powerful inferences of the strength of effort-abundance relationships

The Barrier Prioritization Tool: A GIS Tool Prioritizing Dams for Removal within the State of North Carolina

Kathleen Hoenke*, Southeast Aquatic Resource Partnership

Dam removal has proven to be an effective mechanism for quickly restoring in-stream habitat and returning stream systems to a free flowing state in a wide range of settings Identification of dam removal projects can be a tedious task that often accounts for multiple social, ecological and hydrologic criteria Here, a GIS based approach for prioritizing dams for removal based on eco-hydrologic and social metrics is presented The tool uses a hierarchical decision-support framework to rank dams for removal based on criteria such as good habitat and water quality connectivity, larger stream flow at the dam, improved dam safety and longer stream mile connectivity The tool is applied for three commonly considered prioritization scenarios that rank dams based on their suitability for removal using: ecological criteria, both social and ecological criteria together, and habitability of anadromous fish criteria Results show that highest ranking dams from an ecological prioritization are

located on reaches of high habitat quality and longer connected river miles In contrast, social plus ecological prioritization yields higher ranks to dams that are primarily used for recreation, but are also in areas of high habitat quality Dams in close proximity to anadromous fish spawning areas with high river mileage and few downstream dams are ranked higher by anadromous fish prioritization The top 20 ranked dams, as predicted by the tool, includes dams that had been pre-identified by resource managers as potential dam removal projects, indicating that the tool is performing as intended The tool and presented results should be used as a screening tool in conjunction with the expert knowledge of resource managers to further investigate the influence of site-specific factors, thereby determining the final priority of projects This tool is currently being updated and regularly used by the Southeast Aquatic Resources Partnership as well as American Rivers through the Southeast Aquatic Connectivity Assessment Program (SEACAP) to generate information about current projects as well as identify new dam removal projects within North Carolina

Louisiana Largemouth Bass: Population Dynamics, Fishery Characteristics, and Evaluation of Size Regulation Effectiveness

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Given the popularity of largemouth bass (LMB, *Micropterus salmoides*) fisheries throughout Louisiana, continual evaluation of management strategies is essential and requires baseline information on LMB population and fishery characteristics LMB were collected on 12 waterbodies during fishery independent sampling over a three year period, and a creel survey was conducted one of these years The von Bertalanffy growth function was used to model length-at-age and catch curves were used to estimate total mortality Growth and mortality rates and recruitment variability indicate the presence of several LMB population types within Louisiana Proportional size distribution indices and mean relative weights were mostly within recommended ranges An age and sex structured population model was constructed to simulate the effects of size-specific harvest regulations and different levels of catch-and-release angling on LMB fishery performance Simulations indicate that the same size regulation can affect expected catch differently across population types For most waterbodies, fishing mortality (F) was below the level required for size regulations to influence LMB size structure Low F was partially attributed to a high level of catch-and-release LMB angling in Louisiana, where on average 75% of legal size LMB caught were released At higher levels of F, minimum length limits are predicted to increase quality and preferred size LMB catch for most waterbodies Maximum length limits showed the highest potential for memorable and trophy size LMB production

Population Structure of River Herring in the Albemarle Sound, North Carolina: Does Morphometric Analysis Agree with Other Stock Identification Methods?

Walter Rogers*, East Carolina University and Roger A Rulifson, East Carolina University

River herring use tributaries of the Albemarle Sound, North Carolina as spawning and nursery habitats Stocks of these anadromous fish have experienced dramatic declines in North Carolina, and show no sign of recovery Although the state has designated considerable resources to the management of river herring, we still do not fully understand river herring utilization of North Carolina's estuaries, and know little about the structure and composition of populations Determining the population, or "stock" structure of species is crucial for the proper distribution of management efforts We seek to determine the population structure of river herring in the Albemarle Sound system using morphometric analysis, and compare the results of this analysis to those of other stock identification methods utilized in previous studies

Red Snapper Fine-Scale Movement Patterns Around Artificial Reefs in the Northern Gulf of Mexico

Laura Jay Williams*, Auburn University and Stephen Szedlmayer, Auburn University

Previous conventional tagging studies have examined site-fidelity and large-scale movements of red snapper, *Lutjanus campechanus*, but few have reported on fine-scale movements The present study is a long-term study (2012–2014) that estimated the fine-scale movements (~1 m accuracy) of red snapper on three artificial reefs using a recently developed (2011) telemetry system (VEMCO Positioning System; VPS) Larger red snapper (>450 mm TL) were caught hook and line and internally tagged with transmitters (Vemco V-16; n= 80) After recovery from anesthesia, tagged fish were released using a predator protection cage that allowed for escapement close to the reef of capture (< 10 m) Most of the tagged fish 76% (62 out of 80) remained near their capture site and were tracked for extended periods (> 1,095 d) after an initial 6 day post tagging artifact period Over the 3 year tracking period, 38% (23 out of 61) were caught by the recreational fishery (F = 041), no natural mortality was observed (M = 0), and 28% (17 out of 61) emigrated from the VPS tracking areas Home range (95% kernel density estimates) and core areas (50% kernel density estimates) of tagged red snapper around these artificial reef release sites will be examined for seasonal and diel patterns and compared to environmental parameters

"Dispersal Patterns and Habitat Characteristics for Lake Sturgeon Restoration in the Upper Tennessee River System Based on Differences in Water Quality"

Christina Saidak*, University of Tennessee, csaidak@volsutkedu, Mark Cantrell, US Fish and Wildlife Service and Larry Wilson, University of Tennessee

Lake Sturgeon, extirpated since the 1960s, have been reintroduced into the Upper Tennessee River system as young-of-year fingerlings since 2000 Currently there are limited data on movement or habitat preferences of these maturing, naturalized fish The objectives of this study are to: 1) determine dispersal and movement patterns of reintroduced lake sturgeon in the Upper Tennessee River system; 2) identify water quality characteristics of seasonally important habitats; 3) compare temperature and dissolved oxygen at summer refugia areas of known sturgeon concentrations, with other unused habitats; and 4) identify, map and assess potential spawning habitats in the Upper Tennessee Basin Movement and dispersal patterns are being monitored by acoustic telemetry We identified potential spawning and staging areas by direct observation, reports collected from local fishermen, and expert opinion of biologists; we then assessed water quality conditions at those sites We collected water quality data from fixed station multiparameter water quality sondes In general, water quality was good during the Summer and Fall in areas occupied by Lake Sturgeon

Aquatic Food-Web Structure Varies Longitudinally with Natural and Anthropogenic Influences in the Pecos River, Texas and New Mexico

Jessica East*, Texas Tech University and Allison Pease, Texas Tech University

Understanding how aquatic communities change with natural variation along longitudinal gradients, and how they respond to anthropogenic impacts, is critical for effective riverine management In addition to natural shifts along its continuum, the Pecos River is impacted by a variety of anthropogenic influences that affect water availability, salinity, and riparian and instream habitat structure We assessed variation in main-stem Pecos food webs by estimating carbon sources, trophic positions, niche breadth, and resource use by consumers at twelve sites with stable isotope analysis We found that across physiographic regions, fish species richness, food chain length, and assemblage-wide niche breadth were inversely related to specific conductivity IsoError mixing models revealed differences in sources of dietary carbon supporting fish production along the longitudinal fluvial gradient, with a shift toward reliance on algal production in the Permian Basin region Trophic niche breadth was greatest for assemblages in less degraded sites with higher fish species richness Our analyses also suggest that anthropogenic inputs may be enriching baseline nitrogen isotope ratios at one Permian Basin site Across seasons, isotope signatures remained fairly

constant in five common fish species Characterizing changes in food-web structure in relation to natural and anthropogenic factors is important for habitat assessment, stream restoration, and management and conservation strategies

Society of Lake Management Professionals

Wade Bales*, Quality Lakes Inc

The Society of Lake Management Professionals (SLMP) is a 501-C non-profit organization formed in 2014 The organization was formed to meet the needs of the growing lake management industry across the US whose service scope typically spans the missions of most aquatic resources conservation organizations The SLMP mission is to foster an appreciation for and enhance the management of pond and lakes, managed by for profit companies, with particular concern for the aesthetic and recreational uses and stewardship of such waters Using tools such as innovation, education, representation, accreditation, and standardization of best management practices Advocate wise stewardship of privately owned water, promote and recruit fishing opportunities in private water environments, and protect profitability To preserve the integrity and cutting-edge professional service component of the industry, further development of the accredidation process as well as the continuing education process for all levels of membership will be implemented as the SLMP grows Due to the breadth of services offered by the private lake management industry, opportunities exist to partner with product sponsors to develop new and improved products and equipment as well as provide a medium for a centralized voice on local and national aquatic resource management

Effects of Temperature and Dissolved Oxygen on Metabolic Scope in a Southern Population of Striped Bass

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The South Carolina DNR stock enhancement program has stocked striped bass in the Ashley River, a tributary of the Charleston Harbor system, since 2006 in an effort to restore a self-sustaining population Striped bass is a long-lived species that inhabits coastal estuaries and rivers along the east coast of North America Striped bass populations throughout their range have been exhibiting population declines during the past decade, with the prevailing causal hypothesis being associated with summer temperatures Striped bass in South Carolina are near the southern extent of their range Increased temperature associated with global climate change and extreme temperature fluctuations of shallow estuaries may negatively impact survival, growth, and reproduction of southern striped bass populations Understanding the energetic costs of living under potentially stressful summer conditions such as high temperature and low dissolved oxygen will allow us to understand the potential for striped bass to survive in systems where these conditions are prevalent Metabolic scope is a measurement which can be used to calculate energetic costs related to environmental conditions, as it represents the potential energy an animal has to fuel all activities (growth, motion, digestion, reproduction, etc) under a given set of environmental conditions During the summer, temperature in the Ashley River can reach up to 32 °C, while levels of dissolved oxygen typically range between 25 and 40 mg/L We measured metabolic scope of phase III striped bass (approximately 450 g) at three different temperatures (20°C, 25°C, and 32°C) and three concentrations of dissolved oxygen (25 mg/L, 30 mg/L, and 40 mg/L) in order to understand how metabolic scope changes with temperature and water oxygen concentration Metabolic scope was calculated as the difference between the active metabolic rate and standard metabolic rate, which were measured via oxygen consumption in a 90 L flume, located within a temperature controlled experimental chamber Preliminary results indicate that at every temperature, metabolic scope

increased with increasing dissolved oxygen levels (N=45) On average, scope increased by approximately 80% from 25 mg/L to 40 mg/L dissolved oxygen Preliminary results also suggest that metabolic scope increases with temperature, with scope being higher at 32 °C than at either 20 or 25 °C

Beach Nourishment's Affect on the Longshore Movements of Juvenile Florida Pompano and Gulf Kingfish

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Abstract – As part of a large ongoing research project investigating the effects of beach nourishment on the surf zone fish assemblages, we wanted to investigate whether nourishing the beach affects the long-shore movement of juvenile fishes that utilize the surf zone as exclusive nursery habitat To address this question, a mark and recapture study was conducted immediately after a beach nourishment project on the island of Wrightsville Beach, North Carolina, during the summer of 2014 Four sites were designated as tagging sites (2 nourished and 2 unnourished) and 2 species of fishes, Florida pompano, (*Trachinotus carolinus*) and Gulf kingfish, (*Menticirrhus littoralis*) were selected as the targeted species The targeted species were collected from the surf zone using a 33x2 m bagged haul seine towed parallel to the beach, and implanted with visual implant elastomer (VIE) tags then released at point of capture Five recapture events were conducted at each tagging site over the next eight weeks, each event consisted of five 100 meter long seines performed in the same technique as the original capture event Through the course of this study, 1596 pompano (23-98 mm) and 628 kingfish (23-165 mm) were tagged then released; and 31 pompano and 2 kingfish were recaptured, which produces a recapture rate of 194% and 032% respectfully A breakdown of the pompano recaptures demonstrated that there was a difference of 1575% in the recapture rates between the nourished and unnourished sites, with the nourished sites having an average return rate of 0920% and the unnourished sites averaging 2495% return

The Blackbanded Sunfish and Other Species of Concern in the State of Georgia

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Multiple historic sites and new sites were surveyed for the presence of *Ennaecanthus chaetodon*, the blackbanded sunfish, from May 2011 to October 2013 to determine its status in South and southeast Georgia The status of other species of concern in Georgia (*Elassoma gilberti, Fundulus escambiae, Fundulus rubrifrons*) was also assessed during the study as well as some uncommon species such as Umbra pygmaea and *Ennaecanthus obesus* During the 25 year study an extensive drought occurred that prevented sampling in many historic sites and resulted in a reanalysis of what are actual sites of occupancy for the blackbanded sunfish as well as the other species surveyed With respect to the occurrence of the *E chaetodon*, only one historic site was confirmed as being occupied and one new site discovered Both sites possessed reasonably robust populations Other species studied produced a mosaic of Occupancy models in which covariates such as distance to the main river, elevation and surface area produced the strongest models based on AIC and Maximum Likelihood values

Estimates of Turbine Passage of Fingerling and Yearling Lake Sturgeon Passing the Shawano Project, Wolf River, Wisconsin

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Controlled investigations on turbine passage survival of emigrating Lake Sturgeon are lacking in published literature We estimated survival of fingerling (N =150, average length 199 mm TL) and yearling sized (N =160, average length 260 mm TL) Lake Sturgeon using the HI-Z tag-recapture method in passage through a vertical Leffel-Z (Francis type) turbine at the Shawano Paper Mill Dam,

Wolf River, WI The turbine was relatively small (42 - 74 inch diameter) with 18 blades, a rotation rate of 100 rpm, a discharge of 260 cfs, and 10 ft operational head Recapture rates were 887% for fingerlings, 906% for yearlings, and 98 and 95% for the respective control groups released downstream of the dam Only the HI-Z tags were recovered on another 73 and 88% of the fingerlings and yearlings, respectively The 48 h survival estimate was estimated at 927% ± 35%, 90% of the time for the fingerling sized fish and was estimated at 906% ±38% 90% of the time for the yearling sized fish

Only one fish recovered was injured and observed dead at 48 h Based on the fact that only one recaptured fish was injured and this is the only fish that died, the survival estimates are likely higher than estimated Entrainment survival estimates are important to understanding the effects that hydropower generating facilities have on fish populations and these results will have international implications for sturgeon restoration efforts

Texas' License Utilization and Revenue Enhancement System (LURES): Ensuring Conservation Funding By Understanding Our Constituents

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Funding for resource management and conservation efforts by natural resource agencies, such as the Texas Parks and Wildlife Department (TPWD), comes from revenue generated by customer interactions (fishing and hunting licenses, boat registrations, park visitation fees, magazine subscriptions, etc) TPWD has developed a Business Intelligence system, the License Utilization and Revenue Enhancement System (LURES), which consolidates the agency's licensing point-of-sale system and other revenue-related databases to support enhanced understanding of customer interactions with the agency, in an attempt to improve customer service and retention as well as the agency's finances This comprehensive analytics system integrates SAS software linking each customer's purchasing patterns across agency databases with ESRI software to provide geospatial visualization and analyses of customer demographic profiles to identify the most-effective marketing strategies to reach individual customers, as well as neighborhoods with demographic groups targeted for new-customer recruitment efforts This presentation will highlight the mechanics behind our SAS and ESRI integrated Business Intelligence System, as well as demonstrate the range of analytical capabilities it enables

Factors Affecting Largemouth Bass Size Structure at Wheeler and Guntersville Reservoirs, Alabama

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Largemouth bass *Micropterus salmoides* fisheries place a high value on quality size structure Guntersville and Wheeler Reservoirs, Alabama are popular largemouth bass fishing destinations that experienced declines in catch rates of fish greater than 500mm total length in the late 1990s early 2000s Although size structure has since recovered to historical norms at Guntersville, continued low catch rates of large fish at Wheeler has raised questions regarding factors affecting largemouth bass size structure at these reservoirs We compared growth, recruitment, and mortality (including largemouth bass virus prevalence) estimates between the two reservoirs to assess factors affecting size structure Fish reached a larger size at age early in life (ages 1-4) but achieved a smaller asymptotic length at Wheeler, and these differences were statistically significant for males Despite differences in growth, simulations suggested the differences were not enough to explain the differences in size structure Catch curve estimates suggested that differences in total mortality are likely responsible for differences in size structure between reservoirs Growth-specific catch curves indicated possible positive associations between mortality and early growth rates, which may relate to macrophyte densities at these lakes Our results could have implications for management of bass stocks and habitat at these reservoirs

Response of Lake Pontchartrain Nekton Communities to the Deepwater Horizon Disaster

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To assess possible impacts on Lake Pontchartrain fishes and key invertebrates from the Deepwater Horizon Disaster (DHD), we compared trawl, beach seine, and gillnet collections taken before (2007-early 2010) and after (late 2010-2013) to determine if significant community changes occurred We also compared basic environmental variables to test for oil-spill related changes Significant post-DHD changes in communities occurred in trawl (ANOSIM, R < 0075, p < 005), beach seine (ANOSIM, R < 019, p < 005), and gillnet (ANOSIM, R < 011, p < 005) collections across all seasons The consistently low global R values (all R < 019) across all gears, though, suggest only minor compositional changes in species When peak abundance periods were compared for individual species, Ladyfish (*Elops saurus*) declined in seine collections after the DHD (Friedman's test, $\chi 2 = 500$, $p = 0025$) but also increased in gillnet collections (Friedman's test, $\chi 2 = 500$, $p = 0025$) Bay Whiff (*Citharichthys spilopterus*) and Spot (*Leiostomus xanthurus*) increased in trawl collections, White Mullet (*Mugil curema*) increased in seine collections, and Blue Crab (*Callinectes sapidus*) increased in gillnet collections Bay Anchovy (*Anchoa mitchilli*) declined in trawl collections, Striped Anchovy (*Anchoa hepsetus*) declined in seine collections, and Gafftopsail Catfish (*Bagre marinus*) and Gulf Menhaden (*Brevoortia patronus*) declined in gillnet collections In general, salinity decreased and water temperature increased after the disaster While the overall composition of Lake Pontchartrain communities remains stable, the significant decline of some species is cause for concern Changes in environmental variables seem to reflect natural fluctuations in the Lake not related to the DHD Future monitoring will be necessary to detect any long-term significant declines in the species noted here

A Long-Term Study of the Fish Assemblages of the Wichita River, Texas

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Habitat fragmentation caused by impoundments has led to altered fish assemblages in many streams The effects of the alterations by impoundments can increase over time The effects of habitat fragmentation are notably detrimental to species that must migrate in order to successfully reproduce Fish assemblages of Great Plains streams have been affected by the impacts of impoundments By using museum and literature records of fish collections from the Wichita River, we were able to assess changes of both species composition and species distribution For each reach, we calculated percent relative abundance for ten 10-year intervals dating back to the 1920s Previous studies have shown that since the 1950s, seven species of cyprinids have been lost from the Wichita River and two others have seen consistent declines in relative abundance We sampled the Wichita River, Texas in 2006, 2011, 2013, and 2014 We used 11 sampling sites along the Wichita River, and compared species relative abundances across sites and years We analyzed data for each stream reach; taking note of any significant changes in the percent relative abundance for each species We used a detrended correspondence analysis to assess the changes in relative abundance and distribution Across all sites and years, species diversity was greater in downstream reaches, than in upstream reaches

Identifying Fish Assemblages Near the Mouth of the Savannah River, Georgia before the Savannah Harbor Expansion Project

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Estuaries and surf zones serve as crucial nursery habitats for many fish species The purpose of this study was to characterize fish assemblages near the mouth of the Savannah River over a temporal and spatial scale and to determine which environmental factors most influence their distribution

Locations on an island within the mouth of the river along with surf-zone sites on a barrier island just outside of the river mouth were sampled using a seine net and beam trawl for one year A total of 8,767 fish representing ≥ 62 species were collected and composed 3 distinct fish assemblages: tidally influenced riverine, intermediate, and surf zone Of the parameters tested, salinity and dissolved oxygen explained the majority of the variation in fish assemblages The seine and beam trawl only collected 705% and 721% of the species, respectively This reflects the complications associated with sampling diverse habitats with certain gear types and the importance of using multiple gear types to determine complete fish assemblages Results from this study can be used to assess any changes that may arise from the upcoming dredging of the Savannah River, which is likely to cause increased saltwater intrusion and decreased dissolved oxygen levels

Influences of Hydrology and Spawning Habitat Availability on Alligator Gar Recruitment in Texas Rivers and Reservoirs

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Reduced access to flood plain spawning habitats is a likely contributor to Alligator Gar population declines throughout their range In Texas, river and reservoir populations appear to be dominated by a few strong year classes even though longevity can exceed 50 years Successful management of this species will require strategies that provide access to flood plain spawning habitats with regular periodicity We developed a conceptual model relating Alligator Gar spawning and early development to hydrology and the availability of flood plain spawning and nursery habitats The model predicts that strong year classes of Alligator Gar in rivers will correspond with years of large, long duration floods occurring when water temperatures exceed 20°C Similarly, we expect strong year classes of Alligator Gar in reservoirs in years that have significant water level rises following prolonged low water conditions because these rises would inundate terrestrial vegetation similar to flood pulses in a river Using age structure data from river and reservoir populations of Alligator Gar, we are beginning to evaluate this conceptual model and test these hypotheses Preliminary results are promising In Choke Canyon Reservoir, moderate to strong year classes occurred in 80% of the years with rising or stable water levels compared to only 14% of the years with declining water levels In addition, relative strength of the year classes was highest during years water levels increased

Comparing Data Collected Using iAngler and the Marine Recreational Information Program

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Recreational fisheries are difficult to monitor in both space and time, and due to concerns of overfishing there is growing pressure to more effectively collect data to aid in the management of recreational fisheries The Snook & Gamefish Foundation's iAngler smartphone application allows anglers to submit catch, trip, and spatial data with the hopes of supplementing current information from NOAA's Marine Recreational Information Program (MRIP) Little work has evaluated the reliability and usefulness of electronic reporting programs Our objectives were to conduct a statistical comparison between iAngler and NOAA's MRIP for catch per angler-trip, species composition of catch, and spatial distribution of reporting throughout the state of Florida Since iAngler was designed to supplement state-managed, sportfish stocks (mainly common snook *Centropomus undecimalis*), analysis for catch-per-trip focused on iAngler-MRIP comparisons for snook, spotted seatrout *Cynoscion nebulosis*, and red drum *Sciaenops ocellatus* We fitted the number of fish caught per angler-trip with negative binomial distributions, and showed that mean catch per angler-trip was similar between iAngler and MRIP for several species (Red Drum, Spotted Seatrout, Common Snook) and modes (private/rental boat, private anglers from shore) However, the catch composition of iAngler was more strongly weighted toward inshore sportfish (especially

snook), relative to that of MRIP Further, the majority of the iAngler data comes from a relatively small number of users, and the trips are spatially biased mostly toward counties in South Florida near larger cities Our results showed that the iAngler program can be an effective recreational fishery monitoring tool for certain stocks (eg, snook) and certain areas (South Florida) Future expansion of the program could broaden its utility for other fisheries/regions

Is Cape Hatteras, NC a True Biogeographic Barrier for Nearshore Fishes and Invertebrates?

