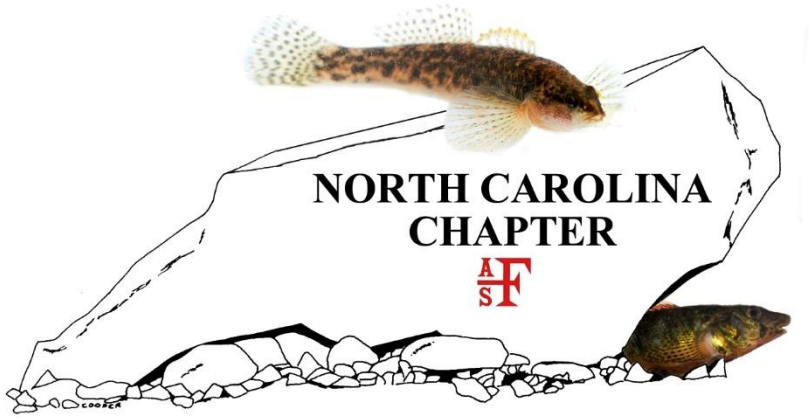
ABSTRACTS

Sorted by presenting author



2017 Meeting of the North Carolina Chapter of the American Fisheries Society and the North Carolina Freshwater Mollusk Workgroup

Tuesday, February 14th – Thursday, February 16th, 2017

New Bern Riverfront Convention Center

203 South Front Street

New Bern, NC 28560

Distribution of Darters in Mecklenburg County Streams

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Charlotte-Mecklenburg Storm Water Services (CMSWS) is a joint municipal/county stormwater utility established in the early 1990's to manage over 3000 miles of stream and protect surface water quality across Mecklenburg County. Currently, CMSWS performs over 10 stream fish community assessments every year, with 31 fixed monitoring sites in a 5-year assessment rotation. Additional sites are monitored for stream restoration feasibility and pre/post-construction assessment. Over the past 21 years, CMSWS has 313 site collection records at 139 unique locations within Mecklenburg County. We build on the previous 2011 presentation "*The Return of Darters (Percidae) to Mecklenburg County Streams*" and combine local data with North Carolina Division of Water Resources (DWR) data to assess spatial and temporal distributions of five darter species across Mecklenburg County. Despite the Tessellated Darter now being essentially ubiquitous across Mecklenburg County, recent, but rare collections of Swamp, Fantail, and Carolina Darters are still fragmented across the county. While no collections of Piedmont Darter have been made by CMSWS since 2007, DWR made multiple collections in adjacent Cabarrus County as recently as 2016. Overall, in Mecklenburg County, Steele Creek was found to contain the highest number of darter species in the Catawba River drainage sub-basins, while Clarke, Clear, Goose, and Mallard creeks contained the highest number within the Yadkin River drainage sub-basins.

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NOTES

Can Soundscapes Be Used to Monitor Estuarine Fish Responses to Oyster Reef Restoration?

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Monitoring the success of marine habitat restoration, such as the creation of oyster reefs, can be costly and labor-intensive. In temperate estuarine systems, the use of visual surveys can be hampered by poor water visibility and an inability to conduct effective visual surveys at night. Moreover, traditional sampling with nets and traps is done intermittently, and thus responses to restoration can only be inferred through "snapshots" in time. Passive underwater acoustics, which can sample continuously for sound-producing species, may provide a low-impact alternative to monitor marine habitats with high spatial and temporal resolution. We investigated the potential use of marine soundscapes as a tool to monitor fish response to the restoration of oyster cultch reefs in Pamlico Sound, NC. We expected that soundscape characteristics would reflect the habitat complexity and diversity of fish communities among reefs that varied in complexity. Two months following oyster reef construction, there was evidence of a weak relationship between habitat complexity, fish diversity, and soundscape characteristics. We expect that as the reefs continue to become colonized and established, this will become stronger. We therefore hypothesize that long-term acoustic sampling of marine habitats will provide essential information on fish behavior and habitat development that cannot be determined solely through traditional sampling methods. The high spatial and temporal fidelity of passive acoustic monitoring may complement traditional sampling methods to provide a more complete understanding of the development and success of restoration, which is necessary for the successful management of marine habitats.

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NOTES

Determining The Effects of Multiple Sites for Stocking Striped Bass Fingerlings in Badin Lake, NC Using Parentage Based Tagging

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Striped Bass (*Morone saxatilis*) fisheries in North Carolina reservoirs are maintained entirely through annual stockings. In most cases, a single access point is used for stocking fingerlings into each reservoir. If unfavorable water quality conditions or increased concentrations of predators are present near these stocking sites, short term mortality could be high and the resulting effects would have implications on the Striped Bass population for several years. In order to buffer potential site-specific impacts on short term post-stocking survival of Striped Bass in Badin Lake, NC, we selected two previously unused boating access areas and stocked each site with exactly half of the annual quota of Striped Bass fingerlings (32,000 fingerlings per site). Each location was stocked with a genetically unique cohort of fingerlings in order to determine the contribution to the fishery of each stocking site. Fall gill netting and spring electrofishing were used to collect striped bass as soon as they were of size to recruit to the sampling gear which typically occurred between 1.5 and 2 years post-stocking. The results from our first year of sampling suggest that there were differential contributions to the fishery between stocking sites. Also, our results indicate that approximately ten percent of the fish we collected came from the upstream reservoir, Tuckertown Lake. An additional two years of surveys have been collected and are currently being analyzed for genetic identification. Our results should provide additional information regarding the use of multiple stocking sites as well as the contribution of fish from upstream populations.