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Understanding community patterns across broad ecological gradients and between management zones requires a comparative approach integrating data from multiple sources We utilized species and abundance data from two fishery-independent bottom trawl surveys, the Southeast Area Monitoring and Assessment Program – US South Atlantic (SEAMAP–SA) and the Northeast Area Monitoring and Assessment Program (NEAMAP), to detect spatiotemporal differences in biomass-weighted composition of the nearshore US East Coast demersal fish and invertebrate assemblage from Cape Canaveral, FL to Southern New England For this analysis, we used tow-level data (N=3041) collected during spring and fall from 2008−2013 and excluded any species not captured by either survey during every sampling year We conducted multivariate regression tree analysis with the goal of determining spatial and environmental breakpoints for the demersal assemblage (140 species) Input environmental variables included year, latitude, longitude, bottom temperature, bottom salinity, water column depth, day length, satellite-estimated surface chlorophyll a concentration, nearest distance to an estuarine-ocean interface (ie, inlets and bay mouths), and nearest distance to land We used similarity percentage analysis to determine which species contributed most to composition differences on either side of tree splits In spring, latitudinal temperature patterns explained the majority of variation in community composition, with the most prominent transition zone occurring near Cape Hatteras, NC Other variables that explained notable variation in spring composition included depth, salinity, and distance to land In fall, spatial location (latitude, longitude) was more important than temperature in structuring composition, with the most prominent transition zone occurring near the mouth of the Chesapeake Bay Results highlight the importance of changing seasonal environmental conditions and sub-regional habitat characteristics in shaping community composition within the study area The divided response of the nearshore assemblage to the sharp latitudinal temperature gradient around Cape Hatteras during cold months supports the traditionally-held view of this land feature as a biogeographic barrier However, greater connectivity in nearshore composition during warm months indicated by species comparisons between tree clusters, as well as documented seasonal migrations of individual species around Cape Hatteras, supports the notion that US South Atlantic and Mid-Atlantic regions are more ecologically connected than separate

The Effect of Aquatic Vegetation on Survival and Foraging Return of Juvenile Largemouth Bass

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State and federal agencies typically introduce aquatic vegetation with the goal of increasing recruitment of sport fishes, particularly largemouth bass Macrophytes may provide predation refuge, but can also reduce the foraging return of juvenile fishes Reduced foraging return may also delay the ontogenetic shift to piscivory, which can decrease overwinter survival However, this has yet to be evaluated for juvenile largemouth bass Therefore, the objectives of this study were to 1) determine if aquatic macrophytes increase survival of juvenile largemouth bass when exposed to predation 2) determine if aquatic macrophytes reduce the foraging ability of pre-piscivorous and piscivorous juvenile largemouth bass To address the first objective, predator-prey interactions between juvenile and adult largemouth bass were observed in tanks with natural densities of American water willow

and compared with trials in vegetation-free control tanks Behavioral trials were conducted with one adult largemouth bass and 10 juvenile largemouth bass in the same tank Each adult largemouth bass was tested once in each treatment (vegetation present or absent) Water willow significantly reduced the attack to capture ratio of adult largemouth bass, and decreased the amount of time spent searching and the number of captures, resulting in significantly higher survival in vegetated trials To address the second objective, juvenile largemouth bass were tested individually in 5-gallon aquaria while feeding on frozen chironomid larvae or juvenile fathead minnows with different levels of structural complexity (artificial macrophytes made from green nylon twine) Pre-piscivorous juvenile largemouth bass (35 – 39 mm total length) and piscivorous juvenile largemouth bass (70 – 80 mm total length) were tested at each of five simple vegetation densities (0, 125, 250, 500, and 1000 stems/m2) and three complex vegetation densities (125, 250, and 500 stems/m2) when feeding on frozen chironomid larvae and juvenile fathead minnows Complex stem density treatments were created using a branched design, which doubled the string abundance within the water Thirty frozen chironomid larvae or five juvenile fathead minnows were used as prey during each 15-minute foraging bout Foraging return was not significantly different between all stem treatments when chironomid larvae were used as prey Trials with fathead minnows are ongoing Our preliminary results suggest that vegetation does provide a predation refuge that increases juvenile largemouth bass survival without reducing their foraging return of pre-piscivorous largemouth bass As such, vegetation enhancement may be an effective management strategy for improving largemouth bass year-class strength

"Assessing Fishing Pressure and Angler Harvest from Marben Public Fishing Area in Middle Georgia"

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Creel surveys are valuable tools that fishery managers use to gather information about angler effort and harvest from water bodies of interest A non-uniform roving creel survey was conducted at the Marben Public Fishing Area in Mansfield, Georgia during 2013 to obtain baseline estimates of fishery characteristics relating to fishing effort, catch, release, and fish harvest at the multiple-lake fishery Fishing effort averaged 7,803 angler-hours monthly (sd = 6,307) and ranged from 23,629 h in May to 1,638 h in December Overall mean catch rate was 122 fish/h (sd = 197), harvest rate was 057 fish/h (sd = 109), and release rate was 122 fish/h (sd = 131) The most highly sought-after sport fish species also had the highest species-specific catch rates and were 211 fish/hr (sd =246) for sunfish *Lepomis* spp, 042 fish/hr (sd = 068) for Largemouth Bass *Micropterus salmoides*, 029 fish/hr (sd = 052) for Channel Catfish *Ictalurus punctatus*, and 027 fish/hr (sd = 066) for Black Crappie *Pomoxis nigromaculatus* Linear regression indicated a strong positive relationship between estimates of mean total monthly catch and mean harvest (r2=087) Sunfish dominated catch and harvest compositions year-round, whereas other species (eg, Black Crappie) were seasonally present in the creel Compared to results from other comparable fisheries, fishing pressure in Marben Public Fishing Area is moderate and catch rates of sunfish are good; however, catch and harvest rates for Black Crappie and Channel Catfish are relatively low These results provide key fishery characteristics that should aid management in improving or maintaining the current quality of fishing at this PFA

In the Red? Using Single Nucleotide Polymorphic Loci to Examine Fine-Scale Population Genetic Structure of Red Snapper in the Northern Gulf of Mexico

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Understanding levels of gene flow and the genetic structure of populations are important steps in understanding the variability and persistence of populations, and allows for the implementation of more stringent management plans This is especially true for marine species, in which populations

were typically thought to be large and relatively genetically homogenous However, this idea has shifted in the last few years with the development of new, high resolution molecular techniques Red snapper (*Lutjanus campechanus*: Lutjanidae) is an economically and recreationally important marine fish species that inhabits reef environments along the western Atlantic and Gulf of Mexico coasts Since the 1970s, their numbers have declined significantly from overfishing and increased juvenile mortality rates from trawl by-catches This has incited heavy fishing regulations and numerous studies to examine the ecology and structure of populations along the Gulf of Mexico and western Atlantic coasts Several genetic studies involving mitochondrial and microsatellite loci all conclude that a single red snapper stock is present along the northern Gulf of Mexico that is further divided into a complex network of semi-isolated metapopulations Newly developed genomic sequencing techniques, such as genotyping-by-sequencing (GBS), can untangle this complexity and provide better insight to stock structure in the northern Gulf of Mexico by providing several thousand single nucleotide polymorphic (SNP) loci to test In an effort to better understand stock structure among populations of red snapper, we used GBS to gather thousands of SNP loci to examine genetic structure across the northern Gulf of Mexico We will present preliminary data on estimates of gene flow and genetic structure for this important fishery species

The Clean Water Act Section 316(b) Rule Impingement Mortality Standard and Technologies for Compliance

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In August 2014 EPA published the 316(b) rule, which requires existing power plants and industrial facilities to install the Best Technology Available for reducing impingement mortality Impingement is defined as the entrapment of any life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of intake water withdrawal The rule provides seven different compliance alternatives for existing facilities, which could be met by a number of intake technologies Various technologies that could be used to meet the impingement mortality standard are discussed, as well as site-specific considerations that would inform a decision on the best and most cost-effective method for compliance with the rule

Dual Spawning Behavior By Atlantic Sturgeon in the James River and Beyond

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Because of the endangered/threatened status of Atlantic sturgeon a better understanding of sturgeon life-history and habit use is important for effective management It has been widely documented that Atlantic sturgeon reproduction occurs from late-winter to early summer, varying clinally with latitude Recent data show Atlantic sturgeon in the James River have two disparate spawning runs, one in the spring and one in early fall Recognition of the later spawning season has drastically modified estimates of population status of Atlantic sturgeon in Virginia The combination of new telemetry data and historical documents show dual spawning strategies likely occur in various degrees along most, if not all, of the Atlantic sturgeon's range Using the combined data sources a new spawning strategy emerges which managers and researchers should note when determining the status of Atlantic sturgeon populations, and implementing conservation measures

A Comparison of Mercury Concentrations Between Two Tertiary Consumers in a South Carolina Salt Marsh

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Scientific studies of mercury cycling in fish populations have primarily occurred in freshwater and open ocean environments Relatively few studies have focused on mercury cycling within estuaries and the majority of these studies were conducted using laboratory conditions Estuaries provide a unique environment that serve as an interface between freshwater systems and the open ocean Additionally, they serve as a nursery for commercial fishes such as summer flounder (*Paralichthys dentatus*) and bluefish (*Pomatomus saltatrix*), which can contain high levels of mercury

Mummichogs (*Fundulus heteroclitus*) and Atlantic silversides (*Menidia menidia*) are year round residents of South Carolina salt marshes and are an important link between the salt marsh and coastal ocean Although mummichogs and silversides are both tertiary consumers, they differ in their food web interactions Mummichogs are opportunistic feeders that eat prey based on the size of their mouth They will feed from the benthos, off of the shoots of Spartina alterniflora during high tide, and from the water column Silversides are planktivorous feeders and prey upon zooplankton that are in the water column above oyster reefs and mudflats during high tide Both species are prey to commercially important fish such as, summer flounder and bluefish This study compares total and methyl mercury concentrations in mummichogs and Atlantic silversides to determine the potential of each species to contribute to the bioaccumulation of mercury in higher trophic fish

Preliminary data shows that these fish have differing gut contents Silversides contain higher percentages of copepods than mummichogs, while mummichogs contain a higher percentage of teleost bones and detritus Additionally, mummichogs gut contents by mass is evenly distributed between crustaceans, teleosts, and algae/detritus whereas silversides gut contents by mass are dominated by crustaceans Relative to mummichogs, silversides have higher concentrations of total and methyl mercury, however the percentages of methylmercury relative to the total are similar in both fish The differences in mercury concentrations in these two fish may impact the bioaccumulation of mercury in higher trophic level organisms When comparing the preliminary results from this study with previous studies on the mercury concentrations in summer flounder and bluefish, summer flounder that feed on mummichogs have lower mercury concentrations than bluefish that feed on silversides This suggests that lower trophic order fish, such as mummichogs and silversides, may be used as indicator species for mercury levels in higher trophic fishes

Relationship of Mercury Concentrations Across Twenty-Three Tissue Types for Three Species of Shark

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Mercury has been shown to cause reduced fertility, slower growth and development rates, abnormal behavior, and mortality in a variety of fish species, and also poses a human health risk The ability of sharks to bioaccumulate high concentrations of mercury in their bodies (ie dorsal muscle, liver) has been well established However, little is known about the relationship of the deposition of mercury among different tissue types (muscle, fin, and organ) within an individual We evaluated total mercury concentrations from eight muscle regions, four fins, and five organs from three different shark species (*Carcharhinus falciformis, C leucas, Sphyrna tiburo*) in order to determine the relationships of mercury concentrations across the different tissues Our goals included determining whether mercury concentrations throughout the body could be predicted from a single fin-clip or muscle biopsy Across species total mercury concentrations were highest in the eight muscle regions (114 ± 031 to 31 ± 212 ppm dry wt) with significant correlations existing between each muscle region Total mercury concentrations were lowest in samples taken from the center of the dorsal, pectoral, and caudal (lower lobe) fins of all species (0017 ± 0008 to 0055 ± 0083 ppm dry wt) Mercury concentrations for these locations were highly correlated, as were samples taken from the trailing edge of the dorsal, pectoral, and caudal fins (upper and lower lobe) We will discuss our findings and the potential for using non-lethal sampling to gain valuable information about the health of the animal and its ecosystem

Assessing Larval Fish Community Responses to Created Habitats on the Lower Missouri River

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Anthropogenic alterations to aquatic ecosystems have greatly reduced and homogenized riverine habitat, especially those used by larval and juvenile fishes Creation of shallow-water habitats is used as a restoration technique in response to altered conditions in several studies globally, but only recently in the United States In the summer of 2012, the US Army Corps of Engineers sampled larval and juvenile fishes at six paired sites (mainstem and constructed chute shallow-water habitats) along a section of the Missouri River between Rulo, NE and St Louis, MO From those samples, we enumerated and identified a total of 7,622 fishes representing 12 families Community responses of fishes to created shallow-water habitats were assessed by comparisons of species richness and diversity measures between paired sites and among sampling events Shannon entropy measures were transformed and γ diversity (total diversity) was partitioned into two components, α (within community) and β (between community) diversity using a multiplicative decomposition method Mantel test results suggest site location, time of sampling event, and habitat type were drivers of larval and juvenile community structure Paired t-test results indicated little to no differences in beta diversity between habitat types; however, chute habitats had significantly higher alpha and gamma diversity as well as increased abundances of Asian carp larvae when compared to mainstem shallow-water habitat Our results show the importance of created shallow water habitat in promoting stream fish diversity, but also highlight the role space and time may play in future restoration and management efforts

Combining Samples from Multiple Gears Helps Avoid Fishy Growth Curves

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Size-at-age information is critical in estimating growth parameters that are used to assess fish populations Due to gear selectivity, single sampling methods rarely sample all ages/sizes equally well Most growth estimates rely on samples from a single gear and therefore provide biased and imprecise growth parameter estimates We evaluated the efficacy of combining samples from two gears with different size selectiveness to estimate the von Bertalanffy growth function (VBGF) and then applied that approach to a case study on the Black Crappie *Pomoxis nigromaculatus* population in Lochloosa Lake, Florida Simulations of age- and size-structured populations were randomly sampled with two gears with different size-selectivity curves (a 'small-size' selective gear and a 'large-size' selective gear) Maximum likelihood VBGF estimates were obtained for each gear separately and compared to estimates obtained via a combined VBGF fitted to data from both gears In every scenario simulated, a combined gear approach reduced bias and increased precision for estimating the VBGF, but the specific combined proportions that improved VBGF estimates depended on size-selectivity Estimates of the VBGF in Black Crappie populations showed the combined gear method had intermediate parameter values compared to single-gear approaches from fisheries-independent trawl sampling and fisheries-dependent angler catch Furthermore, combined approaches had increased precision in individual parameter estimates and much less variance when estimating the VBGF across multiple years compared to single-gear approaches Combining data from two gears can increase sample representativeness leading to improvements in the estimation of VBGF Such approaches can reduce uncertainty in VBGF estimation and provide insight into key demographic processes occurring in fish populations where ontogeny and gear-selectivity lead to inefficient sampling

Pollutant Exposure and Effects in St Johns River Fish

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The lower St Johns River (SJR) is an ecologically and socioeconomically important natural resource in the northeast Florida region, which is increasingly threatened by a variety of environmental challenges including increased urbanization, pollution, and habitat loss or alteration As recently reported in past studies, a number of toxic contaminants that are capable of impairing the health of aquatic wildlife such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), and toxic metals have been found to be present in exceptionally high levels in certain regions of the lower SJR However, to date, biological effects of pollutant exposure in these locations have not been directly examined; they have only been predicted based on comparisons of sediment pollutant concentrations with published sediment quality guidelines, which can be limited by differences in environmental conditions (eg, sediment type, salinity) and other factors (eg, species type) Because of this, direct evaluations of pollutant effects in wildlife residing in the lower SJR basin are greatly needed To begin to address this, we examined biomarkers of pollutant exposure and effects in 3 fish species from multiple sites in the lower SJR: striped mullet (*Mugil cephalus*), pinfish (*Lagodon rhomboides*), and spot (*Leiostomus xanthurus*) Activity of PCB- and PAH-metabolizing enzymes and levels of hepatic lipid peroxidation were found to be significantly increased in all species from certain contaminated locations, suggesting that these fish are exhibiting physiological effects associated with exposure to these compounds New work is currently underway to expand on the range of species examined in the present study, as well as increase the number of biomarkers measured so that the impacts of other pollutants can be assessed

Patterns of Growth in Young Mussels in the Green River, Kentucky

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Freshwater mussels provide a number of ecosystem services, making them an integral component of both riverine and lacustrine environments Although more than 70% of the species in North America are considered imperiled, there are still large gaps in our knowledge of the basic ecology of many species Aging freshwater mussels provides valuable information for resource managers to better understand and conserve this highly imperiled group of animals Common errors in aging freshwater mussels include arbitrary assignment of missing annuli and biased sampling that focuses on larger, mature individuals We examined growth of 13 species (N = 712) in the Green River, Kentucky, with attention given to both commercially harvested and imperiled species Thin-sections of each shell were prepared using a low speed saw with a diamond wafering blade; the number of annuli on each thin-section was determined by three independent observers using a dissecting microscope Growth varied significantly among year classes for eight species ($P \leq 0005$), but was not correlated with water temperature ($P > 050$) in the Green River Variable growth among individuals within a single year class was observed for 11 species The Purple Lilliput, the only species examined with a sexually dimorphic shell, exhibited dimorphic growth, with males becoming significantly larger than females by age 4 ($P = 0014$) All species in this study exhibited exponential increase in shell mass during their first five years ($R2 \geq 087$) By age 4, individuals of 11 species demonstrated the loss of the first annulus due to umbonal erosion Annulus loss varied among species and did not appear to be contingent upon shell thickness Annulus loss coupled with increasing overlap in length-frequency histograms make it difficult to accurately age older individuals We recommend that only young individuals be used when drawing conclusions about the impact of environmental variables on annual growth rates or recruitment

Technologies for Complying with the 316(b) Rule Entrainment Mortality Standard

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In August 2014 EPA published the 316(b) rule, which requires existing power plants and industrial facilities that withdraw large quantities of water to install the Best Technology Available for reducing entrainment mortality For existing facilities, the rule does not give specific guidelines for complying with the entrainment mortality standard, but instead requires facilities to conduct site-specific characterization studies to determine the best method for reducing entrainment At a minimum, these site specific studies are to include consideration of closed-cycle cooling, fine mesh screens, and water reuse or alternate sources of cooling water Various technologies that are available for reducing entrainment mortality are discussed, as well as site-specific considerations that would inform a decision on the best and most cost-effective method for compliance with the rule

Analysis of Texas Resident Angler License Purchases to Estimate Impacts of Year from Purchase Licenses

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Like several other states, Texas Parks and Wildlife (TPWD) may consider changing its license model from one where licenses expire at the end of the fiscal year (FY) to a model in which licenses are valid for one-year from purchase In 2005, TPWD added a license that used the year-from-purchase (YFP) model We compared the behavior of those who had purchased the YFP model license to those who had purchased FY model licenses Specifically, we looked at the following measures: time interval between adjacent purchases of a license, number of licenses purchased, transition between licenses, and changes in first-time purchase trends We found that purchasers of the YFP license were less likely to purchase multiple licenses, took longer to repurchase, and were less likely to purchase higher-priced hunting and fishing combination licenses We also found that many first-time purchasers were choosing the YFP license instead of the FY license Using these findings, we then estimated the effects of these differences on the revenue TPWD might expect were all fishing licenses switched from the FY model to the YFP model Future revenue projections were compared to projections in which no change was made We estimated that TPWD could see a revenue short-fall if the YFP model was adopted but fees remained the same

Classifying VMS Data in Gulf of Mexico Reef Fisheries: Model Selection and Evaluation

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Spatial information can be used to understand and correct potential biases in fisheries dependent data Vessel Monitoring Systems (VMS) are an important source of information for spatial fishing effort With the growth of VMS data comes an increasing need for analysis and classification Much work has already been done within the European Union to develop methods for categorizing VMS data as fishing or non-fishing, especially for trawl fisheries Currently, a knowledge gap exists in the literature for classifying VMS data for vertical line fisheries This project fills the existing knowledge gap by evaluating the best way to classify VMS data as fishing or not fishing for a vertical line fishery Vessels holding a Gulf of Mexico Reef Fish Permit have been required to have active VMS since 2007 Coinciding with this dataset is the Reef Fish Observer Program covering roughly 5-10% of total trips Most of the existing literature detail simple cut off rules such as vessel speed and heading for classifying VMS data, this project assesses the performance of models fit to data points for which there exists observer coverage and then projected to the remaining unobserved data Three models are compared: a Random Forest, Neural Network, and Generalized Additive Model (GAM) These models were selected for their ability to handle non-linear relationships between the variables assigned to each VMS point (speed, depth, latitude, longitude, heading, distance from shore, etc) These models are evaluated on their ability to correctly identify fishing points and avoid assigning

fishing status to non-fishing points based on the observer data Additionally, the distribution of fishing effort generated by each model is evaluated to identify differences in the distributions as a result of the model fits and the implications that this could mean for assessment scientists and fisheries managers Given the large nature of VMS data sets (on the order of 2 million entries a year in the Gulf of Mexico alone) processing this data becomes a significant computational challenge in terms of both computing resources and time It is critical to identify a model capable of accurately handling non-linear relationships in the data in a computationally efficient manner, and where the best model is a tradeoff between accuracy and resource use

Influence of River Conditions on Angler Catch Rates in the Tallapoosa River, Alabama

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Angler satisfaction is a fundamental objective in adaptive evaluation of flow prescriptions below R L Harris Dam (Tallapoosa River , Alabama) We collected fishery specific information to inform management decisions using hook and line sampling from small boats over a range of seasons and flow conditions Regulated and unregulated reaches of the river were fished by 2-4 anglers during three seasons: spring, summer and fall (2013 and 2014) Small spinner baits were trolled behind the boats to present lures to most sport fishes (ie, Micropterus spp, Lepomis spp, Morone spp and Ictalurus punctatus) We recorded capture encounters in the river during sampling trips; individual fish were weighed and measured and catch-per-unit-effort (# fish/angler hour) was calculated by species and angler Angling was conducted during different water conditions; river hydrology and temperature (water and air) were measured Catch rates varied among seasons and river reach; highest catch rates were observed in the spring in the middle reach below Harris Dam (421 fish/h); whereas, the lowest catch rates were also observed in the spring at the site most downstream from the dam (038 fish/h) Results of multiple regression analysis indicated that catch was negatively related to discharge and positively related to water and air temperature; season was also a predictive variable When site-specific multiple regression models were constructed, similar variables predicted catch; however, temperature was not predictive at the most regulated site These findings, coupled with angler preference data can help inform management decisions in this system

“Assessment of the Artisanal Giant Cichlid (Petenia Splendida) Fishery in Lake Petén Itzá, Guatemala"

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Small scale inland fisheries in developing countries extract about one third of the global fish catch The lack of fisheries management is leading to degradation of fisheries stocks, and this is exacerbated in inland systems, thus threatening food supply for developing countries Guatemalan inland fisheries are rarely managed to prevent local stock depletion of important fisheries, and thus, there is a need for stock assessments and management The second largest lake in Guatemala, Lake Petén Itzá, is located in the buffer zone of the Mayan Biosphere Reserve The most sought species in Lake Petén Itzá is the giant cichlid (*Petenia splendida*) One of the main concerns of the fishermen and authorities in Lake Petén Itzá is the reduction of biomass and size of the giant cichlid We assessed fishing mortality for giant cichlid using a tag-reward study in the artisanal fishery Spaghetti tags were applied to 594 giant cichlids (range=145-425 mm total length) through January to August The returns were obtained for 19 months after tagging Return rates increased with the value of reward with reporting rates of 056 for $625 tags, 053 for $1250 tags, 064 for 1875 tags, assuming all the $2500 tags where returned Our total mortality (Z) was 101 estimated using a catch curve analysis Using our analysis we concluded that the fishing mortality was approximately at MSY, and thus regulations such as length limits were not required at this time Considering the difficulties to assess small-scale fisheries, these findings provide critical data for the giant cichlid

fishery where the status of the stock was unknown Through this assessment we can address informed decisions to develop management, and replicate the methodology in similar systems in the region where the overfishing could be occurring

Distribution and Habitat Associations of Black Bass in Tributary Streams of the Middle Chattahoochee River, Georgia and Alabama

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The Middle Chattahoochee River has been designated as an area of focus for the conservation of Shoal Bass (*Micropterus cataractae*)by the National Fish and Wildlife Foundation (NFWF)The Shoal Bass is a fluvial specialist, yet many of the remaining populations of Shoal Bass are affected by the non-native generalist Spotted Bass (*Micropterus punctulatus*) through competition, predation, and introgression Other threats include: a loss of habitat from impoundments, urbanization, and poor land use practices causing erosion, sedimentation, channelization, and altered hydrology The goal of this project is to help determine future habitat restoration for Shoal Bass in the Middle Chattahoochee River Presence/Absence sampling was conducted on selected tributaries from Atlanta, GA downstream to the headwaters of Walter F George Reservoir using a canoe-mounted DC Electrofishing unit with a backpack-type electrode pole Mesohabitats were estimated for each electrofishing transect and black bass were collected Habitat and backpack electrofishing surveys were conducted on selected tributaries measuring microhabitat, mesohabitat, and collecting black bass to determine their habitat associations Shoal Bass were only abundant in Flat Shoals Creek and Mulberry Creek in Georgia and Spotted Bass were gathered in all sampled tributaries There was no difference in mesohabitat use for Spotted Bass and Shoal Bass were found in microhabitats with high velocity, boulders, and shallow depths with no wood cover