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NOTES

Use of USFWS Maxent Model for Smoky Dace (*Clinostomus sp. cf. funduloides*): Ground-Truthing and Model Improvement

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The Smoky Dace (*Clinostomus* sp. cf. *funduloides*) is considered an undescribed species closely related to the Rosyside Dace (*Clinostomus funduloides*). They are known to inhabit low order streams of the upper Hiwassee and Little Tennessee River basins in NC & GA, but little else is known about other habitat associations. A Maximum Entropy (MaxEnt) model was developed by the US Fish and Wildlife Service (USFWS) to improve understanding of aquatic species distributions and macrohabitat use in North Carolina, including Smoky Dace. We used this MaxEnt model for Smoky Dace site targeting and we evaluated model success. We detected Smoky Dace at 50 out of 139 sites sampled in late spring and early summer of 2016. Smoky Dace were predominately found in sand dominated pools with woody debris presence. The use of macrohabitat variables only could have attributed to lower detection rates than expected due to limited knowledge of site microhabitat conditions. However, the USFWS model was determined to be useful in targeting sites for detection of Smoky Dace. Evaluation of the USFWS MaxEnt model led to the development of an improved MaxEnt model using more presence datasets and higher resolution data. Improved understanding of the distribution, status, and habitat (micro and macro) associations of Smoky Dace can lead to more thorough and successful conservation strategies.

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NOTES

Evaluation of Recreational Hand-Crank Electrofishing On Catfish in the Cape Fear River

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In response to declines in native fish species, recreational hand-crank electrofishing was established in four counties in southeastern North Carolina by the NC General Assembly in the 1980's and early 2000's to help control the expansion of non-native catfish in the Black, Cape Fear, Lumber, and Waccamaw rivers. These reaches of river are the only waterbodies in the United States where this gear can be legally used. Although this unique gear type has been allowed dating back to 1985 in the Cape Fear River, it has never been evaluated to determine impacts on the catfish community. These four rivers were sampled using low frequency boat electrofishing in ten 1 rkm sites in two reaches (reach 1; hand-crank electrofishing allowed, reach 2; hand-crank electrofishing not allowed) for a total of 20 sites in each river in 2015 and 2016. Comparisons of relative abundance, size and age distribution, as well as growth rates were made to determine differences among rivers and reaches. Information gained from our findings coupled with further analyses will help determine the efficacy of this unique gear type and its impacts on fish communities and guide future management practices of established non-native catfish.

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Factors Influencing the Distribution of *Leptoxis dilatata* in The Upper New River Drainage in North Carolina

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The geologically-ancient headwaters of the Kanawha River originate in the Blue Ridge Mountains and support a number of endemic invertebrate and fish taxa. *Leptoxis dilatata* is a Pleurocerid snail endemic to the Kanawha Drainage that is considered a threatened species by the State of North Carolina. The objectives of this study were to compare recent and historical occurrence data to assess whether the range of *L. dilatata* has changed over the past decade and to assess the degree to which environmental factors are associated with *L. dilatata* occurrence at sites across the upper New River Drainage in northwestern North Carolina. We sampled 40 sites across the upper New River Drainage during spring 2016. At each site, we used five 30-second kick net samples to estimate the likelihood of detecting *L. dilatata* and measured a suite of water quality parameters (temperature, dissolved oxygen (DO), pH, conductivity) for use in habitat models. *Leptoxis dilatata* was detected at 25 of 40 (62%) sites and within-site detectability was 72%. Historical survey data (1996, 1997, 2005, and 2008) were available for 22 of 40 sites. Comparisons at repeatedly-sampled sites indicate that *L. dilatata* occupancy declined from 95% to 81% during recent surveys. Although this change is not statistically significant, we found that DO, pH and nitrate concentration were significant predictors of *L. dilatata* occupancy. Although *L. dilatata* remains abundant at many sites, changes to water and habitat quality associated with increased urban development and encroachment on riparian habitats in the headwaters coupled with a shift from row crop to ornamental agriculture and ex-urban development in the lower reaches of the watershed will likely continue to have profound affects on the distribution of this snail and other sensitive mollusk taxa in the upper Kanawha-New River Drainage.

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Development and Evaluation of the North Carolina Fishing Trail

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The North Carolina Wildlife Resources Commission partnered with N.C. Bass Federation, local lake managers to create a series of fishing trails around the state. The goal of the trails is to educate anglers on how to effectively fish for Largemouth Bass at different times throughout the year. The sites selected at each lake were enhanced with fish attractors that were designed and deployed in areas based on seasonal movement of Largemouth Bass. Educational materials including brochures, poster and website have been developed to help educate anglers. Prior to expanding this program, the NCWRC will evaluate the Fishing Trail at Oak Hollow Lake using trail cameras and angler surveys in 2017.

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Population Augmentation and Monitoring of the Tar River Spinymussel

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The Tar River Spinymussel (*Elliptio steinstansana*) is a highly imperiled federally endangered species restricted to the Tar and Neuse river basins in North Carolina. Beginning in 2007, the North Carolina Wildlife Resources Commission (NCWRC) partnered with the U.S. Fish and Wildlife Service and North Carolina State University to collect broodstock, propagate Tar River Spinymussels, and ultimately augment remaining populations. Between December 2014 and September 2016, NCWRC and partners released over 9,500 propagated Tar River Spinymussels at four locations in Fishing and Little Fishing creeks (Tar River basin). From December 2014 to October of 2015, 1310 Tar River Spinymussels, were individually tagged, measured, and released into an experimental reach of Little Fishing Creek. In August 2015 and August 2016, a two pass snorkel survey was conducted in the experimental stocking reach to evaluate the success of the initial augmentations, 35% and 20% of the released mussels were recaptured as live individuals, respectively. Mean growth of recaptured individuals was 1.04 mm (SD=0.7mm). Preliminary results suggest that stocking propagated individuals of the Tar River Spinymussel into the best available habitat has the potential to bolster dwindling populations and assist in the recovery of this species.

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Museum Collections Yield Historical and Other Information Vital to the Conservation and Management of North Carolina Molluscan Fauna

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Multiple museums around the country are the repository for historical and modern collections of mollusks from North Carolina, and other accessions relevant to our knowledge of the fauna of North Carolina. While some progress has been made in recent years to update, digitize, and make available electronically information and photographs of these collections, very few are available off-site, requiring physical visits to the museums to access to them. Recent visits to The Ohio State University Museum of Biological Diversity, the National Museum of Natural History (Smithsonian), and the Academy of Natural Sciences of Drexel University (formerly Philadelphia Academy of Natural Sciences) have yielded valuable information and materials important to freshwater mussel conservation in North Carolina. An accurate knowledge of what species occurred where in the state in the past is vital to setting goals for restoration of native communities. Several species were either accurately identified or rediscovered as part of the historical fauna of the French Broad River that were previously unknown, including Tan Riffleshell (*Epioblasma florentina walkeri*), White Wartyback (*Plethobasus cicatricosus*), and Slabside Pearlymussel (*Pleuronaia (=Lexingtonia) dolabelloides*). Information was also gained that allowed better understanding and clarification of species' distributions and accurate taxonomic identification, including Carolina Elktoe (*Alasmidonta robusta*), Tennessee Heelsplitter (*Lasmigona holstonia*), and Tennessee Clubshell (*Pleurobema oviforme*). Desiccated tissue was also recovered from the type specimens of Carolina Heelsplitter that may be key in determining its present status as extinct or extant through molecular analyses. These and other valuable information gained emphasizes the importance of maintaining and accessing historical natural history collections.

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NOTES

Sicklefin Redhorse Candidate Conservation Agreement and Partnership

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In late 2015, a Candidate Conservation Agreement (CCA) for the Sicklefin Redhorse (*Moxostoma* sp.) was finalized and signed by primary partners: US Fish & Wildlife Service, NC Wildlife Resources Commission, Duke Energy, Tennessee Valley Authority, Eastern Band Cherokee Indians, and Georgia Department of Natural Resources. The CCA is a formal agreement to cooperate on actions that conserve, manage, and improve Sicklefin Redhorse populations range-wide with the goal of working to preclude the need to list the species under the Endangered Species Act. The agreement formalizes and expands upon conservation efforts previously established by the NCWRC and partners. Signatories agreed to a suite of specific annual actions for the next ten years, broader measures to be undertaken over the course of the agreement, and commits resources to support them. Since the agreement was signed, a Candidate Conservation Partnership steering committee was formed by representatives of the signatories and administrative and fiduciary functions have been defined and established. Monthly teleconferences of the steering committee and an annual meeting for planning and coordinating implementation of conservation actions were also established. Non-signatory cooperating partners are Brookfield Smoky Mountain Hydro, Conservation Fisheries, Inc., Warm Springs National Fish Hatchery, and North Carolina Department of Transportation.