Evidence of Atlantic Sturgeon Fall Spawning in South Carolina Rivers

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Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) occur throughout rivers and estuaries along the Atlantic Coast Until recent years, most Atlantic sturgeon were thought to begin upriver spawning migrations only during late spring months Beginning in 2010, as part of a multi-state telemetry program funded by the National Marine Fisheries Service, Atlantic sturgeon in the Great Pee Dee, Edisto, and Savannah Rivers were captured and tagged with transmitters capable of detection for multiple years Additionally, an array system of almost 300 ultrasonic receivers was placed throughout South Carolina's major coastal river systems, connecting waterways, and near shore areas Receivers were generally deployed every 5 miles and located from river mouths to potential spawning areas or the first barrier in the system Data from four consecutive years of adult sturgeon movement has documented fall movements consistent with fall spawning runs in all three rivers systems Upriver movement is highly correlated with river temperature regardless of flow conditions Future research efforts will focus on verification of spawning habitat and occurrence

Observed Temporal Size Differences of Vermilion Snapper in the Atlantic Ocean Along the Southeastern United States and Possible Explanatory Variables

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While abundance of fish within a stock is thought of as the key component being examined during assessments for management purposes, the demographics of the population, including size/age

structure and life history, play a vital role as well Productivity of stocks is linked to these parameters, which have the potential to vary based on anthropogenic, environmental, or ecological factors During routine reef fish sampling by the Marine Resources Monitoring Assessment and Prediction (MARMAP) program, abundance estimates of Vermilion Snapper, Rhomboplites aurorubens, in the Atlantic waters off the Southeastern US have declined from 1990 – 2012 Conversely, size of individuals has increased during this same time period This observation was examined in an attempt to explain this further First, the population demographics were characterized and examined to determine possible causes A decrease in older fish from earlier time periods was observed, but this did not account for the larger sizes found during later years of the survey, thus pointing towards a change in growth as opposed to demographics Second, the size-at-age and likelihood-ratio tests were used to further describe and analyze the changes in growth temporally Last, factors that have shown to affect length-at-age were examined, including environmental variables, fishery effects, and small and large scale abundance estimates to investigate potential density-dependent growth differences A better understanding of factors affecting population demographics and life history, along with timely updates will lead to more effective management of fisheries stocks in the future

Use of Stated-Preference Choice Models to Determine Trip Preferences of Stocked Trout Anglers in Virginia

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Stocked trout account for approximately 80% of the trout angling effort in Virginia and anglers spend about $50 million annually fishing for stocked trout Fisheries managers often seek to understand characteristics of fishing trips that anglers prefer Generally, research on angler preferences has relied on researchers asking a series of independent questions without the ability to synthesize responses We used stated-preference choice models to create hypothetical fishing trips to investigate the choices anglers make in selecting fishing trips for stocked trout based on 1) how stockings are announced, 2) if fishing occurs in a stream or a lake, 3) the season when fishing occurs, 4) fishing on weekends or weekdays, and 5) the size and number of trout that anglers prefer to fish Understanding angler choices should improve angler satisfaction by allowing managers to better meet angler preferences

Angler Use of Two Reservoir Populations of Paddlefish in Northeast Oklahoma

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Oklahoma has several self-sustaining populations of paddlefish (*Polyodon spathula*) that support sport fisheries, including Grand Lake O' The Cherokees (Grand Lake) and Keystone Lake The Oklahoma Department of Wildlife Conservation (ODWC) has operated a Paddlefish Research Center (PRC) on Grand Lake since 2008, which has increased communication with paddlefish anglers and provided information about fishery-dependent population trends, suggesting declines in overall fish size Whether these declines were unique to Grand Lake or indicative of a broader pattern were unknown Comparing angler harvest between these two self-sustaining populations would aid managers in conserving this species in Oklahoma Thus, I sought to determine differences in fishing pressure between reservoirs Post-season paddlefish angler surveys indicated no significant difference in per-angler effort (days fishing per angler) between the two reservoirs in both 2010 and 2011 However, Grand Lake had significantly higher per-angler harvest Factors possibly contributing to greater harvest per-angler in the Grand Lake area include: better bank angling areas, a higher percentage of non-resident anglers, and the free fish cleaning service provided by the PRC

EPA cooling water intake structure regulations revolve around larval fish: Impacts of little fishes on sampling plans

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In August 2014 the US EPA finalized a multi-year effort to revise the Clean Water Act 316(b) regulations The intent of the regulations is to reduce injury and death of fish and other aquatic life caused by cooling water intake structures at existing power plants and factories These facilities pull in large volumes of cooling water from lakes, rivers, estuaries or oceans to cool their machinery In many cases permitted facilities will be required to perform studies related to impingement mortality of larval fish and other aquatic organisms How these larval fish are collected preserved, and identified can have a profound impact on the study conclusions Study QA/QC requirements often are vague and seldom reported Variation in verified larval fish identification also can impact study conclusions I will discuss how larval fish studies can dictate the ultimate study conclusions

Determination of Pelagic Larval Duration and Growth of Caribbean Amphidromous Fishes

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Artisanal fisheries for post-larval amphidromous fishes occur on tropical islands globally and can have large economic and cultural value Despite the importance of amphidromous fishes to marine and freshwater ecosystems, their ecology and management have received little research attention Additionally, the life history of amphidromous fishes creates unique challenges to managing fisheries that occur both at early life stages (eg, larval, post-larval) during recruitment to freshwater systems and as adults Post-larvae were sampled weekly at the Rio Grande de Arecibo in Puerto Rico from June to October 2013 and daily growth rings were counted from sagittal otoliths to describe temporal patterns in age and length at recruitment, and to estimate pelagic larval durations Length and age at recruitment of amphidromous fishes generally increased over the sampling period and provide insight on the potential mechanism responsible for recruitment For example, River Goby Awaous banana sampled from the Arecibo River exhibited greater variation in age (46-79 d, CV 11%) than total length (135-167 mm, CV 4%), suggesting recruitment timing to freshwater habitats may be size-dependent despite a wide range in ages and protracted spawning period Overall, results of this study provide crucial information for the ecology and management of Caribbean amphidromous fishes

Stream Conservation Decision Support Tool for Tennessee/Cumberland River Basins

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A stream conservation decision support tool is described for the Tennessee and Cumberland river basins in the southeastern United States This web-based application allows users to engage in the process of modeling and forecasting stream conditions A novel user interface allows the adjustment of spatial indicators reflecting human activities at the catchment and watershed scale These modifications are used to generate updated forecasts of biological condition The underlying models were generated using stream assessment data compiled by the Southeastern Aquatic Resource Partnership (SARP) Assessment findings were related to spatial indicator data using the boosted regression tree machine-learning technique A web service executes a prediction and generates a spatial representation of the results

Assessing Inland Recreational Fisheries Using Catch-at-Age Methods

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Data collection methods vary significantly between marine and inland fisheries Marine fisheries rely heavily upon fishery dependent data for stock assessments These data are often used in catch-at-age models such as virtual population analysis that allow estimates of mortality and recruitment Inland fisheries rarely use catch-at-age models, despite their potential to improve management In the southeastern United States, Black Crappie *Pomoxis nigromaculatus* support important harvest-oriented fisheries Black Crappie stock assessments are typically done only through fishery independent sampling (trap nets or trawls) or fishery dependent methods (creel surveys), with occasional tagging studies to estimate fishing mortality We assessed the effectiveness of catch-at-age models when applied to a Florida Black Crappie fishery We hypothesize that use of catch-at-age models could provide estimates of fishing mortality, recruitment, and factors related to recruitment in a cost-effective manner The use of catch-at-age models commonly employed in marine fisheries can potentially improve the ability to assess and manage inland recreational fisheries

Metabolic Profiles of Intersex Largemouth Bass

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Intersex fish have been increasingly reported in rivers and impoundments across the US and around the world Factors associated with development of testicular oocytes (the most commonly reported form of intersex) in otherwise phenotypic males are not well understood but may be linked to exposure to environmental estrogens or other contaminants Reduced sperm quality and quantity have been reported in intersex fish so the potential exists for population level effects Currently, very little is known about alterations of physiological pathways in intersex fish Increased understanding of these pathways, may lead to the identification of causative factors and adverse effects, as well as development of specific biomarkers for screening individuals for the intersex condition Current methods to positively identify intersex fish are lethal requiring histological evaluation of the gonads Sacrifice of large numbers of wild fish is undesirable or unrealistic, as in the case of sportfish or species of conservation concern Recent advances in technology allow for the simultaneous examination of thousands of endogenous metabolites in body tissues and fluids, including some that can be collected non-lethally (eg blood, mucus) Identification of unique metabolic profiles in intersex fish may aid in identification of key cellular pathways disrupted and may lead to identification of specific metabolites associated with intersex fish, facilitating development of targeted biomarker assays to identify intersex individuals Moreover, development of these biomarkers in matrices that can be sampled non-lethal sampling would greatly enhance our ability to sample larger numbers of wild fish thus increasing our understanding of factors influencing the intersex condition as well as spatial and temporal trends Therefore, we investigated metabolic profiles of intersex (n = 28), male (n = 11), and female (n = 8) Largemouth Bass (*Micropterus salmoides*) collected on the same day from an impoundment in the Piedmont region of Georgia Metabolites in liver, analyzed by liquid chromatography and tandem mass spectroscopy, of intersex fish were unique compared to males and females but less distinct in plasma We describe the pathways affected and specific biochemical markers in intersex fish that may be useful for better understanding the intersex condition and possible development of a targeted and non-lethal approach for diagnosing the intersex condition

Survival of a Dominant Salt Marsh Fish Among Variably Altered Tidal Creeks in a Coastal Landscape

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The relationship between anthropogenic alteration and nekton demographics remain poorly understood in tidal creeks despite increasing human encroachment into the United States coastal zone The mummichog Fundulus heteroclitus is an indicator species of biological impacts to tidal creeks because of its trophic importance, small home range, need for marsh cover, and sensitivity to anthropogenic pollutants We used mark-resight data from PIT tags and autonomous antenna arrays to estimate occasion-specific apparent survival of adult mummichogs over spring-summer seasons in four variably altered first-order tidal creeks in coastal North Carolina Biological (length), environmental (water temperature), and gear covariates (PIT tag size) were incorporated into Cormack Jolly Seber models estimating occasion-specific detection probability and apparent survival We tested the effects of several creek- and watershed-level habitat metrics on survival using generalized linear mixed models (GLMMs) Habitat metrics included high tide area, percent marsh area, percent watershed imperviousness, presence/absence of a culvert, presence/absence of contiguous marsh downstream of the sampled area, and presence/absence of a flooded creek channel at low tide Important covariates of occasion-specific apparent survival and detection probability varied both within and among creeks Fish size and water temperature were not consistent covariates of occasion-specific apparent survival but female mummichogs generally had lower apparent survival than males Larger PIT tag size was a uniformly positive covariate- and water temperature was generally a positive covariate of detection probability The presence of contiguous marsh led to lower apparent survival of adult mummichogs over the growing season Potential explanations for these results are that tidal systems with contiguous intertidal marsh allow for more efficient emigration of adult mummichogs and/or access by its predators Forthcoming estimates of growth and recruitment from these systems will help determine whether creeks with higher mortality nonetheless experience rates of production that equal or exceed those from creeks with lower mortality

Timing, Size, and Movement of Upstream Migrating American Eels in the Santee-Cooper Basin, South Carolina

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Over recent years, upstream migrations of juvenile American Eel Anguilla rostrata in South Carolina portions of the Santee-Cooper Basin have been monitored at several locations Glass eels were collected in Goose Creek, Berkeley County (~ 40 rkm from the ocean) These eels averaged 54 mm TL with peaks generally occurring in March Elvers were collected at the USACE St Stephen Hydroelectric Station on the Santee Rediversion Canal in a different portion of the basin (~92 rkm from the ocean) These elvers typically measured 89 mm TL, and were collected at variable times Spring peaks occurred in April and all collected elvers were passed upstream into Lake Moultrie Finally, year round monitoring occurs at the Wateree Hydroelectric Project (~229 main channel rkm further upstream) where low numbers of elvers and eels (> 150 mm TL) were collected One late-April to early-May collection peak occurred at the Wateree Hydro Low catches of eels upstream of the Santee-Cooper reservoirs is intriguing, discussed relative to observations from a nearby river basin, and worthy of additional research

Is There Potential for Invasive Aquatic Plants to Contribute to Mercury Methylation and Bioaccumulation in Fish from South Carolina Freshwater Ecosystems?

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Mercury (Hg) is a metal that occurs naturally at low levels in the environment The three most prevalent chemical species exist as gas phase elemental Hg (Hgo), divalent inorganic Hg (Hg2+), and methyl Hg (CH3Hg+), which bioaccumulates in fish and poses a risk to higher trophic level organisms who consume these fish Aquatic systems within the Middle Atlantic Coastal Plain (MACP) and Southern Coastal Plain (SCP) ecoregions contain fish with the highest concentrations of Hg Throughout 2010-2011, total and methyl mercury in water and sediments were measured quarterly at 21 sites within South Carolina Sites within differing ecoregions were chosen to assess how the levels of Hg in water and sediment may relate to fish Hg concentrations Total Hg in the water ranged from below the analytical detection limit (01 ng/L) to 72 ng/L and methyl Hg ranged from below the analytical detection limit (00188 ng/L) to 203 ng/L The percentages of Hg as methyl Hg in the water ranged from 0-27% The MACP and SCP ecoregions contained the highest concentrations of total and methyl Hg and the highest percentages of methyl Hg in the water Total Hg in the sediments ranged from 15-162 ng/g dry and methyl Hg ranged from below the analytical detection limit (00151 ng/g dry) to 057 ng/g dry The percentages of Hg as methyl Hg in the sediments ranged from 027-26% Typically, sediments are a primary site for Hg methylation and the percentages of methyl Hg in freshwater sediments usually range from 1-11% The low percentages of methyl Hg in these sediments suggests that methylation may occur in other areas Many reservoirs and rivers within South Carolina contain floating mats of invasive aquatic plants These mats block light and oxygen thus creating environments in the surface waters which may promote the formation of methyl Hg A study conducted in the Waccamaw River quantified the levels of total and methyl Hg in the water column and water hyacinth plants as they grew Total Hg in the water ranged from 32-89 ng/L with 10-31% as methyl Hg Total Hg in the plants ranged from 22-587 ng/g-dry with 2-63% as methyl Hg The high percentages of methyl Hg in the water and plants suggest that: 1) these mats may serve as a site for mercury methylation and 2) water hyacinth plants bioaccumulate methyl Hg and may be a source of methyl Hg to organisms that consume these plants

Movement and Habitat Use of Juvenile Alligator Gar in Western Kentucky

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Alligator Gar (*Atractosteus spatula*) populations have been threatened, extirpated, or are experiencing serious decline across most of their native range throughout the Lower Mississippi River valley The Kentucky Department of Fish and Wildlife Resources (KDFWR) has made a commitment to restore alligator gar in their native waters within the Commonwealth by actively rearing and propagating hatchery fry beginning in 2009 In October 2010, 20 juvenile alligator gar (age-0, ~20-25 inches long) were surgically implanted with Vemco V13 acoustic telemetry tags and stocked in the Clarks River in northwestern Kentucky After nearly one full year of tracking these juvenile alligator gar, linear kernel density estimates of home ranges showed that the overall 50% utilization distribution (ie core range) was 465 km, but seasonal core ranges varied across seasons (109 - 475 km) Spatial distribution was heavily influenced by home range selection, as most fish maintained position near a core range, but occasionally departed with seasonal and environmental changes Home range fidelity was high for all fish, while 70% of all movements were 2,000 m or less, indicating that juvenile alligator gar exhibit strong affinities towards available habitat in the Clarks River Analysis of habitat transects showed that fish distribution in the upper river was correlated with abundance of coarse woody debris (084) and riparian canopy cover (087) in the lower river distribution was influenced by bank slope and median depth in the channel (095) These results show that initial attempts for restoration of juvenile alligator gar in western Kentucky is promising

Histological Vs Macroscopic Ovarian Assessment Techniques for Determining Maturity Schedules for Female Black Crappie

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Understanding size and age at maturity is essential for maintaining spawning stock biomass and preventing recruitment overfishing when managing heavily exploited fish populations Black Crappie *Pomoxis nigromaculatus* is a popular recreational sportfish across much of North America, and few studies have investigated size and age at maturity for this species, especially in Florida Histological ovarian assessment is more expensive and time consumptive relative to macroscopic (in-the-field) assessment, but histological assessment typically offers higher resolution and accuracy in staging ovaries We compared age and size at maturity results from histological and macroscopic assessments on the same individuals from two contrasting Black Crappie populations in Florida We sampled ovaries from each population monthly (before, during, and after spawning) during two annual spawning seasons to determine if individuals were sexually mature during the current spawning season We used generalized linear mixed models to evaluate the effects of length, age, assessment method, and year on sexual maturity We found considerable disagreement between assessment methods among late season samples because it was difficult to distinguish immature ovaries from spent ovaries However, after we excluded late season samples from analyses, there were no differences between assessment techniques Our results show that macroscopic assessment of Black Crappie ovaries can be used to develop accurate and inexpensive age and length at maturity curves, but sampling should occur early in the spawning season, as assessing maturity post-spawn was problematic

Spatiotemporal Trends in Abundance and Life History of Gray Triggerfish Balistes Capriscus Off the Southeast US Atlantic Coast

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Gray Triggerfish, *Balistes capriscus*, is a common reef-associated fish found along the continental shelf of the southeastern US Atlantic coast (SEUSA) Interest in harvest of this species commercially and recreationally has increased over the past two decades, especially in light of stringent management of other preferred species This species currently is undergoing a benchmark stock assessment and a regional fishery-independent index of relative abundance supports that the population in the SEUSA has been depressed in recent years relative to the 1990s The SEUSA Gray Triggerfish center of distribution is found off South Carolina, but they are common in fishery-independent trap catches from Cape Hatteras, NC, to Port St Lucie, FL There also is a strong correlation between depth and both abundance and size We examine whether regional population trends are consistent among all areas or if increases or decreases in abundance co-occur with range expansions or contractions, respectively We also use length and age data to examine the relationship between population size and life history We test whether growth rates vary among areas that show different population trends and compare growth parameters to population trends Differential growth or recruitment among areas, along with density-dependence, may indicate areas where this species is relatively robust to exploitation or relatively vulnerable

Fish Community Response to Channel Restoration in the Coastal Plains

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Natural channel design (NCD) principles are increasingly used in stream restoration projects that aim to remediate degraded stream channels NCD projects have been constructed in West Tennessee to

reverse stream channelization, reestablish channels through valley-plugged systems, and reduce localized flooding issues The ecological effects of these projects are poorly understood and our goal was to assess how fish assemblage composition differed between restored and channelized streams as related to physical habitats A control/impact sampling design was used to inventory instream physical habitat and collect fish assemblages at three restoration sites, three channelized sites, and three reference sites Fish samples were summarized as the relative abundance of each reproductive guild (number of individuals in guild/total number of individuals in sample) Canonical correspondence analysis was used to determine how reproductive guild composition was affected by physical habitat variables between channelized and restored sites Physical factors most influencing fish assemblage composition were large woody debris, number of mesohabitat units present, and water depth Generally, restoration sites were of similar fish community composition and these sites were characterized as having less large woody debris and few mesohabitat units, relative to reference streams Reference sites generally had higher guild abundance of lithophilous spawning fishes and guilds that exhibit less parental investment than restored streams Channelized streams varied widely in habitat structure and fish composition with some evidence of fish community recovery in these systems This work suggests restoration practitioners should, in the near-term, use restoration strategies that ensure the creation and maintenance of mesohabitat units and the recruitment of large woody debris to ensure ecological benefits are achieved

Moving Toward Treating Continuous Covariates As Continuous Variables in Abundance Indices: A Case Study with Gray Triggerfish and Red Snapper

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Abundance indices are one of the integral components of most fishery stock assessments developed to assess stock status compared to biological reference points The development of advanced techniques to develop indices based upon fishery-dependent and -independent data that best characterizes the underlying abundance trends of the population is of paramount importance While work has been made to standardize such indices to account for variable environmental conditions via the inclusion of covariates, the treatment of continuous covariates (eg water temperature, latitude, etc) has remained simplistic Generally abundance is assumed to be either a linear function of a given covariate or, if evidence suggests non-linear relationships with respect to abundance, continuous covariates are converted to discrete variables by binning continuous data to discrete bins An alternative approach is to treat continuous covariates as continuous variables in the model, but use modeling approaches that allow for non-linear relationships with the response variable Here, I explore the use of one such approach in the development of zero inflated negative binomial abundance indices, namely modeling continuous covariates as multi-polynomial functions of the response variable To inform the polynomial maximum order I used preliminary generalized additive models to relate covariates to species presence/absence data and abundance data To illustrate the technique, I use data on two species, gray triggerfish and red snapper, which are routinely sampled in the SERFS chevron trap survey Comparisons are made to traditional relative abundance indices using the same data that transformed continuous covariate data into discrete variables prior to analysis In general, relative abundance indices developed using multi-polynomials are statistically more stable, require the estimate of fewer parameters, and provide a superior fit to analogous models using discrete covariates

Freshwater Mollusk Recovery Programs of the Alabama Aquatic Biodiversity Center

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In 2005 the Alabama Department of Conservation and Natural Resources (ADCNR) initiated the Alabama Aquatic Biodiversity Center (AABC) to address conservation needs of Alabama's rarest

riverine species Initial efforts focused on a $3 million dollar refit and construction of new facilities at the former USGS Claude Harris National Aquaculture Research Center As facilities construction was underway, regional recovery planning documents were completed to coordinate efforts across multiple federal, state, and private conservation groups Alabama's rivers host some 95 federally listed species, including 63 mussels, 13 gastropods and 16 fishes that are current or historic to state waters However, many once wide-ranging species are now restricted to a single or handful of occurrences The primary goal of the AABC efforts is to establish new populations of critically rare species to prevent extinction and promote recovery This is achieved through captive propagation and reintroduction of conservation targets into unoccupied watersheds within historical range Reintroduction efforts are currently underway for 18 freshwater mollusks, including 11 federal T&E species Since 2010 the AABC has reintroduced over 69,000 animals in 13 different localities and developed culture protocols for 26 federal and 15 GCN species Initial reintroduction efforts are persisting, but additional stockings are anticipated to successfully establish reproducing populations Recovery efforts also extend towards habitat conservation and restoration in selected Alabama watersheds through Strategic Habitat Unit (SHU) process Although Alabama's mollusk fauna has suffered greatly from past habitat perturbations, continued diligence of both habitat and species recovery efforts represent an opportunity to prevent future species losses while the SHU process simultaneously addresses other regulatory concerns (National Environmental Policy Act, Clean Water Act) Imperiled species recovery efforts have become a focal point to promote the recovery of the rivers that support them

The Search for the Blackbanded Sunfish: Detection Probability of a Rare Species in Florida

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Conservation of aquatic biota has been an important topic in natural resource management, but interpreting sampling data is often difficult given incomplete detection Knowledge of presence or absence of a rare species is an important part of management decisions, but estimates of the unbiased estimates of the proportion of sites occupied depends on detection probability The Blackbanded Sunfish Enneacanthus chaetodon, is a small, freshwater species that has been collected in Florida several times historically An exhaustive survey across historical collection locations in Florida recently failed to capture any of the fish Our objectives were to estimate detection probability for sampling Blackbanded Sunfish and identify habitat covariates that could be related to site occupancy We sampled four small lakes in northwest Florida to determine sampling efficiency and detection probability We sampled macrophytes and used push-pole boat electrofishing in repeated samples at each lake We found Blackbanded Sunfish in one of the four lakes (Lake Rachel) Detection probability increased with macrophyte coverage and decreased with water depth High detection probabilities in these habitats indicate that on average, ≥ 5 transects would be required to detect this fish in lake of similar habitat and size as Lake Rachel In a worst-case scenario (lower 90% credible interval), ≥ 20 transects would be required to achieve an 80% detection probability Future surveys can use this information to better target likely occupied sites and limit sampling effort in each system to the minimum necessary to reliably detect the fish