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NOTES

Aquatic Fauna Restoration in The Cheoah River

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A nine-mile reach of the Cheoah River, a regulated river recently improved by FERC mandated flow and substrate restoration, is the focus of efforts to augment an existing relict population of the federal endangered Appalachian Elktoe (*Alasmidonta raveneliana*) and to reintroduce NC state listed Slippershell (*A. viridis*), Wavy-rayed Lampmussel (*Lampsilis fasciola*), and Rainbow (*Villosa iris*), as well as the federal threatened Spotfin Chub (*Erimonax monachus*) and other native fishes. Improvements in water and habitat quality can restore suitable habitat for freshwater fauna; however, barriers may exist to natural colonization where species are extirpated or demographics of relict populations may be less than ideal for population recovery. Assisted recovery via augmentation and reintroduction can help surmount those barriers. The Cheoah River situation offers unique opportunities for restoration and relative long-term persistence of rare species that are vulnerable at other locales in NC. A combination of translocation and captive propagation provide animals for restoration. *A. raveneliana* had never been cultured in captivity prior to these efforts and innovative techniques were developed to successfully produce them in sufficient numbers. Since 2012, over 4,700 propagated *A. raveneliana* have been released and an additional 97 adults were translocated; and, over 1500 *A. viridis*, 20,000 *L. fasciola*, and 15,000 *V. iris* were also propagated and released. Since 2009, seven cohorts of captively propagated *E. monachus* yearling fry were reared and released, totaling approximately 2,900, with an additional 205 adults translocated. Assessment surveys performed in 2016 show positive results with all species surviving, growing, showing evidence of reproduction and recruitment, and expansion of occupied range.

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NOTES

Known Knowns, Known Unknowns and Unknown Unknowns: Phylogenetics of The Freshwater Mussel Genus *Elliptio*.

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The genus *Elliptio* is one of the most perplexing cases of cryptic diversity, phenotypic plasticity and taxonomic uncertainty in North America. Estimates of *Elliptio* diversity range from 12 - > 40 species. Prior attempts to clarify taxonomy and phylogenetic relationships within this group have met with limited success. We believe that this may be due, in part, to the fact that previous workers relied on highly variable morphological traits rather than on biochemical or genetic data to define species boundaries. Another weakness of prior studies has been the use of limited numbers of samples in genetic analyses. Attempts to differentiate species based on small sample sizes are limited by their ability to define range-wide levels of genetic diversity and detect problematic data in alignments. With large sample sizes and sampling taxa across their geographic ranges we have chipped away at the obtuse monolith that is *Elliptio*. Our data (along with data generated by other workers) indicate that *Elliptio* is a polyphyletic genus. Earlier work demonstrated that *Elliptio dilatata* constitutes a monotypic subgenus. Additionally, the spinymussels (*E*. *spinosa* and *E*. *steinstansana*) appear to belong in two different genera. We have also identified a core *Elliptio* group comprised of *E*. *crassidens* (the type for the genus), *E*. *complanata* (a widespread Atlantic Slope taxon) and numerous other taxa (e.g., *E*. *arctata*, *E*. *congaraea*, *E*. *jayensis*, *E*. *pullata*). Additionally, it is clear that some lanceolate *Elliptio* taxa (e.g., *E*. *producta*, *E*. *fisheriana*) are divergent from the core *Elliptio* group. With these broad patterns established it should now be possible to refine species boundaries. Preliminary data suggest that historical gene flow occurred across wide geographic ranges and that species boundaries, where they exist, are likely diffuse. We are attempting to better define species boundaries and establish a robust phylogenetic framework for understanding the evolutionary relationships among *Elliptio* taxa.

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NOTES

Intersex, Contaminants, And Fish in A Regulated, Southeastern River

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Endocrine active compounds (EACs) are a group of contaminants that have been recognized as an emerging and widespread problem in aquatic ecosystems globally. We measured aquatic contaminants, including EACs, and assessed their impacts on the fish of the Yadkin-Pee Dee River, North Carolina and South Carolina. Contaminant concentrations within this river's watershed are influenced by agriculture, industry, urbanization, and other anthropogenic impacts. Our objectives were to evaluate organic and inorganic contaminants in water, sediment, and fish muscle tissue, examine the occurrence and severity of the intersex condition (testicular oocytes, a biomarker of endocrine disruption) in wild, adult fish, and conduct an *in situ* bioassay to evaluate survival, intersex, and contaminant uptake in juvenile fish. Longitudinal trends of contaminants and fish health parameters were assessed. Ethinylestradiol, PCBs, PAHs, mercury, and pesticides were the most prevalent contaminants in the river. Intersex condition was most frequently observed in Largemouth Bass (41%) and was not observed in any bioassay fish. Higher concentrations of contaminants and greater occurrence of intersex was observed at the downstream sites. This study has helped to better understand the relationship between contaminants and the imperilment of aquatic organisms, allowing for ecologically comprehensive management decisions.

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NOTES

Phenology, Ontogeny, and Growth of Six Sympatric Suckers in North Carolina

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Suckers (family Catostomidae), and especially redhorse (genus *Moxostoma*), comprise a taxon that is of high conservation concern but has received relatively little attention from the scientific community. Valley River, a major tributary to the Hiwassee River in Western North Carolina, is inhabited by seven species of suckers, including the Sicklefin Redhorse, an imperiled endemic species. Larval and juvenile suckers were sampled from Valley River during April – September of 2013, 2014, and 2015, and were identified to species using genetic barcoding (N=917). Fish were measured for length and development was indexed based on yolk-sac absorption and fin formation. Six species in various stages of development were collected (14.0 – 76.0 mm TL). Silver Redhorse and Northern Hog Sucker larvae typically emerged in early-May, Black Redhorse in mid-May, and Golden Redhorse, Sicklefin Redhorse, and River Redhorse in late-May; this pattern parallels their known spawning sequence. Species with overlapping emergence periods exhibited slightly but significantly different mean ontogeny rates. Larval growth rates were similar among sucker species, mean sizes on specific dates depended on emergence dates, and there was high intraspecific variability in size. Small innate differences in early life histories may have produced the current diversity of suckers in the upper Hiwassee River system, or these differences represent local adaptations that evolved because of specific competition pressures among species. A basic understanding of the early life histories of sympatric suckers is essential for identifying factors that may differentially affect recruitment and for planning appropriate ecosystem and fish conservation and management measures.