Movement By Adult American Shad (*Alosa sapidissima*) in Western Albemarle Sound, North Carolina and Associated River Basins

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Abstract – Populations of American Shad (*Alosa sapidissima*) in Albemarle Sound and Roanoke River are considered to be stable but low As part of the FERC re-licensing of Roanoke Rapids hydroelectric facility, estimates of the number of spawning adult shad in the Roanoke River have been made over

seven years Numbers are considered to be too low (6,000 to 29,000) to permit upstream trap and transport What is unknown is which river basins in Albemarle Sound the shad prefer to ascend – primarily the Chowan or Roanoke rivers Shad movements, survivability, and potential spawning information were gathered by receivers placed within the Chowan and Roanoke rivers Telemetry data will better inform resource agencies on the impacts of current spring water releases from Roanoke Rapids Dam on spawning We question whether these releases are sufficient to attract American Shad to the spawning grounds or if the shad prefer alternative spawning grounds, such as the Chowan River Seven adult shad received acoustic transmitters in the spring of 2013 and 53 in 2014 One male (tagged in 2013) moved up the Chowan River in March, was detected moving downstream in April, and returned to the Chowan River in March 2014 In 2014, nine of the transmittered shad went up the Chowan River and two of its tributaries Two other fish ascended the Roanoke River We hope to continue this work in 2015

American Shad

Spawning

Movement

Effects of a 9-Inch Minimum Length Limit on Angler Exploitation of Black and White Crappie, at Harris Brake Lake, Arkansas

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Crappie populations are highly exploited in southeastern lakes Unfortunately, crappie exploitation rates are relatively unknown for Arkansas Lakes, which makes optimizing the management of this species difficult Angler catch, exploitation, and temporal patterns were determined with a tag reward exploitation study in 2012 and 2013 for crappie (*Pomoxis* spp) in Harris Brake Lake, Arkansas A 9-inch minimum length limit has been in effect since 2001 Catch curve analysis generated by trap net data (2010 and 2012) reveals an average total annual mortality of 60% Due to uncertainty with angler reporting rates and tagging mortality, adjusted annual angler exploitation was estimated over a range of 29% to 48% Anglers caught the majority of crappie from the months of November to May (93%) Modeling indicates if the 9-inch minimum length limit (MLL) is removed, yield could decrease 22% to 34%, the number of 10-inch crappie harvested could decrease 33% to 56%, and the number of 12-inch crappie harvested could decrease 33% to 47%, while increasing total harvest by 20% A 10-inch MLL could increase yield an additional 7% to 16% and increase the number of 10-inch and 12-inch crappie harvested by 22% to 47%, while only decreasing the total number of harvested crappie by 9% This data suggests the current 9-inch MLL is beneficial to the crappie population, however a 10-inch MLL could produce added benefits to anglers Angler preferences to harvest a greater number of crappie, over fewer but larger crappie, would need to be factored into the decision on whether or not to implement a 10-inch MLL

The Exploitation of Largemouth Bass and Suwannee Bass in Northwest Florida

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In Florida, different regions have varying harvest regulations for black basses Thus, obtaining region-wide exploitation rates of black basses is necessary before enacting regulation changes The objective of this study was to determine the exploitation rates of Suwannee Bass and Largemouth Bass throughout northwest Florida Suwannee Bass (n = 108) and Largemouth Bass (n = 160) were tagged in 17 rivers, and an additional 159 Largemouth Bass were tagged in 16 lakes Fish were

tagged with plastic-tipped, high-reward dart tags to ensure high return rates A unique identification number was listed on each tag, as well as a notice of a $100 reward and a contact number to claim the reward Upon claiming their reward, anglers were asked a series of questions about current bass regulations, and their personal harvest practices All rivers and lakes were selected based on public access and the presence of a standard 12-inch minimum length limit regulation The number of tagged fish per water body was directly proportional to the size of the lake or the length of the river During sampling, fish were measured (mm, TL), weighed (g), and tagged prior to release Calculation of exploitation rates assumed a 0% tag induced mortality rate, 8% tag loss rate, and a 100% reporting rate based on previous studies Our results show that exploitation rates of Suwannee Bass and Largemouth Bass in rivers throughout northwest Florida are 0.12 and 0.08, respectively The exploitation rate of Largemouth Bass in lakes throughout northwest Florida was 0.09 Results from the survey questions suggest that a majority of anglers are satisfied with current length and bag limits for Suwannee Bass and Largemouth Bass The exploitation of Suwannee Bass and Largemouth Bass in northwest Florida is low and not a cause for concern with current regulations

Evaluating Stream Restoration Efforts for Eastern Brook Trout in the Chattahoochee National Forest

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The eastern brook trout (*Salvelinus fontinalis*) is important to recreational fisheries and has a native range that extends southward to the southeastern United States In northern Georgia, suitable habitat for brook trout is believed to be limited by land-use changes as well as competition from non-native rainbow trout (Oncorhynchus mykiss) and brown trout (Salmo trutta) Since 2009, the Eastern Brook Trout Joint Venture has supported the addition of large woody debris to several streams within the Chattahoochee National Forest in an effort to restore habitat areas favorable to brook trout populations Over 25 stream locations have been assigned paired control and treatment sites Control sites were left unmodified and treatment sites received an average of 8 new structures Subsequently, GA DNR monitored brook trout abundance using electrofishing 3-pass depletion at these sites In addition, several habitat variables were measured including pool area, counts of large woody debris, mean depth, and dominant substrate type We applied a linear mixed model to the assembled data to test for a treatment effect (ie, addition of structure) on catches of brook trout, using year and site location as random effects and adjusting for differences in effort The maximum observed abundance of adult brook trout was similar between control and treatment sites, but average abundance of adult brook trout was approximately 15% higher in treatment sites than in control sites Likewise, pool area in treatment sites was nearly 25% higher than in control sites

keywords: brook trout, habitat, statistics, stream restoration

Uptake of Polycyclic Aromatic Hydrocarbons (PAHs) in Red Snapper, *Lutjanus campechanus*, after the Deepwater Horizon Oil Spill

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The Deepwater Horizon oil spill occurred on 20 April 2010, which led to approximately 49 million barrels of oil entering the northern Gulf of Mexico Red snapper, *Lutjanus campechanus*, are an important species in the Gulf of Mexico, and were potentially exposed to Polycyclic Aromatic Hydrocarbons (PAHs) from this oil spill To assess this potential PAH exposure, red snapper muscle tissue samples were collected from 2010 to 2012, and analyzed for several PAHs Samples were analyzed using gas chromatography/ mass spectrometry This method is extremely accurate and gives the concentration of each PAH in parts-per-billion (ppb) The highest total PAH in an individual red snapper muscle tissue was 52 ppb among all samples analyzed from pre-spill 2010 (n= 98), post-spill 2010 (n=123), 2011 (n=32), and 2012 (n=448) Significant differences were observed in

total (± SE) PAH by year, with pre-spill 2010 = 002 ± 001 ppb, post-spill 2010 = 459 ± 053 ppb, 2011 = 715 ± 056 ppb, and 2012 = 254 ± 020 ppb (ANOVA: F3,697 = 3370, P < 00001) We have analyzed tissue samples for eight PAH compounds The highest mean PAH concentrations were shown for naphthalene (132 ± 010 ppb) and fluorene (064 ± 009 ppb) However, all measured PAHs were in the range of levels previously observed from pristine Antarctica fish tissue samples (13 to 145 ppb dry wt)

A Comparison of Two Aging Structures for Longnose Gar

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Estimating age in fishes provides important information concerning individuals, populations, and species Age information contributes greatly to our understanding of basic ecological and environmental questions in addition to providing essential life history information to fisheries scientists Many structures are used in estimating fish age including scales, vertebrae, spines, and otoliths One of the problems in age and growth assessment of a species is the selection of the most suitable structure Often an important consideration in selecting an aging structure is the ease in obtaining it and processing it for age estimation However, the easiest structure to obtain is not always the most appropriate one to use Longnose gar Lepisosteus osseus is a relatively long-lived, primitive carnivorous fish species common throughout much of the southeastern region of the US In many aquatic ecosystems, longnose gar is at the top of the foodweb and is an important component in those fish communities For gar species the most common aging technique is to utilize the branchiostegal rays although no study has previously compared the accuracy or precision of branchiostegals rays of longnose gar to otoliths We collected 300+ longnose gar from two tidal river systems in South Carolina and estimated age for those populations using branchialstegal rays and otoliths We found that rays underestimate age by up to ten years in older fish and do not provide consistent age estimates in this species Additionally, we found that the time it takes to obtain and section otoliths is not greater than the time it takes to pull, boil, and clear rays We recommend that future studies concerning longnose utilize sectioned otoliths in obtaining age estimates

Blue Catfish Surveys and Management in Piedmont North Carolina Reservoirs: Starting from the Ground Up

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Blue Catfish were introduced into North Carolina reservoirs in the mid 1960's and self-sustaining populations developed as a result For almost 40 years, little to no sampling for blue catfish occurred Since 2007, we have collected age and growth information from three Piedmont reservoirs: Lake Norman, Badin Lake, and Lake Tillery using gillnetting and electrofishing These efforts have yielded valuable information on Blue Catfish populations We have determined that a one size fits all approach to collecting Blue Catfish across these systems is not effective and that multiple gear types over several time periods in the year may be necessary Also, information collected from these surveys suggests that growth and age composition of Blue Catfish differs substantially among these systems In Lake Tillery and Badin Lake, Blue Catfish reach 800 mm by age 13 while in Lake Norman this length is not reached until age 20 In all systems, fish larger than 800 mm are rare These efforts in multiple systems have provided needed information on this important species and are the baseline for future management strategies

US EPA Cooling Water Intake Structure Regulations: Implications of the New 316(b) Requirements for Fishery Work and Workers

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In August 2014 EPA published new rules regarding cooling water intake structures at power plants and industrial facilities that with draw >2 MGD of water for process cooling purposes The regulatory intent of these regulations is to reduce injury and death of fish and other aquatic life caused by cooling water intake structures at existing power plants and industrial facilities The regulations require that certain aquatic studies be performed at facilities that are impacted by these regulations We describe the required studies and discuss the opportunities that this will provide to fishery and aquatic scientists for project work as well as career implications

Stocking for Striped Bass Stock Restoration: The Good, the Bad, and the Ugly

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Stocking from hatchery-produced fish to restore or enhance spawning runs of anadromous species has occurred since the 1880s In the southeastern US, Striped Bass hatcheries were first developed from the Roanoke Striped Bass spawning run, which were shipped all over the world A network analysis of hatchery records clearly indicates that the Roanoke strain was introduced in nearly every coastal watershed on the US east coast Pamlico Sound watersheds now receive hatchery fish from parents from the Tar and Neuse watersheds Otolith chemistry reveals that the adult populations are primarily stocked fish We urge caution to identify causes of stock decline before initiating stock remediation using hatcheries

Distribution and Community Structure of Coastal Sharks in the Northeastern Gulf of Mexico

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Coastal shark abundance and community structure was quantified across 10 geographic areas in the northeastern Gulf of Mexico using fishery-independent gillnet data from 2003-2011 A total of 3,205 sets were made in which 14,244 carcharhiniform sharks, primarily juveniles, were caught comprising 11 species from three families The three most abundant species, Atlantic sharpnose *Rhizoprionodon terraenovae*, bonnethead *Sphyrna tiburo* and blacktip sharks *Carcharhinus limbatus*, were consistently captured over all areas regardless of environmental conditions; however, some species (eg, bull *C leucas*, blacknose *C acrontous*, finetooth *C isodon*, and sandbar sharks *C plumbeus*) were restricted to a specific area or a range of areas Two-way crossed analysis of similarity (ANOSIM) found geographic area to significantly influence shark species-life stage assemblages while season did not Resemblance matrices between environmental data and shark community assemblage found the two were weakly but significantly correlated, with the combination of salinity and water clarity producing the highest Spearman rank correlation value Species diversity varied by geographic area, but was generally highest in areas with the greatest amount of fresh and saltwater fluctuations Our results suggest that estuarine conditions adjacent to river mouths may affect juvenile shark assemblages across similar latitudes and some areas of the northeastern Gulf of Mexico may be considered important nursery areas for select shark species This study provides important insight into the habitat use of a variety of coastal shark species and can be used to better manage these species through the determination of critical habitat

Fecundity of Alabama Shad (*Alosa alabamae*) from the Apalachicola River

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The Alabama Shad (*Alosa alabamae*) is a species of concern native to the southeastern United States Our study examines the fecundity of 39 female Alabama Shad, averaging 729 g in weight and

ranging in age from 2+ to 4+ years, which were captured from the Apalachicola River, Georgia Samples (1 g) were cut from the center of each ovary (N=78) The oocytes present in the samples were counted, and the diameters of 50 randomly-sampled oocytes were measured for each sample Total mean ovary weight was 6788 g/individual, and the mean oocytes/g was 1,299 ± 273 The average annual fecundity was estimated to be 79,420 oocytes/individual (39,710 oocytes/ovary) Maximum fecundity in our sample was reached at age 3+ and decreased at age 4+ Oocyte diameters ranged from 03 to 27 mm, with a mode of 15 mm Our results were consistent with previous Alabama Shad fecundity studies out of the Apalachicola River Further, the unimodal oocyte diameter frequency distribution suggests that the Alabama Shad is a heterochronal spawner, meaning they have multiple spawning events in a spawning season

Benthic Fauna and Sediment Characteristics Associated with Gulf Sturgeon Habitat Use in a Western Population

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The Gulf sturgeon, *Acipenser oxyrinchus desotoi*, is listed as threatened under the Endangered Species Act with population declines attributable to habitat loss due to dams, commercial fishing, and habitat degradation Critical habitat for Gulf sturgeon includes the shoreline habitat of barrier islands within Mississippi Sound Therefore, disturbance to this habitat caused by the filling of Camille Cut is a concern for natural resource managers To document Gulf sturgeon critical habitat use near Camille Cut, acoustically-tagged Gulf sturgeon were monitored using a telemetry array both in the project area and near neighboring barrier islands A corresponding array of benthic stations was sampled to determine the macrofaunal and sediment composition of areas with high, medium, and low Gulf sturgeon activity levels Benthic community composition differed significantly (ANOSIM) between areas with low and high Gulf sturgeon activity levels Taxa considered to be important prey items for Gulf sturgeon were among those taxa that were more abundant at the “High activity” Gulf sturgeon stations Sediments with high sand content were common and associated with high prey abundances Stations with low sand content in Camille Cut corresponded to areas of low Gulf sturgeon habitat use Seasonal differences in benthic macrofaunal community composition were minor compared to spatial differences that corresponded to variation in physical characteristics of the benthic habitat These results can be used to assess other areas for suitability as Gulf sturgeon foraging habitat

Analysis of Required Environmental Mitigation at Licensed Hydropower Projects Across the US

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Federal Energy Regulatory Commission (FERC) licensing and relicensing of hydropower projects involves a level of uncertainty in regards to the types of environmental mitigation that will be required as license conditions This uncertainty is a result of changes in policy, an increasing number of agencies involved in the licensing process, and a lack of national level datasets of existing mitigation requirements To address the data gap and uncertainty we mined 309 FERC licenses covering 442 hydropower plants to create and populate a national hydropower environmental mitigation database Data extraction was limited to the previous 15 years based on the assumption that recently required mitigation is a better indicator of future mitigation requirements

We developed a geospatial relational database to track and assess mitigation requirements included in FERC licenses A hierarchical database design groups the over 180 possible mitigation requirements into one of six Tier I mitigation categories (fish passage, hydrology, water quality, biodiversity, habitat, and recreation/cultural) which are further organized into 18 Tier II categories and 31 Tier III categories The design of the database permits querying and summarizing of

mitigation requirements by mitigation type, mitigation categories, dam characteristics (through the related National Hydropower Asset Assessment Program database), and stream or landscape features (through linkages with the National Hydrography Dataset)

The most frequent Tier II mitigation categories were: recreational planning (330 plants), recreational mitigation (303), terrestrial biodiversity (292), downstream water quality (233), and sediment/erosion (197) The most frequent Tier III mitigation categories were: recreational management planning (330), downstream water quality monitoring plans (216), sediment and erosion control plans (193), and terrestrial species conservation and management (186) The presentation will provide an assessment of current mitigation requirements, spatial analysis, as well as highlight future directions for analysis and database development

A Potential Emergent Nursery Habitat for the Bull Shark (Carcharhinus leucas) in Pamlico Sound, North Carolina

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The bull shark (*Carcharhinus leucas*) is a seasonal visitor to North Carolina nearshore and estuarine waters, but previous studies have provided little evidence of nursery habitat for this species in state waters Catch, size, and environmental data from North Carolina Division of Marine Fisheries gillnet and longline surveys were used to identify and spatially delineate potential shark nurseries in Pamlico Sound Depth (m), temperature (°C), salinity (ppt), dissolved oxygen (mg/L), and straight-line distance from the nearest inlet and seagrass bed (km) were interpolated across the entire sound, including lower reaches of the Neuse and Pamlico Rivers All sharks were classified as adult, juvenile (age 1+), or neonate based on recorded total length (mm) Generalized linear models were used to identify environmental and spatial factors related to the abundance of each bull shark demographic, and correlation and regression tree models were used to specify “break points” in these factors between high and low shark abundance Areas of Pamlico Sound falling within these points were mapped to spatially delineate potential bull shark nursery habitat From 2007-2013, a total of 42 bull sharks were captured within the sound, of which 30 fell within length-at-age ranges for juveniles or neonates Confirmed juveniles and neonates were first captured in in 2011 and 2012, respectively, and have been documented every year since Neonates were captured May-July, which corresponds with timing of pupping in other bull shark nurseries on the Atlantic and Gulf coasts Both juvenile and neonate abundance were significantly related to temperature and salinity Environmental preferences did not differ significantly between juveniles and neonates, but adults were found at significantly greater depths and in closer proximity to inlets Neonate and juvenile bull sharks were found at stations ≥ 259 °C and ≥ 1735 ppt, and potential nursery habitat in Pamlico Sound encompassed an area between the mouth of the Pamlico River and Croatan Sound Significant increases in water temperature and decreases in salinity during the months of May-August have occurred over the course of the study period These changes may have created favorable conditions for a bull shark nursery in Pamlico Sound

Juvenile Gulf Sturgeon Abundance in the Brother's River, FL

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The Gulf sturgeon, *Acipenser oxyrinchus desotoi*, is a federally threatened anadromous fish species found in Gulf coast drainages from Louisiana to Florida Throughout much of the 20th Century, overfishing and the construction of dams on spawning rivers led to rangewide population declines Fishing for Gulf sturgeon is no longer permitted, but dams located downstream of spawning areas continue to hamper species recovery on many rivers In the Apalachicola River, FL, Jim Woodruff Lock and Dam (JWLD) has eliminated Gulf sturgeon access to 78% of their historic riverine habitat

Although several previous studies have provided useful information about adult Gulf sturgeon abundance in the Apalachicola, quantified estimates of juvenile abundance have not been attempted - yet these estimates provide critical information regarding annual recruitment and long-term population trends The objective of this study was to quantify current age-1 Gulf sturgeon abundance in the Brother's River, - a tidally influenced tributary of the Apalachicola that is known to provide important summer habitat for juvenile Gulf sturgeon During the summer months of 2013 and 2014, we used entanglement gear deployed in channel habitats of the Brothers River and the Lower Apalachicola to conduct a capture-mark-recapture estimate of juvenile Gulf sturgeon abundance We also employed sonic telemetry of juveniles to identify the range of juvenile habitats used during the summer months and to provide important information about population closure Using the Huggins closed-capture model in program Mark, we then estimated annual abundance of age-1 juveniles at 53 (95% CI 45-75) individuals in 2013 and 216 (95% CI 193-252) in 2014 The results of this study suggest that recovery of the population is currently being limited by low recruitment; however, additional years of study are needed to more firmly establish mean annual recruitment and to identify any other potential juvenile holding areas within the Apalachicola River

The Effect of Season on the Residency and Distribution Patterns of the Atlantic Stingray in Two Georgia Creek Systems

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The Atlantic Stingray *Dasyatis sabina* is a demersal predator that is found in freshwater, estuarine, and saltwater habitats along the Atlantic Coast of the United States There are discrepancies about whether this species is a seasonal or year-round resident of coastal habitats along its entire geographic range The purpose of this study was to determine the effect of season on the residency and distribution patterns of the Atlantic Stingray in two creek systems near Savannah, Georgia Forty stingrays were surgically implanted with acoustic transmitters and passively tracked with receivers deployed in Romerly Marsh Creek and the Herb River Bottom-water temperature was monitored with a stationary logger attached to one receiver in each creek A monthly residence index was calculated for each stingray for each creek system, and seasonal distribution was determined for each stingray at each receiver location Monthly residence was positively correlated with average bottom-water temperature in both creek systems Monthly residence (>70% of days) and bottom-water temperature (>27°C) were highest during summer months and lowest during winter months (<10% and <10°C, respectively) Presence was low at all receiver locations during winter in both Romerly Marsh Creek (00-92% of days) and the Herb River (00-157%) Atlantic Stingrays are mostly absent from both creek systems during winter; however, why the rays leave the creek system during this time is still unclear Atlantic Stingrays are predators of commercially important blue crabs and shrimp, so the drivers of their migratory patterns should be investigated in future studies

A Quantitative Traits-Based Approach for Choosing and Prioritizing Study Species and Surrogate Species in Altered Ecosystems

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The bar for justifying use of vertebrate animals for study is becoming increasingly raised for researchers requiring increased rigor for justifying selection of many study species Although we have power analyses to provide quantitative backing for numbers of organisms used, quantitative backing for selection of study species is not frequently employed This can be especially important when measuring the impacts of ecosystem alteration, when study species must be chosen that are both sensitive to the alteration and of sufficient abundance for study Just as important is providing justification for designation of surrogate species for study, especially when the species of interest is rare or of conservation concern and selection of an appropriate surrogate can have legal implications

In this study, we use a combination of GIS, a fish traits database, and multivariate statistical analyses to step through two examples to present a quantitative, traits-based approach for designating study species and surrogate species In our first example, we present a case study where we select broadly-representative fish species for understanding the effects of turbine passage on fishes based on traits that suggest sensitivity to turbine passage In our second example, we build off of our first example and present a framework for selecting a surrogate species for an endangered species We suggest that our traits-based framework can provide quantitative backing and added justification to selection of study species while expanding the inference space of study results

Observations of Shortnose and Atlantic Sturgeons in the St Marys River, Georgia/Florida

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Both Shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are federally endangered anadromous fishes found along the east coast of North America, from maritime Canada to the St Johns River, Florida Decades of overfishing and habitat degradation have led to range-wide declines in the populations of both species Although fishing for these sturgeons is now prohibited, a number of factors, including quality of available habitat, have likely impeded their recovery The St Marys River on the Georgia/Florida border is near the southern extreme of the range for both species Recent studies there have reported only a few adults or sub-adults and no river-resident (age ≤1) fish of either species, suggesting that spawning populations of both sturgeons may have been extirpated Because sturgeons are long-lived intermittent spawners, however, continued monitoring of the St Marys is needed to be certain about the status of both species there In particular, the occurrence of juvenile, river-resident sturgeons would indicate the continued survival of a remnant population The primary objective of this study was to determine the presence or absence of juvenile shortnose and Atlantic sturgeon in the St Marys River Secondary objectives were to evaluate seasonal movements and habitat use of juvenile sturgeon, if their presence was confirmed, as well as to evaluate the genetic structure and population “discreteness” of any captured sturgeon From May to June, 2014, we sampled the fish community in the St Marys estuary with bottom set gill nets and trammel nets deployed in the main channel during slack tides Over 85 net sets, we captured 9 Atlantic and 2 shortnose sturgeons, including young juveniles of both species Ten of the captured sturgeons were implanted with acoustic transmitters, to facilitate monitoring of their movements and habitat use throughout the summer months Our results suggest that remnant naturally reproducing populations of both species are still present in the St Marys, and that river resident juveniles occupy the tidally influenced habitats below the head of tide Microsatellite DNA analysis of the juvenile Atlantic sturgeon collection from the St Marys indicated that it was distinct from all other populations coast-wide