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NOTES

Gap Analysis and Survey Updates for Crayfishes in North Carolina's Piedmont and Coastal Plain

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Roughly half of North America's 360+ species of native crayfishes, two-thirds of which are endemic to the southeastern US, are considered imperiled. Although North Carolina's 40 described species face challenges shared by other declining aquatic taxa, such as degraded water quality and habitats, competition from exotic species, and movement barriers, relatively few crayfishes are protected by federal or state regulation. Continuing a statewide effort to update both native and exotic crayfish distribution records, the WRC initiated a multi-year study in 2016, including a "heat mapping" gap analysis of previous data for a suite of 11 species, and instream sampling in the upper Cape Fear river basin. At 50 sites completed to date, five native species and one exotic (Red Swamp Crayfish *Procambarus clarkii*) have been collected. Work is planned to proceed across the remainder of the Cape Fear, Lumber, White Oak, and Yadkin-Pee Dee river basins. Concurrent reviews of species' status will be included in research outcomes.

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NOTES

Little Tennessee River Basin Native Fish Conservation Partnership: Aquatic Conservation On a Landscape Scale

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In 2015, the Little Tennessee River watershed became the nation's first Native Fish Conservation Area (NFCA). NFCAs are watersheds that are managed for the conservation and restoration of native fish and other aquatic species, allowing compatible uses.

The Little Tennessee River watershed spans three states (Georgia, North Carolina, and Tennessee) and features a diverse set of aquatic habitats, from high elevation coldwater trout streams to warmwater rivers to large reservoirs. Historically, it was one of the most biologically rich watersheds in the nation, but aquatic communities have been impacted by a host of stressors, including dams, agriculture, industrial pollutants, piscicides, and development. Some streams impacted in the past now offer restoration opportunity, and numerous efforts are underway to restore native fish to streams in the Great Smoky Mountains National Park, on US Forest Service land, on the Eastern Band of Cherokee Indians reservation, and private lands.

More than twenty-five organizations, including federal and state agencies, industry, and non-government entities, form the Native Fish Conservation Partnership (NFCP). The NFCP supports work already underway by partners by providing additional funding, public exposure, and a space for collaboration. It implements educational initiatives, including a snorkeling education program, a riparian education and restoration initiative, and a video project, which will result in a series of Freshwaters Illustrated videos on the biodiversity of the Little Tennessee River basin, the importance of clean water to industry, agriculture, and recreation, restoration efforts, and the importance of river stewardship.

Perhaps most importantly, the NFCP provides a forum to plan and implement watershed conservation on a landscape scale. Partners are developing an on-line mapping platform, which will be used to house data, map threats, identify focal areas for restoration and protection, and ultimately serve as a conservation plan for the watershed.

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Long-Term Monitoring of White Bass in B. Everett Jordan Reservoir, NC

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White Bass (*Morone chrysops*) are an important fishery in the Piedmont and mountain regions of North Carolina. The NCWRC began closely monitoring White Bass in Jordan Lake in 2013 after research and monitoring throughout the state indicated that White Bass, particularly in Jordan Lake, experienced high fishing mortality and exhibited population characteristics related to overharvested populations. Survey results indicate White Bass in Jordan Lake have a severely truncated age distribution that is dominated by fish younger than age 3. The overall body condition of White Bass exceeds 100 annually and fish reach a preferred length (300 mm) around age 1. These monitoring efforts in Jordan Lake along with the collapse of the natural White Bass population in Lake James, NC, lead to the proposal of a new statewide White Bass regulation, effective 2018. Under the new regulation, fish harvested may not be less than 356 mm and the daily creel has been reduced from 25 fish per day to 10 fish per day. The proposed regulation is intended to allow female White Bass the opportunity to spawn at least once before being removed from the population. Long term monitoring of White Bass in Jordan Lake is needed to evaluate whether any population changes occur after the proposed regulation change. Continued monitoring will also determine the frequency of strong year classes and the environmental conditions coinciding with them and expand the knowledgebase on the annual variance of their population characteristics.