Nocturnal Periodicity of Upstream Migration of Yellow-Phase American Eels at an Eel Ladder on the Shenandoah River

Joni Aldinger*, West Virginia University and Stuart Welsh, USGS, WV Cooperative Fish and Wildlife Research Unit

The American Eel (*Anguilla rostrata*) is a migratory species of ecological and economic importance with current conservation concerns due to population decline While studies have examined the extensive upstream migration of yellow-phase American Eels, little is known about the diel periodicity of upstream migration For example, although American Eels are nocturnal, few studies have examined the nocturnal timing of upstream migration Using passage data (2008-2014) collected at an eel ladder on the Shenandoah River, we found periodic patterns of nocturnal upstream migration Most eels (98%) used the ladder at night, between sunset and sunrise The majority (69%) of individuals passed through the ladder closer to sunrise than sunset across all dates The modal passage time (29%) was two hours before sunrise Our data supported diel and

nocturnal periodicity in the timing of upstream migration of American Eels Further research will focus on the association of migratory timing periodicity with environmental variables, including lunar illumination and river discharge

Using Catch Rate Indices to Monitor American Shad in the St Johns River, Florida; Juvenile Abundance Predicts Future Year Class Strength

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The Florida Fish and Wildlife Conservation Commission uses rate-based indices to monitor the spawning stock abundance and juvenile production of American Shad in the St Johns River An electrofishing survey for adults began in 2003 and a trawl survey for juveniles began in 2007 Both indices yield a geometric mean catch per standard sample (CPUE) This paper describes an evaluation of these indices Electrofishing samples occured bi-weekly for the duration of the spawning season each year and were randomly selected from representative sections of the spawning grounds The nursery zone was delineated using monthly sampling from March to September at 48 randomly selected stations between river kilometer (rkm) 125 and 304 (measured in distance from the river mouth) in 2007, 2008, and 2009 Juvenile collections have been revised to occurr bi-weekly at 12 randomly selected stations in each of two reaches; an upper reach just below the spawning grounds, rkm 210-259, and a lower reach in tidal freshwater, rkm 125-164 The age composition of the adult population was determined from whole otoliths taken from a subsample of the adult catch in each year beginning in 2011 Males were age 2 to 6 with age 3 to 5 predominant Females were age 3 to 7 with age 4 to 6 predominant Therefore complete recruitment of any single year class of this semelparous population takes up to 7 years The CPUE at age of each sex was calculated using age subsamples, length frequency data, and electrofishing CPUE from 2010 through 2014 The cumulative CPUE at age for each cohort was used as an index of abundance of that year class Ages 3 through 7 were summed for the 2007 year-class; ages 3 through 6 for 2008; and age 3 through 5 for 2009 The cumulative CPUE at age for these cohorts was significantly positively correlated with the CPUE of juveniles of that cohort from the lower reach but not from the upper reach The juvenile abundance index from the lower reach may predict future run size The lower nursery is less influenced by river discharge and may be more stable as a nursery from year to year and provide a better index A model to test the relationship of juvenile CPUE to subsequent year class strength of adults will be developed and tested as new data are collected in each year

The Effects of Black Bass Fishing Tournaments on Smallmouth Bass in the New River

Ashley Weston*, Virginia Tech, Brian R Murphy, Virginia Polytechnic Institute and State University and Vic DiCenzo, Virginia Tech

Some anglers have expressed dissatisfaction with the Smallmouth Bass *Micropterus dolomieu* fishery on the Lower New River, Virginia One concern is an increasing number of small-scale tournaments on this section of the river and their possible effect on Smallmouth Bass mortality Such mortality may be particularly increased by high summer water temperatures and limited live-well aeration Our objectives were to investigate tournament catch and size structure, and to assess potential effects on mortality For 37 tournaments in the summer of 2014 we recorded angler catch relative to the restrictive slot limit (14 in—20 in) and compared size-related catch to concurrent creel survey data We are assessing differences in size structure of the general-angling and tournament catches, and simulating (FAMS) possible effects of the tournaments on Smallmouth Bass mortality Simulation results will help to determine whether concerns about tournaments in this fishery are valid Possible future management and outreach actions might include monitoring or permitting tournaments, and public outreach to improve fish-handling procedures

Predation By Juvenile Longnose Gar on Brazos River Fishes

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We conducted a series of laboratory and field feeding experiments to access feeding rate and size-selectivity of juvenile longnose gar *Lepisosteus osseus* We collected 21 juvenile longnose gar, ranging in length from 118- to 208-mm total length, from the upper Brazos River in August 2013 In the laboratory, we assessed size-selective predation by placing one gar each into 21 replicate 17-l aquaria Fifteen prey of known length then were added to each aquarium After 24 hours, gar were removed and the remaining prey were measured In two trials, one using only red shiner *Cyprinella lutrensis* as prey and another using a using a variety of Brazos River fishes as prey, we found that juvenile longnose gar fed on prey of all sizes, except for those greater than 50-mm standard length There was a significant ($P < 0001$) negative relationship between prey length and probability of being eaten In the field feeding trial, we placed five 5 juvenile gar into each of four replicate152-l aquaria We then added 60-90 g of prey (primarily minnows), collected from the Brazos River to the replicate aquaria We placed similar amounts of prey into each of four 152-l control aquaria Juvenile gar were allowed to feed for 48 hr, after which prey were removed and weighed Compared with controls, there was a significant ($P < 00001$) decrease in prey mass in the experimental aquaria Our results show that juvenile longnose gar consume a mass of prey equivalent to be 25% of their mass, per day

Fish and Oil: Not the Tasty Outcome You Expect

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Understanding population structure is an important and necessary component for the effective management of fisheries, especially in the case of anthropogenic disasters, such as oil spills Although relatively little is known about the population structure of many important marine species, molecular technologies offer a comprehensive approach to assess stock structure The 2010 Deepwater Horizon oil spill discharged more than 49 million barrels into the Gulf of Mexico, impacting many different species The red drum (Sciaenidae: Sciaenops ocellatus) is a marine-estuarine fish that is a recreationally important species It occurs across the northern Gulf of Mexico and is heavily fished in the areas impacted by the oil spill We conducted a comparative study to examine pre and post oil spill changes on genetic structure of the red drum We gathered data from more than 600 individuals pre- and post oil spill, and used multiple microsatellite loci to determine genetic stock structure of red drum before and after the spill in Louisiana waters Using multiple population genetic analyses, we examined the differentiation of these populations and recovered a genetic split associated with the outflow of the Mississippi River before the oil spill Little variation was recovered among populations before the oil spill west of the Mississippi River, suggesting ongoing gene flow among these western populations Results from the post oil spill samples indicated that there was no longer any genetic differentiation east and west of the Mississippi River, and that red drum experienced an Fst reduction by an order of magnitude between these areas In addition, there was also a loss of private alleles from the eastern populations, and an influx of private alleles from the western population after the spill The implications of these results will be presented in a comprehensive summary

Assessing the Economic Impact of Tournament Black Bass Angling on Lake Guntersville, Alabama

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Lake Guntersville, Alabama boasts one of the most popular Largemouth Bass *Micropterus salmoides* fisheries in the United States and, as such, competitive bass fishermen constitute a large proportion of angling effort on the lake Black Bass Micropterus spp tournaments bring in additional revenue to local communities surrounding the reservoirs on which they occur, as well as, a source of tax revenue for local, state and regional governments We estimated the economic impact of tournament Black Bass fishing expenditures and tax revenues generated at Lake Guntersville, Alabama to the local towns, counties, and state We also estimated effort and catch for the tournament fishery During this twelve month study we sampled 77 tournaments and distributed 1,672 surveys with 439 returned for a 26% response rate Overall tournament angling effort was estimated to be 90 thousand hours which resulted in approximately $46 million in direct economic impact Mean trip travel costs ranged from $103 for wildcat tournament anglers to $1,568 for professional anglers Data collected during this project is valuable to policymakers and stakeholders to demonstrate the importance of tournament angling on the Lake Guntersville area and how management plans can be adopted to increase local expenditures

Influence of Bait Type on Catch and Bycatch in Tandem Hoop Nets Set in Kentucky Small Impoundments

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Minimizing bycatch while maintaining adequate catches of target species is important in fisheries management Baited tandem hoop nets have become a preferred gear by biologists for sampling channel catfish but high bycatch often coincides Aquatic turtles are particularly susceptible to tandem hoop nets and often drown when captured Many bait types (eg, soybean cake and cheese) have been examined for its effect on catch of channel catfish in hoop nets but how these bait types affect bycatch rates in tandem hoop nets has not At Lake McMurtry, Oklahoma, baiting tandem hoop nets with Zote™ soap and cheese logs (BoatCycle, Inc, Henderson, TX) resulted in similar catch rates and size structure of channel catfish with lower rates of turtle mortality, but this study was limited to one reservoir Expanding on this, we sought to; 1) determine if bait type (Zote™ soap and cheese log) would affect catch and size structure of channel catfish in small impoundments and, 2) determine if bait type would affect bycatch of aquatic turtles We set four to six tandem hoop net series (three nets per series), in two sampling periods at 13 lakes in Kentucky in June 2014 Each sample period, one half of the sites had nets baited with either 1 kg of ground cheese logs or 1 kg Zote™ soap Nets were fished for two days, fish and animals removed and processed, and then re-set with the opposite bait and allowed to fish another two days Bait type did not affect relative abundance of channel catfish ($P > 005$), but hoop nets baited with soap caught larger-sized channel catfish on average (344 mm TL) compared to those baited with cheese (320 mm TL) ($P < 001$) Additionally, hoop nets baited with soap not only caught significantly fewer turtles ($N = 332$) than those baited with cheese ($N = 608$), but those caught experienced lower mortality ($P < 005$)

Mortality, Dispersal and Habitat Use of Stocked Juvenile Muskellunge in Western North Carolina Rivers

Dylan Owensby*, North Carolina State University, James A Rice, North Carolina State University and D Derek Aday, North Carolina State University

Muskellunge *Esox masquinongy* is a highly popular sport fish native to the Mississippi River drainages of western North Carolina It is thought that high levels of water pollution led to its extirpation in North Carolina by the 1950s After water quality began to recover with the implementation of the Clean Water Act, the North Carolina Wildlife Resources Commission (NCWRC) began a stocking program in 1978 to provide a viable muskellunge fishery in North Carolina Although there are currently established muskellunge fisheries in the French Broad and Catawba

Rivers, there is little evidence of a viable fishery in the North Carolina sections of the New River To address the perceived failure of the New River muskellunge fishery, we initiated a study to investigate the dispersal, mortality and habitat use of the stocked juvenile muskellunge During fall of 2013 we implanted radio transmitters into 50 age-0, hatchery reared muskellunge (mean TL 282 mm) prior to stocking in the New River Preliminary analysis indicates that mortality was 78-96% at 86 days post stocking Average dispersal was 142 km, with a maximum individual dispersal of 673 km Due to the high mortality on the New River, we decided to switch the study site for the second field season to the French Broad River, where stocking has been successful During fall of 2014 we implanted radio transmitters into 50 age-0, hatchery reared muskellunge (mean TL 306 mm) prior to stocking in the French Broad River Any differences in mortality and dispersal between the two rivers may provide some insight into factors that determine a successful muskellunge fishery During the summer of 2014 we quantified habitat availability in the study reach, and during tracking we are recording habitat use data for each relocated fish Habitat use will be compared to habitat availability to infer habitat preferences of the stocked muskellunge This study will provide fisheries biologists with information from which to re-evaluate stocking plans to maintain an important native fishery in North Carolina rivers

Preliminary Observations of American Shad Usage of an Alaskan Steeppass Fishway

Alan Stuart*, Duke Energy Carolinas LLC and Jason Brown, Duke Energy Progress

Preliminary Observations of American Shad Usage of an Alaskan Steeppass Fishway

Alan Stuart, Duke Energy Carolinas LLC and Jason Brown, Duke Energy Progress

Duke Energy Carolinas, LLC and Duke Energy Progress, LLC (Collectively, Duke Energy) is required to provide American Shad passage at the Blewett Falls Hydroelectric Development (FERC Project No 2206) and the Wateree Hydroelectric Development (FERC Project No 2232) As part of the Federal Energy Regulatory Commission relicensing process, these requirements have been prescribed by the US Fish and Wildlife Service in accordance with their authority under Section 18 of the Federal Power Act

In meeting passage obligations at the projects two commonly accepted styles of baffled chute type fishways are the Denil and Alaskan Steeppass (Steeppass), both of which have been used effectively to pass Alosine species in other parts of the United States The Steeppass “Trap” technology utilizes baffled sloped chutes that allow fish to swim up from the tailrace into a mechanically operated holding basket To better understand if this technology can be successfully implemented to meet fish passage obligations at the Blewett Falls and Wateree developments, Duke Energy deployed and tested a portable Model C type Steeppass in the Blewett Falls tailrace during the spring of 2014

The American Shad and Blueback Herring spring spawning run below the Blewett Falls Project (river mile 188) can be highly variable with respect to timing and magnitude In 2014, American Shad and Blueback Herring spawning migrations were delayed by southward shifts of the North Polar Vortex in early 2014

Despite facing challenging environmental conditions, testing documented American Shad utilizing the Steeppass device During the Steeppass testing period (February 26 – June 5) a total of 28 American Shad successfully ascended the Steeppass representing 84% of the total number of fish collected Further, a total of 305 non-target resident fish successfully utilized the Steeppass during that time period as well Gizzard Shad represented 944% of the total non-target resident fish collected Other non-target species found to utilize the Steeppass include Threadfin Shad, Longnose Gar, sunfish and catfish

Preliminary results suggest American Shad occupying large tailraces will successfully utilize a Model C Steeppass given the correct setup and design Further refinement of Steeppass design and testing is planned for 2015 at the Blewett Falls development and in 2016 at the Wateree development

Trout Population Monitoring within Nantahala River Bypass Reach, NC, in Response to Recreational Flow Releases

Amanda Bushon, North Carolina Wildlife Resources Commission, Jacob Rash*, North Carolina Wildlife Resources Commission, jacobrash@ncwildlifeorg and Christopher Goudreau, North Carolina Wildlife Resources Commission

Recreational flow releases were established within Nantahala River Bypass Reach through the Federal Energy Regulatory Commission relicensing of Duke Energy's Nantahala Project In 2012–2013, the North Carolina Wildlife Resources Commission, in conjunction with other resource managers, attempted to monitor the influence of recreational flow events on wild trout populations within the Nantahala River Bypass Reach and Nantahala Tailwater Monitoring included temperature and flow loggers, fish population sampling, and fish held in live cages during the flow events Temperature effects of release events were most pronounced during late summer and fall releases Densities and standing crop estimates of adult wild trout did not vary substantially among the sample dates; however, age-0 Rainbow Trout were not present during the last sample date at either site Short-term effects of the releases were not apparent in fish held in live cages Although recreational releases have the potential to affect wild trout populations, stocking trout in the bypass reach remains a viable management approach

Fish Community Composition on Artificial Reefs in the Northeast Gulf of Mexico before and after the Deepwater Horizon Oil Spill

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The 2010 Deepwater Horizon oil spill, one of the largest in US history, has been implicated in a variety of environmental and biological changes in the region One of these is drastic reductions in reef fish abundance and shifts in community composition We used multivariate tools to examine potential changes in reef fish community composition on small artificial reefs in the Northeast Gulf of Mexico between 2009 and 2014 Our analysis suggests that community composition on these reefs differed globally among years (perMANOVA: pseudo-F = 1604, pseudo-p <00001) While the change between 2009 (pre-spill) and 2010 (early post-spill) was significant (perMANOVA: pseudo-F = 1348, pseudo-p <00001), subsequent changes between consecutive years have also occurred In fact, the largest shift appears to have occurred between 2013 and 2014 (perMANOVA: pseudo-F = 2140, pseudo-p <00001) Reef fish communities surveyed in 2014 shared the least overlap with observations from other years Community differences between the 2009 (pre-spill) observations and the 2010 (early post-spill) communities appear to be driven by a decrease in red snapper, vermillion snapper, and grey triggerfish (three important fisheries species), with concomitant increases in lane snapper and tomtate

Fine scale movements of the Atlantic Stingray: a tidal or diel pattern?

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Stingray behavior can be affected by external cues in the environment such as time of day and tide The purpose of this study was to determine how these two variables affected the movement patterns of the Atlantic Stingray *Dasyatis sabina* in the Herb River system near Savannah, GA Seven stingrays were tagged internally with Vemco continuous, depth-sensing acoustic transmitters Stingray movement was tracked using a Vemco VR100-acoustic receiver with a directional hydrophone for a

cumulative total of ~22-70 h per stingray A 95% kernel density estimation was used to determine the activity area of each ray There appeared to be more of an effect of tidal stage than time of day on stingray movements The activity area of each stingray overlapped less between high and low tide (~0-50%) than between ebb and flood tides (~80-95%) Most stingrays had similarly sized night and day activity areas that overlapped by ~70-90% Stingrays typically occupied the channel of smaller tributaries at high tide but the edges of deeper branches at low tide Stingrays may have altered their movement patterns based on changes in access afforded by the higher tidal stage Further research will be conducted to determine if there is a relationship between stingray movements and small-scale habitat features that may be linked to food resources

Strong Diet Overlap in Four Sympatric Gar Relatives (Lepisosteidae), Including Reintroduced Alligator Gar (*Atractosteus spatula*), of Western Kentucky

Bradley Richardson*, Murray State University, brichardson@murraystateedu and Michael Flinn, Murray State University

During the past decade, increased efforts to reintroduce alligator gar (*Atractosteus spatula*) to the Lower Mississippi River basin have resulted in the early success of low density populations To ensure sustainable populations of alligator gar, continued monitoring is critical The reintroduction of alligator gar to western Kentucky places the species into a system from which it was absent for more than 50 years and occupied by three other native gar species: longnose gar (*Lepisosteus osseus*), shortnose gar (*L platostomus*), and spotted gar (*L oculatus*) The objective of this study is to compare diets of these four species within Clarks River, Kentucky Strong overlap was not expected, as different gar species often partition feeding times and locations Gar were captured via mono- and multifilament gill nets with 51 cm mesh Prey items were collected from stomachs and/or fecal matter and identified to lowest taxonomic resolution possible Fish prey items were comprised primarily of shad (Clupeidae), freshwater drum (Sciaenidae), and sunfishes (Centrarchidae); however, a number of macroinvertebrates were also found in the stomach contents Statistics were performed on the frequency of occurrence and prey-specific abundance of each prey item to investigate differences in diets between gar species Principle Component Analysis was performed across prey items to distinguish the importance of each in the diet of the four gar species Levins' Niche Breadth was performed, and indicated resource partitioning between gar species However, a Simplified Morisita Index displayed large diet overlap between these predators Our results suggest that there is no significant difference in diet composition of gar species, but that specific prey items indicate biological differences in diet, consistent with resource partitioning

Genetic Impacts of Net Pen Failures on Gulf of Mexico Cobia Populations: A Simulation Study

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Global aquaculture production has expanded rapidly over the last half-century, with present production levels accounting for more than 50% of the global seafood demand Offshore cage-based fish farms are highly cost-efficient for production and grow out, and there is great interest in expansion of net pen operations in US waters However, the development of net pen farming has raised concerns over the possible genetic and ecological impacts of escaped fish on wild populations We used a forward-time individual-based simulation model to investigate the potential impacts of net pen failures over the short term (50 years) on standing genetic variation of native cobia stocks in the Gulf of Mexico These effects were assessed through simulations with varying net pen failure rates, broodstock sizes, and broodstock source populations In response to these parameter changes, we examined several genetic response variables focused on the levels of standing genetic variation in the population and the degree of temporal genetic differentiation within the native population As expected, higher net pen failure rates resulted in greater genetic impacts on the native cobia

population Additionally, the use of more genetically differentiated source populations resulted in larger influxes of non-native genetic variants and greater temporal genetic differentiation in the native population following net pen failure Our results highlight the importance of considering the appropriate source of broodstock in net pen aquaculture systems, quantify levels of introgression and genetic differentiation associated with alternative management practices, and provide recommendations for broodstock selection and maintenance A better understanding of the potential influences of net pen failure rate, broodstock number, and broodstock source on the genetic composition of the native stock will allow for the development of management protocols for responsible net pen aquaculture operations

American Shad Passage at Boshers Dam Vertical Slot Fishway in the James River Piedmont/Coastal Plain Fall Zone

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The vertical slot fishway at Boshers Dam on the James River near Richmond was built in 1999 Last in the fall zone, this 31 m high dam is 1823 km from Chesapeake Bay Shad have access to 2214 km of historical spawning habitat on the mainstem and 3219 km on tributaries Fish are attracted into the entrance by a 63 cms (max) attraction flow system Fish ascend 13 pools (31 m x 37 m) gaining 023 m at each slot (041 m) between pools Fish are counted at a viewing window in the exit channel Methods evolved from live counts, to time lapse vhs, to digital video Review evolved from 6 hrs/day live counts, to 100% of video, to 15 minutes/hour subsampling Most review is of daytime hours with night video subsampling American Shad and at least 22 other fish species use the fishway Fishway counts play a vital role in assessing the progress of American shad restoration efforts on the James River and are an integral part of the Chesapeake Bay abundance indicator Long-term average annual Gizzard Shad passage is 85,000 (~90% of total) while American Shad is 200 American Shad passage estimates are correlated (r = 076) with tidal gillnet (128 km downstream) results and trends are similar to other east coast river abundance estimates Passage numbers continue to be well below goals that were set 20 years ago based on historical numbers and available upstream spawning habitat Upstream American shad fry stocking continues annually

Characterization of the Function of Different Call Types in the Acoustic Repertoire of Spawning Spotted Seatrout

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Spotted Seatrout is an ecologically and recreationally important estuarine-dependent finfish along the coast of the Gulf of Mexico The species exhibits a relatively complex mating system, of which sound production is an important component During spawning, male Spotted Seatrout use an acoustic repertoire of four distinct call types However, the function of these call types has not been characterized We used a combination of video and passive hydroacoustics to monitor the reproductive behavior of a captive population of Spotted Seatrout in 2011 and 2013 Fertilized eggs were collected daily using a surface skimmer and counted volumetrically We were able to identify the four types of calls characteristic of spawning as described in previous literature The call types differed in their relative frequencies and timing depending on whether spawning occurred, as evidenced by eggs being recovered from the tank the next morning Multiple-pulse calls and long grunts were produced more frequently than paired dual-pulse calls during the spawning season, while staccato call was the least common among the four call types The number of eggs produced was positively correlated to sound production, and the probability of eggs being collected was correlated to both paired dual-pulse calls and long grunts Spotted Seatrout produced lower energy, but higher pitched calls on nights that spawning occurred compared to nights where no eggs were recovered Preliminary analysis of video data suggests behavioral responses to different call types

Our data indicates that dual-pulse calls and staccato calls may function as attractors to females or for establishing male dominance hierarchies, while multiple-pulse calls and long grunts are likely used for courtship displays This information may enable for higher resolution in-situ monitoring of Spotted Seatrout aggregations both in the wild and in production facilities

Assessment of Spawning Runs of Anadromous River Herring in North Carolina, 2006-2014

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Stocks of anadromous river herring, collectively alewife *Alosa pseudoharengus* and blueback herring *A aestivalis*, are severely depressed throughout much of their geographic range A moratorium on anadromous river herring harvest was enacted in inland waters of North Carolina in July 2006 and was extended statewide in September 2007 In spring 2006, North Carolina Wildlife Resources Commission biologists initiated annual boat electrofishing spring surveys in select tributaries in the Chowan, Roanoke, Tar, Neuse and Cape Fear river basins Tributaries were selected based on previous surveys and anecdotal evidence of significant historical runs of river herring Our survey objectives were to sample the systems on a weekly basis and assess population characteristics during their spawning run and monitor relative abundance in relation to the current harvest moratorium Thus far, our monitoring has indicated little improvement in alewife or blueback herring since implementation of the harvest moratorium These findings suggest the need for continued protection as well as the consideration of alternative enhancement strategies

Having Your Cake and Eating It Too: Simple Gear Modifications to Reduce Sub-Legal Bycatch but Maintain Target Catch in the US South Atlantic Black Sea Bass and Blue Crab Trap Fisheries

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Bycatch is a management and conservation issue in commercial trap fisheries where gear configurations are not optimally sized to both reduce bycatch of sub-legal individuals and maintain the catch of legal individuals of the target species This appears to be the case in commercial fisheries for two well-known species harvested in federal and state waters of the US South Atlantic, the black sea bass and blue crab, for which increasing trap mesh and escape (cull) ring sizes, respectively, have not kept pace with evolving minimum length limits The body depth of black sea bass and carapace length of blue crabs are dimensions that determine whether these two species can fit through square trap mesh or circular cull rings, respectively, but biological size regulations pertain to total length and carapace width of these respective species We used a relationship between black sea bass body depth and total length to predict a new optimal mesh size that would retain fish at least as large as the new commercial minimum size limit (279 mm total length) but increase rates of egress of sub-legal fish Similarly, a relationship between blue crab carapace length and width was used to predict a new optimal cull ring size that would retain male blue crabs at least as large as the minimum size limit (127 mm carapace width) but increase rates of egress of sub-legal males For each of these respective species we undertook cooperative research that involved fishing experimental traps with progressively larger mesh/cull ring sizes as well as control traps with sub-legal mesh sizes/no cull rings to provide data to estimate contact selectivity of each experimental trap type Selectivity calculations revealed that the mesh size (fish traps) and cull ring size (crab traps) can be increased from their commercial minimums to reduce the catch rate of sub-legal individuals while maintaining the catch rate of legal individuals These simple gear modifications, if used in commercial fisheries, would result in a substantial annual reduction in catches of sub-legal black sea bass that experience discard mortality as a result of handling and of sub-legal male blue crabs that are often commercially retained as landed catch We showed that simple morphometry can successfully predict the approximate minimum body sizes of individuals retained by trap gear and recommend this approach in other trap fisheries where bycatch of smaller animals is an issue

Seasonal, Non-Tournament Catch and Release Mortality of Largemouth Bass Caught on Artificial Lures in a Florida Water Body

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Several studies have researched mortality rates of largemouth bass caught in tournaments However, few studies have evaluated non-tournament catch and release mortality of largemouth bass caught in the wild The objective of this study is to determine angling induced mortality of largemouth bass caught and released on single and treble hooked artificial lures in relation to: hook location, fight time, air exposure, and water temperature Largemouth bass were angled twice a month from December through March and from June through September Thirty largemouth bass were caught on artificial lures during each sample and were held in submerged holding pens for 72 hours; control fish sampled by electro-fishing were also placed in these cages Total mortality of largemouth bass caught on artificial lures was 395 % and mortality was higher in the summer (750 %) than the winter (041 %) Mortality of largemouth bass was significantly correlated to hook location, water temperature, and air exposure Results of this study can help managers to have a better understanding of the factors that affect mortality of largemouth bass that are caught and released, and this data may allow managers to make more valid comparisons between recreational and tournament mortality

Seasonal Movement Patterns of Walleye in a Hydropower Reservoir

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Cheat Lake, a hydropower reservoir in northern West Virginia, was historically impacted by severe acid mine drainage Although the native walleye population was extirpated several decades ago, the reintroduced walleye fishery has seen recent improvements owing to management efforts and improving water quality Improvements to the fishery have until recently been relatively slow and the influence of natural reproduction unclear It is also unclear whether impacts of current hydropower operations and lingering effects from acid mine drainage are limiting the walleye fishery Of particular interest are the influences of natural and anthropogenic (ie, hydropower operations) factors on walleye seasonal movements, with particular interest in spawning related movements Walleye movements have been monitored over the course of three years both by manual tracking and with submersible, stationary receivers placed throughout the lake Results suggest that spawning movements are correlated primarily with changes in lake elevation and water temperature Following increases in lake elevation and water temperature, adult walleyes move upstream to the head of the lake to spawn Also, approximately 32% of tagged walleyes leave the lake entirely and spawn in the river upstream Females typically move downstream immediately after spawning while males may remain near the spawning grounds for up to several months Movements during non-spawning seasons are influenced by incoming river flow, water temperature changes, lake elevation changes, and possibly dissolved oxygen levels In particular, walleyes located in the main lake make frequent movements to the upstream reaches during summer as water temperatures increase and dissolved oxygen levels decrease Additionally, increases in river flow during summer and fall often trigger upstream movements by walleye in Cheat Lake Ultimately, results suggest that hydropower operations have a stronger influence on spawning season movements of walleyes, while natural factors such as water temperature and river flow are more important during non-spawning seasons However, low dissolved oxygen levels due to reservoir stratification during summer may also be influencing summer movement patterns

Can Changes in Regulations and Stocking Strategies Affect Predatory Interactions Between Muskellunge and Smallmouth Bass

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The management of fisheries that include multiple predatory sport fish species can be difficult, from both the perspectives of ecological balance and competing angler interests Such interactions and complications certainly exist for the Muskellunge *Esox masquinongy* and Smallmouth Bass *Micropterus dolomieu* fisheries of the New River, Virginia Changes in Muskellunge stocking strategies to increase recruitment (a shift to fall-stocking of advanced fingerlings), and an increased minimum size limit (30”to 42”) to create a trophy Muskellunge fishery have seemingly resulted in increased natural reproduction and standing stock for the species Concurrently, Smallmouth Bass anglers are voicing growing concern regarding possible increases in predatory interaction between Muskellunge and Smallmouth Bass and the possible effects that interaction might have on the quality of the bass fishery We are evaluating size structure and food habits of the current Muskellunge population to assess possible changes since the management adjustments circa 2005 Our preliminary results indicate an increase in size structure of the Muskellunge population, but Smallmouth Bass still constitute only a small portion of their diet We are now evaluating possible changes in standing stock (biomass) Sampling will continue through the spring of 2015 We will use FAMS to simulate potential effects of Muskellunge population changes on the Smallmouth Bass population and fishery

Seeking Rare Fish in a Fragmented, Hydropower Driven, Metro-Area, Braided Prairie Stream: Exceptions to the Rules

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Shovelnose sturgeon Scaphirhynchus platorynchus is native to the Mississippi and Missouri rivers and their tributaries, including the Arkansas River of Oklahoma at the southwestern extent of the species range The Arkansas River enters Oklahoma from Kansas as a braided prairie stream but is then impounded by two large reservoirs before becoming the channelized McClellan-Kerr Navigation System Oklahoma Department of Wildlife Conservation (ODWC) is investigating habitat selection and movement of shovelnose sturgeon in a large segment of the Arkansas River from Sand Springs, OK to Webber Falls, OK This reach spans 212 rkm, primarily consisting of pseudo-natural braided prairie stream habitat dominated by swift, shallow channels and sand substrate before transitioning to reservoir habitat in Muskogee, OK Although common and abundant throughout the remainder of the species’ range, angler reports and ODWC encounters with shovelnose sturgeon in the Arkansas River have been rare or incidental Thorough testing of published capture methodologies for shovelnose sturgeon (including trotlines, gill nets, hoop nets, trammel nets, seines, and benthic trawls) were largely inappropriate in this system due to the unique, shallow, and fragmented prairie river habitats in addition to hydropower water management and urban access issues Development of new collecting methodologies, hydrological manipulation, interagency collaboration, and persistence resulted in the capture of 29 adult shovelnose sturgeon in 30 days These hybridized methods are described here in addition to a preview of ODWC’s foray into shovelnose sturgeon research, conservation, and management in Oklahoma

Effects of Hydrology and Temperature on the Growth of Shovelnose Sturgeon in the Lower Mississippi River

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Shovelnose Sturgeon *Scaphirhynchus platorhynchus* are the most widespread of the three species of North American freshwater sturgeon Over the past century, however, shovelnose sturgeon populations have declined In the lower Mississippi River, these declines are possibly due in part to river modifications for shipping and flood control To inform population analyses and to guide restoration of shovelnose sturgeon, we assessed the effects of hydrologic and temperature conditions on the growth of shovelnose sturgeon in the lower Mississippi River Shovelnose sturgeon were aged by sectioned pectoral spines, and annual growth increments were back calculated by direct proportion Regression analysis of growth increments that spanned 7 years of hydrologic and thermal variation indicated that a longer duration of days at or below 11°C hindered growth Growth was positively related to duration of days at a milder temperature range of 10-21°C We found no effect of river stages Our results suggest that shovelnose sturgeon growth is largely determined by the temperature fluctuations that occur annually on the lower Mississippi River

Genetic Substructure within the Native Range of the Shoal Bass

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The Shoal Bass (*Micropterus cataractae*) is a fluvial-specialist species endemic to the Apalachicola-Chattahoochee-Flint (ACF) Basin of the southeastern US The species is in decline throughout much its range because of extensive habitat alteration and fragmentation To inform future management and conservation efforts, our objective was to examine genetic substructure of the Shoal Bass throughout its native range Putative Shoal Bass tissue samples were collected from localities within the upper and middle Chattahoochee River Basin, upper and lower Flint River Basin, and the Chipola River Individual genotypes consisted of 17 polymorphic microsatellite DNA markers We used factorial correspondence analysis (FCA) plots for initial visualization of genetic substructure We then employed a Bayesian K-clustering approach in Program STRUCTURE, along with accessory programs CLUMPP and STRUCTURE HARVESTER, to proportionally assign individual genotypes to clusters Using the Evanno method for determining K, two distinct subgroups were recovered; however, our results suggest that appreciable substructure exists beyond K=2 Our clustering results also suggest that populations are experiencing varying degrees of fragmentation For example, genomic proportions estimated in STRUCTURE show limited evidence of reproductive exchange in the Uchee Creek and Chipola River populations, whereas those from the lower Flint River suggest a much higher frequency of exchange Our results have direct implications for future management and conservation measures for the species, which could include stocking efforts to re-establish populations, alleviate inbreeding depression, and/or combat introgression with non-native congeners Future studies will include genotypes from additional localities and will focus on identifying riverscape features contributing to the fragmentation of Shoal Bass populations

Osmotic Stress Limits the Distribution of New Zealand Mud Snails within Redwood National Park

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New Zealand mud snails (hereafter mudsnails) are exotic mollusks present and very abundant in many waterways of the western United States and in the Great Lakes region In 2009, mudsnails were detected in Redwood Creek in Redwood National Park in Northern California Although mudsnails are noted for their ability to increase rapidly in abundance and colonize new habitats, after more than 4 years in the Redwood Creek, their distribution remains limited to a ca 300 m reach of the estuary Recent literature suggests that low specific conductivity and environmental calcium can limit mudsnails distribution within watersheds We conducted laboratory experiments, exposing mudsnails collected from Redwood Creek to both natural waters and artificial culture media, to

determine if low conductivity and calcium concentration limit the distribution of mudsnails in Redwood National Park For natural water exposures, we held mudsnails in water from their source location in the estuary (conductivity 135 µS/cm, calcium 20 mg/L) or water from one of four other locations in the Redwood Creek watershed that encompass a range of conductivity (77 -158 µS/cm) and calcium concentration (8-275 mg/L) For artificial media exposures, we manipulated both conductivity (range 20-200 µS/cm) and calcium concentration (range 5-175 mg/L) in a factorial design Response variables measured included mortality and reproductive output Adult mudsnails survived for long periods (> 4 months) in the lowest conductivity waters from Redwood Creek and all but the lowest conductivity artificial water treatments, regardless of calcium concentration However, reproductive output was very low in both the low-calcium natural water and low-calcium artificial media Our results suggest that water chemistry may limit the spread of mudsnails in Redwood National Park by reducing their reproductive output

Adult American Shad Movment through Santee Cooper Reservoir System

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Adult American shad enter the Santee-Cooper watershed, South Carolina, each spring to complete their anadromous life cycle An impediment to migration is encountered at river kilometer 84 (St Stephen Dam), however a fish lock provides passage above the dam The fish lock began operating in 1985 and since 2000 has passed an average of ~250,000 American shad/year From February-April in 2009 and 2010, American shad were captured as they passed through the fish lock or via electrofishing in the tailrace and were implanted with acoustic transmitters A total of 643 (396 in 2009, 247 in 2010) were tagged and released on the lake side of St Stephen Dam An array of 45 acoustic receivers was deployed throughout the Santee Cooper system to assess movements within the reservoir and tributary rivers Similar patterns of migration were observed each year Post tagging 'fall back' below St Stephen Dam was experienced in both years, and due to high flows a significant percentage (23%) occurred during 2010 73% in 2009 and 58% in 2010, of American shad that did not experience fall back were able to navigate through the Santee Cooper reservoir system, a minimum of 65 kilometers, to upstream areas that were presumed to be suitable spawning habitat within the reservoir and tributary rivers Detections of American shad in tributary rivers decreased with distance from the reservoir, however 15% in 2009 and 17% in 2010 were detected 35 kilometers upriver from the reservoir, a minimum of 100 kilometers from St Stephen Dam

Impacts of Angling for Nesting Florida Bass, Micropterus Floridanus, on Nest Success and Recruitment

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Nesting black bass *Micropterus* spp exhibit parental care during the spring spawning season Anglers often intentionally target black bass that are guarding nests Previous studies of largemouth *M salmoides* and smallmouth bass *M dolomieu* have shown that catching fish off of nests will increase predation of eggs and larvae, which can reduce individual nest success Little work has been done evaluate whether this indirect fishing-associated mortality could influence population level recruitment and no work has been done to look at impacts bed fishing has on Florida bass *M floridanus* During this study, nine replicate ponds were stocked with adult Florida bass, forage fish, and nest predators, and brush piles and vertical structure were placed into the ponds to simulate a natural system during two consecutive years Ponds were snorkeled every other day throughout the spawning season to track nest success and abandonment During each year n five of the ponds, every nest located was angled Angled fish were held in a cage within the pond for one hour before being released back into the pond No angling was conducted on the other four control ponds each year Nests were considered successful if swim up fry were observed Nest success rates were 52%

for fished ponds and 45% for unfished ponds during year one and 36% and 57% in year two respectively Off the fish caught off of nests, 50% in year one, and 45% in year two returned to that nest and ended up with swim up fry During both years combined, fish in unfished ponds produced significantly higher numbers of nests Nest sizes were no different between fished and unfished ponds During year one the average number of adults contributing to the yearclass produced was similar between fished and unfished ponds Ponds were drained nine months after stocking in order to compare young-of-the-year recruitment between fished and unfished ponds During both years there was no significant difference in the number of recruits produced between fished and unfished ponds Results from this study indicate that in Florida bed fishing likely does not negatively impact year class production

Determination of Seasonal Abundance and Density of Nekton Species Proximal to Cedar Bayou Pre- and Post-Opening

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Determination of Seasonal Abundance and Density of Nekton Species Proximal to Cedar Bayou Pre- and Post-Opening

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Keywords: tidal inlets, nekton, estuarine dependence, sportfish

Texas estuaries are separated from the Gulf of Mexico by a series of barrier islands While these islands obstruct connectivity, a handful of tidal inlets provide direct exchange between the open Gulf and nearshore estuary systems These tidal inlets are crucial conduits for migration and dispersal of juvenile and adult nekton In September 2014, a collaborative dredging effort was completed that reopened Cedar Bayou, a natural tidal inlet that historically linked Mesquite Bay, TX, to the Gulf of Mexico The overall goal of this project is to assess the impact of reopening Cedar Bayou on nekton productivity and sustainability in adjacent nursery habitats within the nearby Aransas and Mesquite Bay complexes Specifically, we determined how juvenile nekton densities change in Mesquite Bay pre- and post- opening and assessed the nekton productivity as a food resource for economically and ecologically important species Nekton samples were collected using a before-after-control-impact (BACI) design at specific sites during peak recruitment seasons Prior to reopening Cedar Bayou we found very few key estuarine-dependent nekton, such as Red Drum (Sciaenops ocellatus) and Southern Flounder (Paralichthys lethostigma), at impact sites near the closed inlet, while fish densities were significantly higher at the control sites near the open and flowing Aransas Pass inlet Post-opening samples are showing high recruitment of these estuarine-dependent species at impact sites For example, even though no juvenile Red Drum were found at the impact sites in two years of pre-opening surveys, they were present at every impact site within days of water flowing through the inlet While the post-opening studies are in the early phase, these preliminary results show estuarine-dependent nekton are accessing the productive habitats of Mesquite Bay through Cedar Bayou, which could translate into higher fisheries productivity as these areas were inaccessible before the inlet was reopened

Genetic Composition of Largemouth Bass in Coastal Rivers of Northwest Florida

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Coastal rivers provide exceptional fishing opportunities throughout the southeast US for a variety of freshwater species Largemouth Bass are a major component in these fisheries and are highly valued by anglers, especially in northwest Florida where few impoundments and natural lakes exist Typical of most northern Gulf Coast rivers, salinity levels in the upper portion of the Escambia River are low but may exceed 13 ppt in the lower, estuarine section of the river Recent sampling on the Escambia River indicated there may be large differences in age and size structure in Largemouth Bass populations inhabiting the main river compared to estuarine habitats Previous research on coastal rivers have documented life-history differences between individuals in river and estuarine habitats, however it is unknown if this variation can be attributed to phenotypic plasticity or limited gene flow between the two groups Genetic samples were collected in both river and estuarine habitats in the Escambia River to determine if individuals existed as a single randomly mating (panmictic) population or if some environmental barrier or behavior was preventing individuals from mating randomly Microsatellite DNA analysis indicated no genetic differences between samples collected from the upper and middle sections of the river, suggesting that individuals in the river habitat exist as a panmictic population Allele frequencies were significantly different between fish in river and estuary habitats at a number of microsatellite loci; however the magnitude of the differences indicated there was a relatively small amount of genetic structure between these groups Overall, this indicates that samples from the river and estuary were not taken from a randomly mating population, but that there is some amount of gene flow between fish in the estuary and river subpopulations It is possible that environmental differences between river and estuarine habitats have led to divergent selection and limited mating between subpopulations within the same river system Hybridization between Largemouth Bass and Florida Bass has historically occurred within this system and this study confirmed that the population is composed of pure northern Largemouth bass and hybrid individuals A greater proportion of the fish in the estuary were determined to be pure northern Largemouth Bass than in river habitats This suggest that individuals with northern Largemouth Bass genes may have greater fitness than hybrid individuals in estuarine environments located in the northern Gulf Coast, allowing them to flourish in these unique habitats

A Review of Published Literature on Crappie Supplemental Stocking

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Abstract- There is a wide range of procedures that fisheries managers may employ during crappie supplemental stocking efforts The influence of specific choices, among the procedures, on success of stockings is unclear We compared and summarized methods and procedures of supplemental crappie stocking We examined system size, number of fish stocked, stocking density, mean TL at stocking, handling mortality, and hatchery contributions Our analysis focused primarily on published literature that utilized chemical marking as a method for estimating year-class contribution We summarized seven published studies and our own unpublished data, which reported sixty-six separate incidences of crappie stocking These stockings occurred in five states within the past thirty-four years White Crappie, Black Crappie, and black-nosed crappie were all stocked, though Arkansas was the only state to report stocking white crappies and Tennessee was the only state to report stocking black-nosed crappie There were 21 water bodies stocked, ranging in size from 58 to 12,270 ha The number stocked per incidence ranged from 100 to 453,121 fish, at stocking densities between 22 and 2440 fish/ha The mean TL of fishes stocked ranged from 388 to 1170 mm Handling mortality was monitored for periods as short as a few hours, up to as long as 4 d, or not reported at all Handling mortality at the end of the hauling process ranged from 35% to 940% Ninety-six hour handling mortality ranged from 70% to 560% Only two marking methods were reported (oxytetracycline mark and coded microwire tags) All studies utilizing oxytetracycline immersion followed the protocol outlined by Brooks et al 1994 Marking efficacy ranged from 88% to 100% Efforts to recapture stocked fish utilized trap nets, rotenone, otter trawls and electrofishing Four of the studies reported contributions of hatchery fish to the year class at various times following

stocking Contributions ranged from zero shortly after stocking, to 92% in the fall for age-2 fish High variability in handling mortality may be confounding relationships between stocking density or mean length at stocking and hatchery contribution to year classes High variability in handling mortality also appears to directly influence to high variability in hatchery contributions to year classes

Tag Retention of Dart Tags By Riverine Smallmouth Bass

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Mark-recapture studies are a useful tool for the management of aquatic resources and recent advances in tag technology have increased their application and effectiveness Population dynamics, growth, survival, movement and sampling efficiency have all been estimated from the recaptures of marked fish in freshwater and marine environments New technologies, such as radio-frequency identification, pit tags, genetic finger printing, elastomer tags, and dart tags have increased recapture rates and subsequently increased the accuracy of these parameter estimates The objective of this study was to evaluate the retention of dart tags on riverine smallmouth bass The advantages of dart tags are: unique identification, easy to read, quick to use, data maintains readability, highly visible to anglers, and they come in a range of sizes (eg, 12 mm, 16 mm, and 20 mm) that are appropriate for fishes of various lengths Stream systems are diverse and complex and we hypothesized that there would be a myriad of factors that might influence tag retention in streams that might be less problematic in reservoirs (eg, high water velocities) Fish were captured using a variety of methods, anesthetized, and tagged Fish < 305mm were tagged with PDS (16 X 83mm) tags and fish > 305mm were tagged using PDAT (2 x 110mm) tags In addition, each fish was double tagged with a 12-mm PIT tag Preliminary results suggest retention of these tags may be low (~ 20%) but were limited by few recaptures warranting additional sampling effort Additional studies are ongoing to evaluate tag retention in the field but also under controlled laboratory conditions

Defining Fish Communities: Factors Affecting the Organization of Fish Communities in the Mobile Bay Estuary

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Estuaries are important ecosystems at the interface between marine and freshwater systems They provide many critical ecosystem services, such as water filtration, habitat protection, and nursery habitat for numerous commercially and ecologically important fishes and invertebrates The Mobile Bay Estuary, Alabama is a river-dominated estuary in the northern Gulf of Mexico Patterns of freshwater input from the Mobile River drive both the upstream-downstream spatial gradient and seasonal fluctuation of salinity in the greater Mobile Estuary Changes in river discharge as well as wind and storm-driven water movements can produce rapid changes not only in salinity, but also in other physical-chemical conditions in the estuary Because of the variable nature of these abiotic conditions in the estuary and the overlap of marine and freshwater organisms that occurs in estuaries, the aquatic community structure can vary dramatically both spatially and temporally

We quantified the fish and macroinvertebrate communities at 7 sites along an upstream-downstream abiotic gradient within the Mobile Bay Estuary over a three year period (April 2011-June 2014) to quantify trends in community structure Sites were sampled using electrofishing and standardized seine hauls, and we also measured salinity (ppt), water temperature (ºC) and dissolved oxygen (mg/l) Multivariate ordination methods were used to characterize patterns in fish and macro-invertebrate communities Statistical techniques were then used to determine the correspondence of these relationships with the measured abiotic variables

Upstream sites were dominated by centrarchids (eg, *Lepomis microlophus, Lepomis miniatus, Lepomis macrochirus, Micropterus salmoides, Lepomis gulosus*), while downstream sites were dominated by species such as spot (*Leiostomus xanthrus*), clupeids (eg, *Anchoa mitchilli, Brevortia patronus*) Downstream sites separated in ordination based upon differences in pinfish (*Lagodon rhomboides*), macroinvertebrates such as blue crab (*Callinectes sapidus*), grass shrimp (Palaemonidae spp) and estuarine fundulids (eg, *Fundulus grandis, Fundulus similis*) Ordinations revealed that sites differed greatly due to variation in abiotic variables Salinity was identified as the most important variable in discriminating the upstream-downstream gradient Water temperature was found to play the largest role in defining differences between sites of similar salinities, with dissolved oxygen levels playing a secondary role in dividing sites along this axis Patterns of community composition suggested that sites were more strongly influenced by physical-chemical properties specific to the habitat than proximity to the Gulf of Mexico