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Changes in River Herring Spawning Phenology Within the Albemarle Sound Watershed

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Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestavalis*), collectively known as river herring, are economically, ecologically, and culturally important fishes that are at low levels of abundance. Low population sizes are thought to be due to a combination of overfishing and habitat loss but there has been little work examining the impact of increased warming trends on their spawning migrations. We analyzed spawning habitat survey data collected by the North Carolina Division of Marine Fisheries to characterize the phenology of spawning migrations in the Albemarle Sound from 1973-2015. We modeled presence/absence data from multiple sampling sites within the Albemarle Sound watershed and found a significant interaction between year and ordinal day for both Alewife and Blueback Herring. Alewife are now arriving later (+10 days) and leaving earlier (-12 days). Shifts in initial ingress and final egress were -2 and -17 days for Blueback Herring. These shifts have shortened the time at spawning habitats by 22 days for Alewife and 15 days for Blueback Herring. We plan to explore multiple factors (e.g. population size, age structure) that may influence phenology of river herring spawning but one potential explanation is faster spring warming which has been occurring since 1993. Warmer temperatures on the spawning grounds may lead to earlier egress. Although habitat loss and overfishing led to low population sizes, we recommend research to test for links between length of time in spawning habitats and subsequent recruitment to river herring populations.

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NOTES

The New Kerr Reservoir Water Control Plan: a Case Study in Agency and Stakeholder Cooperation

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John H. Kerr Dam is a U. S. Army Corps of Engineers (USACE) project located on the Roanoke River along the North Carolina and Virginia border. The dam is operated for flood control, hydropower, recreation, and other uses. Downstream of the dam, the lower Roanoke River floodplain supports the largest and least disturbed bottomland hardwood forest ecosystem on the Atlantic Coast. It provides excellent habitat for a multitude of wildlife species as well as productive anadromous and resident sportfish populations. The regulated flow regime, which often causes extended periods of moderate flood conditions, has resulted in substantial changes within the lower Roanoke River floodplain ecosystem. Congress authorized a Section 216 study in 2000 that directed USACE to examine operational changes that would improve the quality of the environment, particularly in the lower river basin. After fifteen years of studies and examination of multiple alternatives, only one management alternative, the Quasi Run of River flow regime (QRR), was identified to benefit environmental conditions. The Section 216 study ended in 2016, and USACE issued a revised water control plan that identified QRR as the new model for flood control operation. The QRR flow regime will result in more frequent flood releases of up to 35,000 cfs, the operational capacity of Kerr Dam, which will in turn cause higher magnitude but shorter duration floods than the previous water control plan. Reducing the duration of flood events, especially during the growing season, will have beneficial effects on lower river forests, wildlife, and fisheries. Developing the new water control plan was not without controversy and opposition; however, communication, compromise, and cooperation among multiple state and federal governmental agencies, non-governmental organizations, industry, and public stakeholders eventually led to the changes that should benefit the Roanoke River Basin and its natural resources for many years to come.

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NOTES

Striped Bass *(Morone saxatilis)* and American Shad *(Alosa sapidissima)* Spawning Distribution in the Cape Fear River

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The Cape Fear River system is an anthropogenically impacted system in coastal North Carolina that has historically supported healthy populations of anadromous species. However, disturbances including flow regulation and a series of locks and dams have had detrimental impacts on Cape Fear anadromous species such as Striped Bass *Morone saxatilis* and American Shad *Alosa sapidissima*. A study conducted by the NC Wildlife Resources Commission collected eggs and larvae using 500 µm mesh bongo nets below each lock and dam structure (LD 1-3) during March through May 2016 using methodology from a 2012 study conducted by Smith and Hightower at the same sites during 2007-2008. The objective of this study is to compare past collections to current spawning activity and document changes in spawning distributions following the construction of a fish passage structure, or rock arch ramp, in 2012. Preliminary data analyses from 2016 indicate peak Striped Bass egg density (mean eggs/1000 m^3 ± SE) below Lock and Dam 1 during the week of 25 Apr. (3896 ± 31) whereas peak American Shad spawning activity occurred below Lock and Dam 2 during the week of 9 May (928 ± 6). Results from 2007-2008 show peaks of Striped Bass eggs at LD3 (22.0 ± 16.8) and American Shad at LD1 (895). Egg collections and annual electrofishing data support some use of the rock arch ramp by American Shad and little use by Striped Bass. These data allow managers to make informed decisions for anadromous species recovery in coastal rivers, especially regarding fish passage through lock and dam structures.

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NOTES

Seismic Survey Noise Disrupted Fish Use of a Temperate Reef

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Marine seismic surveying discerns subsurface seafloor geology, indicative of, for example, petroleum deposits, by emitting high-intensity, low-frequency impulsive sounds. Impacts on fish are uncertain. Opportunistic monitoring of acoustic signatures from a seismic survey on the inner continental shelf of North Carolina, USA, revealed noise exceeding 170 dB re 1μ Pa peak on two temperate reefs federally designated as Essential Fish Habitat 0.7 and 6.5 km from the survey ship path. Videos recorded fish abundance and behavior on a nearby third reef 7.9 km from the seismic track. During seismic surveying, reef-fish abundance declined by 78% during evening hours when fish habitat use was highest on the previous three days without seismic noise. Despite absence of videos documenting fish returns after seismic surveying, the significant reduction in fish occupation of the reef represents disruption to daily pattern. This numerical response confirms that conservation concerns associated with seismic surveying are realistic.