Status and Conservation of Anadromous Alabama Shad in the Appalachicola-Chattahoochee-Flint River Basin

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The Alabama shad *Alosa alabamae* is an anadromous member of the family Clupeidae Alabama shad historically ascended rivers flowing into the Gulf of Mexico from the Suwannee River in northwest Florida west to the Mississippi River in Louisiana to spawn However, populations of Alabama shad have declined precipitously throughout its range over the past 50 years, likely due to the proliferation of lock and dam structures which block spawning migrations, water pollution, and other habitat degradations The largest known remaining population of Alosa alabamae can be found in the Apalachicola-Chattahoochee-Flint River system, and has been the focus of extensive research by Federal, State, Academic and private investigators since 2005 Annual population estimates of returning fish at Jim Woodruff Lock and Dam (JWLD) over 2006 to 2013 have yielded estimates ranging from 2,039 to 122,578, and voluntary passage through the lock at JWLD during this time ranged from 24-45% Radio telemetry of these fish has found that virtually all Alabama shad moving through the lock migrate up the Flint River, where they presumably spawn Age-0 Alabama shad remain in the river throughout the summer and fall, and are regularly collected in gill-net samples conducted in Lake Seminole above JWLD in early December However, spawning and juvenile habitat characteristics of this species in the Flint River remain unknown Likewise, little is known about the timing of outmigration and biology and ecology of these fish in the Gulf of Mexico The 2013 and 2014 spawning population of these fish at JWLD were the lowest recorded since research began on this species in 2005, and thus concerns about the long-term viability of this species may be warranted

Simulating Population Level Impacts of Fishing Spawning Largemouth Bass Using Empirical Data from Lake Eustis, Florida

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Florida anglers continue to express concern about fishing for spawning Florida Bass Micropterus salmoides No special regulations exist in Florida during the bass spawning season Fishery managers assume that catching nesting bass can result in higher nest failure, but they also assume that nest fishing should have little impact on the overall population Quantifying population-level impacts caused by fishing nesting bass is difficult in natural systems because of high recruitment variability resulting from environmental fluctuations (eg, water levels, vegetation, weather) We designed a study that would use empirical data collected from a moderately pressured Florida lake

(Lake Eustis, FL) to simulate impacts that nest fishing may have on recruitment if all bass caught by anglers during the spawning season were nesting fish and all caught bass had 100% nest failure (ie, worst case scenario) An equilibrium population model was built to evaluate the affects of various regulations; including closing the fishery for bass during the spawning season Simulations for a spawning season closure resulted in increases in the adult population (9%), recruitment (6%), catch rate (29%), and spawning potential ratio (62%; increased from 054 to 084) Although under this "worst case scenario", most metrics tested increase slightly with a spawning closure, these results indicate that the bass population is not heavily impacted by fishing nesting bass There are substantial tradeoffs for implementing a spawning season closure in Florida as this is the peak season for bass angling and the spawning season can occur over three months or more A much more significant impact on the bass population would have to be seen before managers would consider a spawning season closure

The Introduction of Blueback Herring *Alosa aestivalis* to Lewis Smith Lake, Alabama and Its Effects on Sport Fish and Other Native Fishes

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Introductions of invasive species can have a broad range of effects on resident fishes, potentially including both positive and negative impacts Blueback Herring *Alosa aestivalis* were first discovered in Lewis Smith Lake, Alabama in 2010 and it is uncertain what their overall effect will be on native species It is clear, however, that there are likely to be both some positive and some negative effects Given the responses of other systems, Blueback Herring may compete with other fish species for zooplankton at various life stages, possibly leading to reduced growth and survival Alternatively, positive effects could include increased prey availability for piscivores, leading to increased growth and body condition To test these possibilities, we sampled all life stages of Blueback Herring and resident sport and prey fishes from 7 sites in Lewis Smith Lake in 2013 and 2014 Diet data suggest that there is potential for competition between Blueback Herring and both Gizzard Shad and Threadfin Shad at the larval and juvenile life stages with much lower potential for competition among adults due to differences in prey size selection As adults, Alabama Bass, Largemouth Bass, crappie spp, and Bluegill, are likely to experience less competition with Blueback Herring because of reduced diet overlap We compared catch-at-age and length-weight data collected after the introduction of Blueback Herring to historical pre-Blueback Herring data for adult black basses and Striped Bass We found significant increases in relative weights of both Alabama Bass and Largemouth Bass; although relative weights of Striped Bass Morone saxatilis were greater after Blueback Herring were present, the increase was not statistically significant In the years following the introduction of Blueback Herring recruitment of Largemouth Bass has been more variable and apparently reduced compared to trends seen in historical pre-Blueback Herring introduction data However, it is still unclear whether these changes in recruitment are outside the range of normal variation We are continuing to explore causal linkages between this pattern and Blueback Herring introduction Given that we are seeing evidence for a mix of positive and negative responses to Blueback Herring introduction, additional work will be required to determine the overall influence of the introduction for this system

Use of Side-Scan Sonar to Identify and Count Alligator Gar: Potential for Evaluating Population Density from Sonar Imagery

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Declines in the abundance and distribution of the Alligator Gar *Atractosteus spatula* have spurred the initiation of many management and research efforts to conserve remaining populations However, inefficient sampling gears and low abundance in many systems, often hamper the collection of sufficient data to inform management We tested a consumer-grade, side-scan sonar system to

determine if it could serve as an efficient, non-invasive means to identify and count Alligator Gar We first conducted a replicated pond experiment in which six ponds were stocked with known numbers of Alligator Gar and other large-bodied fishes to determine if Alligator Gar could be accurately identified and enumerated We then conducted a field-based evaluation by comparing abundance estimates derived from side-scan sonar images to those derived from mark-recapture sampling of a small isolated riverine population of Alligator Gar In pond experiments, Alligator Gar density based on sonar image interpretation was consistently underestimated (52% - 92% of true abundance) and other fishes were seldom falsely counted as Alligator Gar (7% of possible occasions) Side-scan counts from the river population (mean = 70 fish, range = 59-77) were remarkably close to the mark-recapture population estimate of 76 fish (95% CI = 43-149) We concluded that side-scan sonar has much potential for efficiently identifying and enumerating Alligator Gar with minimal effort The technology may also prove useful for evaluating Alligator Gar habitat association and improving sampling efficiency using traditional gears

Morphometric and Meristic Analysis of the Choctaw Bass (*Micropterus sp cf puntulatus*) from Alabama and Florida Gulf Coastal Plain Rivers

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While investigating hybridization in Shoal Bass *Micropterus cataractae* in the Apalachicola River system in Florida, Florida Fish and Wildlife Conservation researchers discovered a genetically distinct and unknown taxon that inhabits the Gulf Coastal Plain Rivers of Alabama and Florida Superficially, these bass that we are referring to as the Choctaw Bass appear similar to Northern Spotted Bass *M punctulatus* and was previously recognized as such Investigations into meristic and morphometric differences between this species and the Northern Spotted Bass, Alabama Bass *M henshalli*, and Guadalupe Bass *M treculii* are subtle yet evident Differences between this nominal form east of the Mobile River system and the Northern Spotted Bass residing in coastal systems west of the Mobile River system were less apparent, and warrant further investigations Historically these fish were all once considered the same species, however genetic, morphometric, and meristic analysis discovered that they all are in fact unique While these basses are best distinguished by watersheds in which they reside, there is still a management need to distinguish between these species based on traditional counts and measurements Therefore we propose a provisional dichotomous key to delineate differences between these aforementioned species Given the relatively restricted distribution of this population of Choctaw Bass, management and protections are needed to prevent negative ecological and genetic impacts to this population that has been observed in other endemic black bass species

Discussions of River Herring Restoration Needs in the Santee-Cooper River Basin

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Atlantic Coast Fish Habitat Partnership along with The Nature Conservancy is currently trying to identify river herring restoration needs in specific watersheds along the Atlantic Coast This project is funded by National Fish and Wildlife Foundation and is part of their 10-year river herring initiative The Santee-Cooper watershed was chosen in the southeast as one of the priorities by NFWF and we will take this opportunity to reach out to all stakeholders in order to hopefully discuss what might be the best approaches to prioritizing restoration needs for blueback herring in this basin Goals of this discussion would be to think beyond connectivity or passage issues while identifying data gaps and thinking holistically about restoration projects During this time, a brief roundtable discussion will be

held in order to present attendee's ideas concerning restoration needs for river herring in the Santee Cooper River Basin

Predation of Anadromous Alosines By Non-Native Ictalurids in Virginia's Tidal Rivers

Joseph Schmitt*, Virginia Tech and Don J Orth, Virginia Tech

Abstract— Native to the Midwest, blue catfish *Ictalurus furcatus* and flathead catfish *Pylodictus olivarus* have been widely introduced into many Atlantic slope rivers Both of these species thrive in Virginia's tidal rivers, though blue catfish have become especially abundant throughout the Chesapeake Bay Fisheries managers are now concerned that these non-native catfish may be preying upon depleted anadromous species such as American shad, blueback herring, and alewife Diet items were extracted from 740 blue and 123 flathead catfish from March – May, as these months correspond with the spawning migration of anadromous Alosines Prey items were identified to the lowest possible taxon and unidentifiable fish remains were analyzed using DNA barcoding techniques Dietary indices calculated included percent by weight (%W), percent occurrence (%O), and prey-specific index of relative importance (%PSIRI) for all major prey groups Fish were grouped into 100 mm length classes and one-way analysis of variance was used to assess ontogenetic diet shifts Three pass removal methodology (Seber 1982) was used to estimate the relative abundance of prey in the environment using high-frequency electrofishing Feeding selectivity was then analyzed for blue and flathead catfish using Chesson's alpha, which compares the relative abundance of prey in the environment to the frequency of occurrence in the diet

Selectivity of Gillnets Used to Capture Alligator Gar and the Effects on Estimates of Growth, Age Structure, and Survival

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Gillnets are often used to collect Alligator Gar *Atractosteus spatula*; however it is unknown if this gear provides an accurate sample of fish sizes for this species We fished five gillnets with different mesh sizes (ie, 889, 1016, 1143, 1270, and 1397-mm bar measure) routinely used for capturing Alligator Gar and caught 692 Alligator Gar between 1000-2300mm We estimated the size selectivity of the five gillnet meshes We then used simulations to estimate the effects of sampling bias on estimates of length frequency, growth, mean length at age, proportional year-class strength, and survival We found the best model of selectivity was achieved using a series of binormal distributions in which the assumption of geometric similarity had been relaxed (ie, binormal with deviations) The combined meshes underestimated the proportion of smaller fish, leading to a biased length-frequency distribution This biased length-frequency distribution affected estimates of most vital statistics, especially for young fish Estimates of vital statistics for older fish were only slightly biased, likely because the lengths of older fish have considerable overlap Survival estimates had very little bias because we used the catch-curve approach, which eliminates younger fish from the analysis If the goal of sampling is to estimate vital parameters for younger fish, length frequencies should be adjusted to account for the biased length-frequency However, bias adjustments for older fish are probably unnecessary Results of this study will allow researchers to either adjust for known size biases or develop a bias-adjusted sampling design that should catch a more representative sample of Alligator Gar

The Ecological Consequences of Claw Removal on Stone Crabs and Their Fishery Implications

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The stone crab fishery practice of claw removal can affect fished populations in an atypical way because harvested individuals are not necessarily killed The number of legal-sized claws that can be removed from an individual differs throughout stone crabs' range Crabs are returned to the water after their claws are harvested with the expectation that claws may be regenerated, thus "renewing" the fishery We examined the consequences for stone crabs of removing one or two claws by monitoring mortality and prey consumption in the short-term Claw removal induced mortality within days when wound widths were > 7 mm, regardless of the number of claws removed Results suggest that short-term survival following claw removal could be high in a two-claw fishery for crabs that do not incur large wounds; however, the indirect effects resulting from altered prey consumption abilities may be substantial In our study, crabs with one claw removed consumed fewer oysters and mussels than intact crabs, while crabs with both claws removed did not consume any bivalves, but ate fish flesh Control crabs and crabs missing their crusher consumed mussels of all sizes, but the restricted feeding ability of clawless crabs indicates that their diet is limited to soft-bodied prey Consequently, bivalves, an important prey resource throughout stone crabs' range, are eliminated from their diet until their claws are regenerated Reduced prey consumption for crabs missing claws, combined with a long intermolt duration, indicate that return to the fishery of previously harvested crabs is probably an uncommon occurrence

Costs and Consequences of Dam Passage for Paddlefish in Northeast Oklahoma – Rostrum Amputation and the Hydropower Diet Plan

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Habitat fragmentation is often cited as a key threat to wide-ranging, big river fishes For potadromous species such as the American paddlefish (*Polyodon spathula*), fragmentation due to dams can prevent access to upriver spawning locations and isolate river stocks into discrete, genetically-insulated reservoir populations Downstream dam passage can occur in many cases for paddlefish larvae, juveniles, and adults, but the duration, magnitude, and ecological and genetic effects of such passage are not well documented Potential negative effects of rostrum damage caused by downstream movement of fish are also not well documented In Northeast Oklahoma, the Neosho / Grand River was impounded in 1940, 1949, and 1965 to create a series of reservoirs (Grand, Ft Gibson, and Hudson, respectively) which are managed in different ways; each reservoir supporting robust stocks of paddlefish An investigation on downstream passage of adult paddlefish and physical consequences of passage is described here Netting returns of jaw-banded adult fish indicate a low rate of downstream emigration, but this passage is likely a result of periodic offseason flood releases, rather than normal dam operations or springtime flooding The frequency of rostrum injury and amputations was investigated in relation to downstream passage In addition, the effects of rostrum injury on downstream stocks were analyzed in relation to fish condition (relative weight) and reservoir productivity An analysis of genetic exchange between these stocks is ongoing These efforts are a small facet of broad-scale research endeavors focused on long-term management of paddlefish in Oklahoma

The Spread and Traits of Introduced Stream Fishes in the Middle and Upper New River Drainage

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A better understanding of the ecology of introduced fishes is important for managing harmful invasive species, assessing risks and benefits prior to future introductions, and assessing fish-community responses to environmental change With the highest proportion of introduced fishes of any eastern US drainage, and also a high level of endemism, the New River provides an ideal natural laboratory for the study of stream-fish introductions The goal of this study was to identify important

biotic, abiotic, and anthropogenic drivers of stream-fish invasions in the middle and upper New River drainage of Virginia and North Carolina

We compiled an historical fish-distribution data set for the New River and analyzed the spread of introduced and native fishes during the past century Preliminary analysis showed that over a third of the New River fishes have been expanding their range, with introduced species comprising three quarters of these “spreaders” However, among the most rapid spreaders were the native nest-spawner, Bluehead Chub Nocomis leptocephalus and a native nest associate, Mountain Redbelly Dace *Chrosomus oreas* Traits of the introduced species differed from the natives—the former showed greater longevity, body size, and fecundity, and tended to be non-lithophilic Thus, the successful introduced fishes were more aligned toward periodic and equilibrium life-history endpoints, and therefore better adapted to novel niches in impoundments and regulated streams, whereas nest association has facilitated opportunistic native spreaders Further analysis of the traits of introduced and native spreaders and non-spreaders is underway

Is Rugosity on Intertidal Oyster Reefs Related to Spat and Associated Resident Fauna?

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Habitat vertical complexity is an important physical feature of many marine systems (eg, rocky intertidal, coral reefs, and bivalve communities) that can influence factors such as predator-prey interactions and recruitment High vertical structure on intertidal Eastern oyster, *Crassostrea virginica*, reefs is beneficial to both fishery and habitat functions Quantifying related parameters, such as oyster size frequencies and associated fauna, typically requires destructive sampling (eg, excavating quadrats) Using the chain method to measure reef rugosity (Rq) is an alternative, non-destructive method for quantifying vertical reef structure This method entails placing a chain (1 m long with 1 cm links) across the reef surface so that it conforms to the reef substratum and calculating Rq as 1- d/l, where d is the horizontal distance covered by the conformed chain and l is the length of the chain when fully extended I am investigating the relationship between rugosity and factors such as oyster size frequencies, recruitment, and associated faunal assemblages In summer 2013, experimental trays were deployed at two sites in Charleston Harbor, Charleston, SC to examine whether oyster recruitment and associated faunal densities are related to vertical complexity (standardized by Rq measures) After twelve weeks, trays were collected and washed Oyster spat were counted and measured and associated macrofauna were identified, counted and measured To date, results indicate that rugosity is more strongly related to the abundances of some crab species (eg Eurypanopeus depressus and Petrolisthes armatus) compared to others (eg Panopeus herbstii) To compare these experimental results with natural oyster habitat, rugosity was measured in the summer of 2014 on restored reefs over 025 m2 quadrats before excavation The excavated quadrats were processed in the same manner as the experimental trays Results indicate that the rugosity metric can serve as a reliable management tool that characterizes the oyster habitat vertical complexity used by associated macrofauna

What Can We Learn about Florida's American Eel Populations with Ongoing Monitoring Efforts?

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According to the 2012 American Eel Benchmark Stock Assessment by the Atlantic States Marine Fisheries Commission (ASMFC), the American eel stock is in a state of decline There are many mechanisms that may be playing a role in this decline, including habitat loss and degradation, turbine mortality, commercial harvest, climate change, and disease As a result of this assessment, the ASMFC identified data gaps and provided research recommendations for the future conservation

of the species Although funding is limited, several monitoring programs currently in place throughout Florida may be useful in gathering important information to address some of these issues We have conducted a young-of-year survey since 2001 and have observed a significant negative trend in catch rate for the 14-year record Furthermore, size of eels was highly associated with catch rate but not with timing of their inland migration, suggesting that conditions in the marine environment may be influencing recruitment patterns In 2006, the Florida Fish and Wildlife Conservation Commission (FWC) also established a long-term monitoring program for collecting fish community data in a subset of lakes and rivers Since that time, a total of 13 to 118 American eels have been observed in electrofishing samples from 34 water bodies, including canals, rivers, and lakes Beginning in 2014, FWC biologists began surveying these eels for Anguillicoides crassus parasite infestation To date, 31 eels have been processed with an overall infection rate of 39% All infected eels were collected in Atlantic coastal systems and had pathology index values ranging from 1 to 4 for the Swimbladder Degenerative Index (SDI) and 003 to 030 for the Length Ratio Index (LRI) With a paucity of information about Florida's eel populations, ongoing monitoring efforts can provide an economically feasible way to collect important data for the future conservation of this species

Utilization of Genetic Markers to Improve Age Assignment of Striped Bass in Coastal Rivers of North Carolina

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Accurate representation of the age structure of migratory Striped Bass populations is critical to the development of stock assessment models and subsequent management of these important recreational and commercial fisheries Currently, NC Wildlife Resources Commission biologists collect length, weight, sex, scales, and fin-clips of Striped Bass Morone saxatilis during spawning ground surveys to characterize populations and to evaluate hatchery contribution Scales are utilized as the ageing structure of choice (although otoliths are recognized as providing more reliable age estimates) primarily as a way to reduce sampling mortality on depressed populations Fin-clips from Striped Bass have been collected since 2010 from several North Carolina coastal river systems to examine genetic markers and assign origin of hatchery fish Because genetic analysis provides a report card of hatchery contribution of each cohort annually, this information can also be used to build a data set of known-aged fish With hatchery contribution potentially as high as 100% in some rivers, fin-clips could replace or supplement the use of scales for age analysis A subset of scales would likely still need to be collected on all individuals; however, ageing would only occur if the Striped Bass was determined to be of unknown or wild origin Since stocking has occurred in coastal rivers longer than the broodstock genotype database has been available, fin-clips could also be used to validate previously estimated Striped Bass ages A review of past ageing procedures and discussion of new opportunities will be presented

Blue Crabs (*Callinectes sapidus*) and Freshwater Inflows: A National Perspective

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Freshwater inflows are critical to maintain the health of estuary ecosystems and the fisheries they support, but can become severely depleted due to human use and drought Ecologically and economically important focal species can be used as a tool for managers to balance demands and allocate limited freshwater resources Although several studies have linked the economically important blue crab, Callinectes sapidus, to freshwater inflows in individual systems with a variety of approaches, no study has synthesized data across the range of the blue crab to examine these relationships with a standard approach and make direct comparisons between diverse systems Fisheries independent long term monitoring data from hundreds of sampling sites across 30 estuaries was synthesized, comparing relationships between blue crab abundance, freshwater

inflows, and salinity between individual sites and estuaries The results of this large scale analysis will help managers of freshwater resources and blue crab stocks make better informed decisions as pressures continue to grow into the future

The curious case of eastern oyster stock status in Apalachicola Bay, Florida

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The Apalachicola Bay, Florida, eastern oyster (*Crassostrea virginica*) industry has annually produced about 10% of the US oyster harvest Unprecedented attention is currently being given to the status of oyster resources in Apalachicola Bay as this fishery has become central to the decision making related to multi-state water disputes in the southeastern US The oyster fishery collapsed in 2012, leading to economic losses, under employment, and community concerns over the current and future status of oyster resources, ecosystem health, and local economic opportunities We used best available data to develop a stock assessment model to assess what mechanism(s) may have led to the collapse of the Apalachicola Bay oyster fishery We then used this model to assess the efficacy of alternative management strategies (eg, restoration, fishery closure) to accelerate oyster population recovery Our results suggest that the Apalachicola Bay oyster population is not recruitment overfished, but that the collapse was driven by lower-than-average recruitment levels and/or poor survival of juvenile oysters in the years preceding the collapse This reduction in recruitment not only reduced the biomass of oysters available to harvest, but more important from a population resilience perspective, likely reduced the amount of dead shell material available as larval settlement area This oyster fishery has proven resilient over its 150+ year history to periods of stability and instability yet the fishery now seems to be at a crossroads in terms of continued existence and possibly an irreversible collapse It is likely that restoration and management decisions made now will strongly influence the long-term viability of the Apalachicola Bay oyster fishery

Comparing Spatial Effort Allocation Across Fishery Sectors: A Case Study with Gag Grouper

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The spatial allocation of effort in fisheries for wide-ranging fish stocks is becoming of greater interest to managers, particular when the species biology aggregates in particular locales Local ecological knowledge (LEK), such as that provided in fishing reports and angler diaries can provide meaningful environmental data without the requirement of traditional presence/absence information for recreational fisheries In the commercial sector, vessel monitoring systems (VMS) can provide coordinates of vessel spatial presence which were translated into environmental relationships We present a modeling framework and case study in Gag Grouper (*Mycteroperca microlepis*) to translate LEK and VMS relationships from environmental space to geographic locations in the Gulf of Mexico This distribution of recreational and commercial effort was compared with a generalized species distribution from physiological tolerances of the species Distributions were created in relation to depth, temperature, season, and structure (salt marsh, seagrass, tidal flat, and reef) A GLM was used to define functional environmental relationships and to derive habitat suitability indices for the geographic space given 1000 random seeds Hotspots of species occurrence were identified across effort distributions and the generalized species distribution These hotspots can help allocate research effort into particular areas and identify locations where habitat management maybe of particular use

The Value of Supplementary Fish Habitat in Lentic Systems: Attraction Versus Production

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The debate surrounding whether supplementary fish habitat can increase production or simply increases fish aggregation has been ongoing for decades Until recently, the focus of the discussion has primarily been on marine ecosystems, leaving large lentic systems mostly unaddressed Research applied to marine systems indicates claims of production increases could be substantiated if the following processes are present: increased primary production, reduced larval recruitment bottlenecks, and increased foraging opportunities Structure supplementation programs can be expensive enterprises, and in many cases are subject to intense political and public scrutiny Fisheries managers need to know the amount of resources which should be allocated to structure supplementation, as well as how to effectively allocate resources Excessive supplementation may have deleterious effects or may not provide additional benefits, and not enough supplementation may not produce desired results and may be wasted effort If the major value of supplementary structure is to aggregate fish so that anglers can harvest them, and if exploitation rates are already high, then managers should resist the pressure to embark on structure-enhancement programs A review of the literature in search for evidence of production versus aggregation suggested structure supplementation does both, although the magnitude of the effects varies temporally, spatially, and according to species Sorting out the extent of production and aggregation is problematic