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Contaminant Dynamics in the Food Web of a Large Southeastern Regulated River: Implications for Common and Imperiled Species

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Persistent and bioaccumulative contaminants often reach concentrations that adversely impact aquatic life and consumers. We conducted intensive sampling at five sites along the Yadkin-Pee Dee River of North Carolina and South Carolina. Sampling sites spanned a range of diverse physical characteristics, land uses, and influx of point- and nonpoint-source pollution that facilitated longitudinal examination. The objectives of this research were to determine the aquatic food web structure and trophic transfer and accumulation of contaminants within a riverine food web. Major food web components and pathways were determined by stable isotope ratios of representative producers, consumers, and organic matter. Contaminant analyses performed on biotic and abiotic samples revealed that organic and inorganic contaminants were prevalent, including several of ecological and human health concern. Total polychlorinated biphenyls (PCBs) were detected in 32% of biotic samples (mean 0.24 ppm, range 0.01 - 3.33 ppm); total DDTs (a legacy organochlorine pesticide and its metabolites) were detected in 90% (mean 0.014 ppm, range 0.0004 - 0.29 ppm), perfluorooctane sulfonate (PFOS), an emerging global pollutant used in stain resistant fabrics, was detected in 67% (mean 0.032 ppm, range 0.0002 - 0.34 ppm), and mercury was detected in 99% (mean 0.19 ppm, range 0.006 – 1.17 ppm). Our results identify basal resources that support consumers and contaminant pathways and accumulation through the riverine food web, potentially threatening the health of fish and other biota.

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NOTES

A Comparison of *in Vitro* and *in Vivo* Propagated Juvenile Mussels: Do Propagation Method and Age Influence Juvenile Chemical Sensitivity?

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Identifying and mitigating chemical stressors is important to freshwater mussel conservation, as is assessing mussel-specific sensitivity to pollutants to establish water quality criteria. The newly transformed juvenile life stage is sensitive to certain toxicants and is often used in toxicity testing. Thus, there is a need to transform mussel larvae (glochidia) into juveniles within a laboratory setting. Over the past several decades, host-fish (*in vivo*) propagation techniques have significantly advanced, as have long-term growth and maintenance of propagated mussels. Recently, *in vitro* culture methods have made laboratory rearing of juveniles more efficient and cost-effective. However, ASTM International cautions against using *in vitro* propagated juveniles in toxicity tests unless their relative chemical sensitivity to *in vivo* juveniles is described. The objectives of this study were to evaluate the relative sensitivity of juvenile mussels from both propagation methods to selected chemical toxicants and at multiple ages post-transformation. We conducted 96-hour acute toxicity tests according to ASTM International guidelines with three species (*Lampsilis cardium*, *L. abrupta*, and *Utterbackia imbecillis*) and six chemicals: chloride, nickel, ammonia, copper, and aquatic herbicides Clearigate and Nautique. We calculated the median effective concentration (EC50) for each species-chemical exposure, comparing the EC50s between *in vitro* and *in vivo* juveniles. Statistically significant differences in EC50 between both propagation types were observed in 8 of 17 trials, and *in vitro* juveniles were more sensitive in 7 of the 8 observed differences. All statistically significant differences were within the variation for between-laboratory juvenile mussel EC50 comparisons for a given chemical reported in a recently published evaluation of results from mussel toxicity tests (a factor of 3.6). Additionally, age of juvenile (0 to 22d post-transformation) did not influence relative chemical sensitivity. This study demonstrates that both fish-transformed and *in vitro* transformed juveniles may be appropriate for use in standardized toxicity testing.

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NOTES

Genetic Characteristics of Wild Brook Trout Populations in North Carolina

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We genotyped 7,588 Brook Trout representing 406 collections from across North Carolina at 12 microsatellite loci. The vast majority of collections appeared to represent single populations, based on general conformance to Hardy-Weinberg equilibrium and limited evidence for linkage-disequilibrium. Allelic diversity was low to moderate relative to Brook Trout populations endemic to higher latitudes. Effective population sizes varied widely among populations, but were often very small and indicate that many populations are at risk of losing diversity through genetic drift. Remarkable levels of genetic differentiation exist among populations, which suggests that little, if any, gene flow occurs among most populations. Analysis of molecular variance (AMOVA) revealed that a substantial portion of the observed genetic variation was attributed to differences among patches (44.8%), and there was some variation (11.2%) even among collections within a single patch. These results, taken in conjunction with high levels of genetic differentiation among populations, suggest that the fundamental unit of management for Brook Trout should be the population. Despite extensive stocking across the state, the vast majority of wild populations show limited evidence of introgression by northern origin hatchery strains. These results represent a valuable baseline for management and restoration efforts of Brook Trout in North Carolina.

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NOTES

Fish Collecting in Thailand

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During a trip to Thailand in late January-early February 2016, 14 collections were made in three areas of Thailand: west near Sankhlauri; east near Ubon Ratchathani; and an estuary southeast of Bangkok. Various methods were employed: cast nets, dip net, haul seine, fish trap, gill net, snorkeling, and fish market. A total 114 species in 34 families were observed; the Cyprinidae were the most speciose with 39 species.