Challenges of Establishing Trophy Fisheries in Private Ponds

David Beasley*, SOLitude Lake Management

Managing private ponds and lakes to grow trophy fish has its own unique set of challenges, when compared to fisheries being managed in public waters Though diverse in size and scope, private waterbodies have the same core obstacles to overcome before fish can thrive: habitat, predator densities, client expectations and budget Private pond management allows biologists greater control of a system As a result, biologists have greater odds of improving fish growth with a variety of techniques and utilizing natural and man-made products The strategies and techniques in the fisheries management plan are often recommended by a fisheries biologist and approved by the client Client goals and methodologies chosen to achieve their goals will vary greatly Successful projects involve owners and biologists working together to share a common vision

Catch-and-Release Mortality and Spawning Migration of Sauger *Sander canadensis* in the Cumberland River, Tennessee

Grant Scholten*, University of Florida and Phillip Bettoli, Tennessee Cooperative Fishery Research Unit

Humans can radically alter aquatic ecosystems directly and indirectly Fragmentation of river systems via the construction of dams affects the ability of migratory fish to move throughout a system and can hamper their ability to spawn Overexploitation of fish stocks, especially when they congregate below dams, can result in recruitment overfishing where harvest exceeds the ability of a stock to replenish its numbers Restoration of fisheries should focus on the anthropogenic influences that preceded their decline Sauger *Sander canadensis* in the tailwaters of several Tennessee impoundments represent the largest percid fisheries in the southeast USA However, declining Sauger populations have been evident since historical spawning migrations were blocked by dams and little is known about current spawning areas in the Cumberland River Additionally, Sauger were seasonally vulnerable to anglers in tailwaters and it is important to evaluate the population-level effects of catch-and-release (CR) mortality The objectives of this research were to (1) describe the spawning migration of Saugers in the Cumberland River, and (2) estimate the instantaneous rate of CR and harvest mortality To assess spawning movements, Saugers were implanted with radio transmitters in January 2014 and tracked weekly throughout the spawning season To estimate the instantaneous mortality rate associated with CR fishing, Saugers implanted with radio transmitters were also tagged with an external high-reward Floy ($100) tag and the reporting rate was assumed to be 100% Telemetry relocations in conjunction with tag-return data allowed for the estimation of

catch rates, release rates, and CR mortality for released fish The monthly instantaneous mortality rate was 011, which represented one natural mortality, one harvest mortality, and two fish that died of CR mortality Therefore, the instantaneous monthly natural mortality rate was 0031, fishing harvest mortality rate was 0035, and CR fishing mortality rate was 0041 The weekly instantaneous emigration rate was 002 and their movements downstream and out of the tailwater began after water reached 10°C

Upper Willamette River Spring Chinook Prespawn Mortality: Synthesis and Optimal Management Actions

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Upper Willamette River (UWR) spring Chinook salmon represent an ecologically, economically and culturally important threatened species High head dams block access to high quality spawning areas within UWR tributary basins thereby limiting natural production Fish are captured at dams and outplanted in upstream spawning habitats to mitigate passage limitations and provide additional natural production essential for species recovery However, efficacy of outplanting efforts has been limited by high prespawning mortality (PSM) in outplant basins, especially in years associated with elevated water temperatures Management alternatives have been hypothesized to minimize PSM of outplanted fish by reducing pathogen and thermal exposure within the UWR system Some management alternatives include: continued direct outplanting after broodstock quotas are met, modification to collection and outplant timing across the run, and collection and holding in ambient or cool pathogen-free water prior to outplanting A need exists to allow prediction of the optimal management alternative (ie, the set of management actions that maximize natural production) given environmental and among-tributary variability We developed a model that stochastically simulated UWR spring Chinook migration, outplanting, and natural production The model predicted the hypothesized effects of management alternatives on PSM and ultimately natural production in UWR tributary populations Simulation outputs were then used to parameterize a decision model and evaluate management alternatives A sensitivity analysis was performed using the decision model to identify model components strongly influencing natural production For example, results were sensitive to the criteria used in the model to assign fish as prespawning mortality and therefore could be targeted for additional research We use the model to illustrate the application of this approach to identify optimal tributary-specific management alternatives

Monthly Mortality of Juvenile and Adult Striped Bass in the Lower Neuse River

Caitlin Bradley*, North Carolina State University

Monthly mortality of juvenile and adult striped bass in the lower Neuse River

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Abstract

Striped bass *Morone saxatilis* historically supported important commercial and recreational fisheries within the Neuse River system in North Carolina, however, post 1960s and 1970s abundance greatly declined due to factors including high harvest and habitat degradation In response to this decline, effort has been made to recover the population, including the implementation of strict harvest limits, stocking and dam removal However, the Neuse River striped bass population has experienced no substantive increase in abundance, size distribution or age structure To better understand the lack of recovery, mortality and survival estimates at different life stages must be determined The goals for this project are to use active and passive telemetry techniques, paired with external high reward tags, to estimate survival of different life stages of striped bass in the Neuse River System Specifically, we surgically implanted acoustic tags into 50 hatchery juveniles (TL=202-227 mm) in December, 2013, and 50 juveniles (TL=192-245 mm) collected from the wild but from the same cohort as the previous group (will be corroborated with genetic evidence) in May, 2014 Additionally, we implanted acoustic and high reward tags in 50 wild sub adult/adult (TL=349-710 mm) individuals in February and March, 2014 We monitored their monthly mortality as well as seasonal and episodic changes in water quality (eg, temperature, dissolved oxygen, salinity) for 360 and 600 days We used a multistate capture-recapture model to estimate survival of the juveniles Monthly discrete survival estimates from December-June ranged from 66-91%, averaging 811% (95% CI=719-885%) Additionally we will use a multistate capture-recapture model to estimate natural, fishing and catch-and-release mortality of sub adult and adult striped bass in the Neuse River

Key words: striped bass, Morone Saxatilis, mortality estimates, survival estimates, stocking

Estimating Capture, Release, and Mortality Rates of Largemouth Bass at Guntersville and Wheeler Reservoirs, Alabama

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Catch-and-release angling for largemouth bass (*Micropterus salmoides*) has substantially increased since the 1980s, yet few studies have assessed the population-level consequences of these activities Guntersville and Wheeler Reservoirs, Alabama are nationally known largemouth bass fishing destinations with high levels of angling effort and high rates of voluntary release (>85%) We used a variable reward tagging study to estimate rates of capture, release, mortality, and angler reporting of tagged largemouth bass at these reservoirs Separate estimates were obtained for non-tournament release, tournament release, and harvest fisheries to evaluate the relative magnitude of potential population impacts among these fishery sectors Preliminary results from the first year of the study suggest that 388% of largemouth bass are captured by anglers annually, with 38% harvested, 119% released in tournaments, and 231% released by non-tournament anglers Peak capture occurred in the spring and capture rates were higher in Guntersville than Wheeler Reservoir The annual natural mortality at these reservoirs is an estimated 036 yr-1 and did not differ between reservoirs Our results could improve management strategies at heavily fished reservoirs with high rates of voluntary release

Estimated Survival of Subadult and Adult Atlantic Sturgeon in Four River Basins in the Southeastern United States

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Information on survival of Atlantic Sturgeon *Acipenser oxyrinchus oxyrinchus* is essential for effective recovery planning We used telemetered subadult and adult Atlantic Sturgeon and broad coverage by receiver arrays to estimate detection probabilities and monthly apparent survival in the Roanoke and

Cape Fear basins in North Carolina, the Ashepoo-Combahee-Edisto (ACE) basin in South Carolina, and the Altamaha River basin in Georgia The Roanoke and Cape Fear basins are part of the Carolina Distinct Population Segment (DPS) whereas the ACE and Altamaha basins are contained within the South Atlantic DPS Atlantic Sturgeon in both DPS have been listed as endangered by the National Oceanic and Atmospheric Administration Estimated detection probabilities varied strongly by season but were similar among river basins, likely reflecting a winter migration into marine waters with minimal receiver coverage Apparent monthly survival was very high and precisely estimated for the Roanoke (099, 95% credible interval 096-099), Cape Fear (098, 097-099), ACE (099, 098-099), and Altamaha (099, 098-099) basins These monthly rates imply annual apparent survival rates of 084, 078, 085, and 084 for the Roanoke, Cape Fear, ACE, and Altamaha basins These survival estimates are similar to other recent estimates for Atlantic Sturgeon, but less than recent estimates for several Gulf Sturgeon populations Recovery of Atlantic Sturgeon in these southeastern rivers will occur more quickly if total mortality can be decreased to estimated levels of true natural mortality (003-007; annual survival of 093 or higher)

A New Tool for Evaluating Prey Sufficiency in Southern US Reservoirs

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Gizzard shad often compose a majority of the prey biomass in southern US reservoirs Previous studies suggest prey limitation frequently occurs in these systems, indicating that fisheries managers need tools to evaluate the production potential of the populations they manage Bioenergetics modeling was used to quantify the abundance of age-0 gizzard shad necessary to sustain multiple piscivore species under a wide range of growth rates, population sizes, mortality rates and diets found in the published literature Resulting piscivore consumption rates were used to evaluate the community-wide piscivore demand for gizzard shad by randomly choosing population characteristics for each of seven piscivore species and summing their consumption estimates in 100,000 Monte Carlo simulations Gizzard shad biomass at the 50th percentile of published values was insufficient to support seven piscivore species in 64% of the simulations, suggesting that above-average prey biomass is required to support multiple piscivore populations at high abundance and growth rates To help guide management, estimates of the gizzard shad biomass needed to sustain piscivore communities are provided for management situations in which coarse-scale (low, medium or high) growth, population size and percent of shad in diet data are available These published data can be used as a simple tool to estimate prey abundance required to meet piscivore demand under current conditions or to evaluate the prey required to support targeted population characteristics based on proposed management goals

Student Best Papers and Posters

Evaluating the Accuracy of Data-Poor Stock Assessment Methods in the Southeast United States

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Many fish stocks in the Southeast do not have sufficient data to allow for traditional stock assessments. These ‘data-poor’ stocks lack or have unreliable information concerning catch time-series, stock size, or life history parameters. Such data are the primary information sources for traditional stock assessments. Without this information it is difficult to conduct stock assessments and determine annual catch limits (ACLs) and other reference points legally required for every fished stock by the Magnuson-Stevens Act. While data-poor stocks are present around the United States, 75% of stocks and stock complexes assessed for ACLs in the Southeast are stocks that have only catch history data. Alternative data-poor methods to calculate catch limits in such cases exist, but their effectiveness is still subject to question. Two of the more common data-poor methods, DCAC and DB-SRA, have been applied to data-rich stocks on the West Coast and found to be relatively accurate at estimating Maximum Sustainable Yield in comparison to the more traditional stock

synthesis assessment method. Accuracy ranged from 70% to 85% for DCAC and 80% to 155% for DB-SRA for the west coast studies, but no similar work has been done on stocks in the Southeast. This study compares catch limits in terms of overfishing limits (OFLs) and biological reference point outputs from the Southeast Data, Assessment, and Review (SEDAR) stock assessments to those of data-poor methods for the same stocks in order to determine the accuracy of the data-poor estimates when compared to the SEDAR estimates for fisheries in the Southeast. Data-poor methods estimate OFLs of SEDAR assessed stocks to varying degrees of accuracy on a stock-by-stock basis. Some methods, especially DB-SRA, are not applicable to many SEDAR-assessed stocks. Further analysis will reveal which, if any, data-poor methods are best suited to certain life history types, with the intent to identify the best methods for creation of ACLs for actual data-poor fish stocks.

Using Tournament Angling Data to Assess Alien Fish Invasions

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Fishes are one of the most commonly introduced aquatic taxa worldwide, and invasive fish species pose threats to biodiversity and ecosystem function in recipient waters. Considerable research efforts have focused on predicting the invasibility of different taxa; however, documenting the establishment and spread of alien invasive species in non-native environments remains an important goal in invasion biology. We used angler catch data, specifically records from competitive bass angling tournaments, as a means of assessing the abundance and growth of bass (Micropterus sp.) in one portion of their non-native range (southern Africa) relative to their native distribution (southern and eastern United States). In total, we utilized catch data from 14,297 angler days of tournament fishing (11, 045 days from South Africa and Zimbabwe; 3,845 days from United States) to test for differences in the catch rates (average number of fish retained per angler per day), daily bag weights (the average weight of fish retained per angler), and average fish weight. Comparisons of means indicated no significant differences between catch rates, average daily bag weight, or the average fish weight between countries, suggesting that southern Africa bass populations reach comparable sizes and numbers relative to waters in their native distribution. Given the minimal cost associated with data collection (i.e. records are collected by tournament organizers), the standardized nature of these events, and consist bias (i.e. selection for the biggest fish in a population), we propose that the use of such data can be helpful in inferring the invasion status of non-native fish.

Evaluating the Effects of Threadfin Shad on Largemouth Bass and Bluegill Populations in Small Impoundments

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Threadfin shad are commonly stocked into small impoundments to increase the growth and condition of largemouth bass, ultimately to enhance recreational fishing. However, the effects of threadfin shad on largemouth bass and bluegill recruitment, growth, and condition are not fully understood. To date, much threadfin shad research has focused on large reservoirs with few studies conducted on small impoundments. With over 250,000 small impoundments in Alabama alone, understanding the role of threadfin shad in these systems is paramount to providing best management advice. We evaluated the impacts of threadfin shad on largemouth bass and bluegill growth, condition and diets, as well as zooplankton density at five recently-stocked and 16 established small impoundments in central Alabama. Preliminary results from the first summer of pond surveys suggest that threadfin shad may be associated with higher largemouth bass growth and condition, as well as reduced zooplankton and larval bluegill densities. This study will provide a better understanding of interactions between threadfin shad, largemouth bass, and bluegill and provide managers with insight on how to better manage small impoundments.

Life History of the Altamaha Shiner,Cyprinella Xaenura

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The Altamaha Shiner, *Cyprinella xaenura*, is endemic to the upper Ocmulgee and Oconee river systems of Georgia. Although considered vulnerable by the American Fisheries Society and listed as threatened by the State of Georgia, information pertaining to its life history is lacking. This study examined the life history of a population of *C. xaenura* from the Alcovy River, Newton County, Georgia. Collections were conducted March through December 2014. Digestive tracts of adults revealed a diet consisting of benthic aquatic macroinvertebrates, primarily Diptera and Trichoptera. Length-frequency analysis suggests *C. xaenura* lives three years. Males were larger than females in both length and weight, with the largest male and female being 101.1 and 82.8 mm SL and 20.6 g and 11.74 g, respectively. Both gonadal staging and gonadosomatic index (GSI) were used to determine reproductive condition. GSI was calculated from monthly collections with the highest GSI occurring in April (Female=22.13; Male= 1.02). The presence of females with mature ova and males with nuptial tubercles persisting through the summer months suggests a protracted breeding season for *C. xaenura*.

Can River-Reservoir Interfaces Serve As Surrogate Nurseries for Riverine Fishes?

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Anthropogenic modifications to riverine systems have reduced access to important off-channel nursery habitats, but the river-reservoir interface (RRI) may offer surrogate nursery habitat. We sampled ichthyoplankton assemblages in off-channel and main channel habitats of the Lake Livingston RRI and middle Trinity River to: 1) compare species composition and abundance in these different habitat types, and 2) evaluate the influence of abiotic and physicochemical characteristics on ichthyoplankton assemblages in these habitats. Ichthyoplankton was sampled using light traps and paired push nets deployed off jet-powered kayaks during February-July 2013 and 2014. A total of 43,518 larval fishes were collected, representing 29 taxa. During the second year of sampling, two sites from the middle Trinity connected to the main stem of the river resulting in an increased diversity index. A few taxa were dominant at all sites, however, less common ichthyofauna such as moronids, sciaeinds, and centrarchids were captured more frequently in RRI habitats. Sites with frequent connectivity to the main channel had higher species richness, diversity, and overall abundance. Push net samples were more effective, however, species richness and diversity were similar between light traps and push nets. Multivariate analyses were used to compare species richness, diversity, and evenness among habitats which indicated all were greater in the RRI. These differences suggest RRI habitat may act as a surrogate nursery for some species when access to other off-channel habitat is limited.

Do Truck Followers Catch All of the Fish?

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Trout fishing in the southeastern United States depends primarily upon stocked trout. In Virginia for example, over 80% of the trout-angling effort focuses on stocked-trout waters and in 2011, trout anglers accounted for approximately 14% (1,116,000 days) of the total freshwater fishing effort in the state. Surveys show that Virginia anglers seeking stocked trout report lower levels of satisfaction compared to anglers seeking warm water species. Among the major concerns expressed by stocked-trout anglers is the trepidation that the majority of the fish are harvested by anglers following the

hatchery trucks on the day of stocking or soon thereafter. As many fisheries managers use catch rate as a surrogate for angler satisfaction, the reported low levels of satisfaction alarmed the Virginia Department of Game and Inland Fisheries. We sought to address anglers' and managers' concerns by investigating how catch rates and return-to-creel rates varied along a temporal gradient following stocking and attempting to elucidate the relationship between catch rates and angler satisfaction. During the first season of angler-creel surveys, we conducted over 2,500 interviews on six different waters. On the day of stocking, anglers on average caught 2.6 trout per angler hour, significantly faster than any day following stocking. Average catch rates 1-14 days after stocking were significantly lower than catch rates on the day of stocking, but remained relatively constant between 1.0 and 1.3 trout per angler hour. Although the average catch rate on the day of stocking was high, 52-79% of the fish stocked remained in the stocked waters after the first weekend following stockings and some trout stocked in the fall showed up in creels eight months later. Nearly 75% of stocked-trout anglers reported being somewhat to highly satisfied with their fishing experience on the day we interviewed them and we found no significant relationship between catch rates and angler satisfaction. Our results suggest that stocked-trout anglers are more satisfied than previously thought and that anglers' fears of truck followers harvesting all of the trout may be unfounded.

Estimation and Validation of the Length-at-Age Relationship of Mississippi's Spotted Seatrout

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The length-at-age relationship for Mississippi's Spotted Seatrout (*Cynoscion nebulosus*) stock was estimated using three non-linear models to describe sex-aggregated ontogenetic growth. Non-linear models were fit to tag-recapture data collected from the "Mississippi Spotted Seatrout Tag-and-Release Program" which was initiated in 1995 and continued until 2013. Participants in the program, mostly recreational anglers, tagged 19,311 individuals ranging in length from 197 to 648 mm (Total Length, TL) with uniquely numbered plastic-tipped dart tags. A total of 530 individuals were recaptured after zero to 741 days at large, and we focused our analysis on only those individuals (n = 160) that were at liberty for at least 22 days and exhibited positive change in length. Three candidate models were used to analyze the tag-recapture data: Fabens' (1965) method which is a modified two-parameter von Bertalanffy growth function (VBGF), Francis' (1988) GROTAG method, and a re-parameterized Gompertz model (Troynikov et al., 1998). Each model was fit to the observed tag-recapture data assuming that the distribution of residual error was normally distributed. The Fabens' approach resulted in estimated mean VBGF parameters of $L\infty$ = 630 mm (TL, 95% CI 538 to 873) and k = 0.43 yr-1 (95% CI = 0.22 to 0.67). Estimates of VBGF parameters using the GROTAG method were $L\infty$ = 732 mm and k = 0.31 yr-1. The reparameterized Gompertz model resulted in mean growth parameters of $L\infty$ = 583 mm (TL, 95% CI 520 to 704) and g = 0.68 (95% CI 0.46 to 0.93). Model support was determined using Akaike information criteria (AIC). Because the GROTAG estimated VBGF had the greatest support, this study validates the current use of the VBGF to describe the length-at-age relationship of Mississippi Spotted Seatrout. In addition the tag-recapture analysis we provide can be used as a validation for otolith-derived age estimate methods. Although we recognize that there are differences in sex-specific length-at-age of Spotted Seatrout, our study supports the continued use of the VBGF, indicates that the GROTAG model is the preferred algorithm to determine VBGF parameters, and reinforces the need for sex determination when devising tag-recapture studies.

Habitat Suitability Modeling for Shovelnose Sturgeon in the Lower Mississippi River

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Shovelnose Sturgeon *Scaphirhynchus platorynchus* have previously been found to select particular habitat types, and these selected habitats vary seasonally. Ecological niche factor analysis (ENFA) is a presence-only multivariate technique for modeling habitat suitability. We used ENFA to evaluate how Shovelnose Sturgeon telemetry locations relate to habitat types common in the lower Mississippi River (main channel, sandbar, island tip, revetted bank, wing dike field, natural bank, and secondary channel) along with depth and slope of the river bottom. We recorded 338 locations of Shovelnose Sturgeon over a six month period that included both high and low river stages. The analysis showed Shovelnose Sturgeon occupied deep water at all river stages. Telemetered individuals were located in and near the main channel and avoided secondary channels and wing dike fields during low river stages; fish were located near island tips and areas with steep bottom slope during high river stages. This type of spatial or distributional analysis can be used to guide conservation and restoration of habitat to benefit Shovelnose Sturgeon in the lower Mississippi River and possibly other large rivers.

Reproductive Characteristics of Blueline Tilefish (*Caulolatilus microps*) Off the Coast of Virginia

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Blueline tilefish, once thought to only exist in the US South Atlantic and Gulf of Mexico, are now the focus of relatively new recreational and commercial fisheries in the submarine canyons off the coast of Virginia and further north. The Atlantic stock is managed as a single, continuous unit along the entire US Atlantic coast. However, Virginian blueline tilefish grow at significantly slower rates and to larger maximum sizes than their South Atlantic counterparts, possibly indicative of genetic stratification within this stock across Cape Hatteras, NC, as seen in other species like golden tilefish. Such population structure would not be possible without local spawning within the Mid-Atlantic; therefore, we investigated the reproductive characteristics of blueline tilefish from this area. Specimens were collected via recreational, commercial, and fishery independent sampling off the Virginian coast from 2009-2012. Size measurements were taken for all 2106 specimens, and ages were determined for 1484 specimens using sagittal otoliths. Gonads extracted from 297 freshly caught specimens were fixed with 10% formalin, sectioned, and stained with PAS/MY. Ages ranged from 2 to 40 years and total lengths ranged from 283 to 892 mm. Males dominated the largest size classes, while females dominated the oldest age classes. Overall sex ratio was significantly different from 1, with males comprising the majority. Females were collected for all phases of the spawning cycle, indicating local spawning. Spawning capable females were collected during May-November, with actively spawning females collected during June-November. Larger, older females spawned later into the year than smaller, younger females. GSI measurements indicated a peak in spawning activity during September-October. The timing of this reproductive cycle coincides with that observed in the South Atlantic. However, local spawning indicates larval production from this population. Further genetic and juvenile studies would be necessary to determine whether and to what extent this production translates into recruitment.

Atlantic Sturgeon Recruitment in the Savannah River, Georgia

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Atlantic 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 sturgeon are now considered endangered, quantified recruitment data are largely lacking for most systems, particularly among populations within the South Atlantic Distinct Population Segment (DPS). The objective of this study was to quantify annual recruitment of Atlantic sturgeon in the Savannah River, Georgia by estimating annual abundance of age-1 river-resident juveniles. During the summers of 2013–2014, we used anchored gill nets and trammel nets to sample juvenile Atlantic sturgeon throughout the Savannah

River estuary. Ages of captured juveniles were determined using length-frequency histograms that were verified with fin ray sections removed from a subsample of the captured fish. Abundance of each juvenile age class was then estimated with Huggins closed-capture models in RMark. Our results showed that the Savannah River contained 528 (95% CI, 402–726) age-1 juveniles in 2013 and 616 (95% CI, 500–775) age-1 juveniles in 2014. These findings suggest that the Savannah River population is likely the 2nd largest within the South Atlantic DPS. Future estimates of juvenile abundance should help provide quantified information regarding population trends as well as identify key environmental variables affecting recruitment in the Savannah River system.