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NOTES

Post Hurricane Mathew Sport Fish Assessment in The Tar and Neuse Rivers

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In coastal North Carolina, the effects of hurricanes on fish populations are variable. However, recent hurricanes Isabel (2003) and Irene (2011) caused wide-spread fish kills in coastal North Carolina's rivers and creeks, and heightened public concern for fish populations following cyclonic events. Hurricane Matthew made landfall on October 8, 2016, at McClellenville, SC. By October 9, 2016, coastal North Carolina had received hurricane associated rainfall in excess of 38 cm in some locations. The rainfall from Hurricane Matthew resulted in flooding in the Neuse and Tar Rivers for nearly 2.5 weeks. The Wildlife Resources Commission began to conduct dissolved oxygen surveys immediately after Hurricane Matthew which continued through November 1, 2016. Low dissolved oxygen was only observed in two creeks; the Neuse River in Swift Creek and the Tar River in Tranters Creek. Electrofishing surveys were conducted targeting resident sportfish from November 9 to 16, 2016. No evidence of fish kills was observed during these surveys including the areas where low dissolved oxygen was observed. Therefore, the impact of Hurricane Matthew on fish populations in central coastal North Carolina appeared minimal.

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NOTES

Estimating Delayed Mortality of Gray Triggerfish Using Surface and Bottom Tagging

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The number of discarded Gray Triggerfish (*Balistes capriscus*) in the US southeast has nearly doubled in recent decades, perhaps as a result of stricter management measures and increased effort. High numbers of discards represent large sources of uncertainty in stock assessments, necessitating robust estimates of discard mortality. We used conventional tagging of Gray Triggerfish in depths of 35-40 m, a depth common to the fishery in the US southeast. We tagged one group of triggerfish on the seafloor (by SCUBA divers via traps) and another group at the surface (via traps and hook-and-line) to estimate discard mortality by observed condition. Discard mortality in best-condition surface-released Gray Triggerfish was ~ 40% (relative to the assumed zero mortality for seafloor tagged fish) and was higher for fish with outward signs of barotrauma (~ 66%). Preliminary application of these condition-specific values to numbers-by-condition for released fish from a survey of for-hire vessels indicates a substantial increase in overall discard mortality with depth of capture. On average, overall discard mortality may be 45% or higher for triggerfish discarded in the US southeast which is substantially greater than the value (12.5%) assumed in the most recent assessment. These findings will be important in calculating the number of dead discards required as input into stock assessments for Gray Triggerfish in the US southeast and other areas of the world where they are fished.

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Roanoke Logperch Recovery in North Carolina

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Ten years after the discovery of the Roanoke Logperch in NC we are well on the way to recovery. The highly resilient, large darter has shown great propensity to immigrate and recolonize previously extirpated reaches in spite of decades of habitat degradation. In 1992 the fish was thought to be endemic to VA and only occurred in four isolated populations. Now there are at least seven populations in two states, it occupies at least 40 river miles in NC, and it is no longer considered an exceptional find the Dan River. Recent genetic results showed the Dan River genetic effective population estimate to be 1,035 individuals (95% confidence interval 196 to infinity), equivalent to the best population in the upper Roanoke River. This estimate is far above the threshold of concern for many conservation biologists and the actual number of fish in the Dan River superpopulation could be in the thousands. Previous genetic work from Virginia Tech (N=98) coupled with recent work from in NC in 2015-16 (N=66) showed the population is increasing in size, likely due to increasing range size, increasing density at occupied locations, or both. In order to fully recover this species in NC the fish will be repatriated to previously occupied reaches in the Dan and Mayo Rivers. Approximately 70 river miles of unoccupied, optimal habitat exists upstream of Lindsey Bridge Dam in the Dan River and upstream of Avalon Dam in the Mayo River. The ultimate result will be Roanoke Logperch occupying over 100 river miles in NC.

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Estimating Mortality for Southern Flounder Using a Combined Telemetry and Conventional Tagging Approach

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The Southern Flounder (*Paralichthys lethostigma*) is a valuable marine resource in North Carolina that is currently designated as overfished with overfishing still occurring. We used a combination of acoustic telemetry and conventional tagging methods at two spatial scales over three years to generate direct estimates of fishing (F) and natural (M) mortality. Southern Flounder tagged with acoustic transmitters were released and tracked in a single estuary to provide system-specific estimates of F and M using a multistate capture-recapture model. Conventional tags were deployed throughout the state to provide additional direct information about F on a larger scale and indirect information about M. During 2014-2016, totals of 94, 96 and 81 Southern Flounder were tagged with acoustic transmitters respectively, and released throughout the New River estuary between May and December. Additional external tags contained contact information and a high monetary reward to meet the assumption of 100% reporting of recaptures. Fish were detected via a passive array of acoustic receivers, with data downloads every ~ 3 months, and manual tracking that occurred bi-weekly or monthly. Harvest removed an average of ~30% of individuals from each annual cohort over 3 years with commercial landings responsible for over 70% of reported fishing mortalities. Fishing removals occurred throughout the estuary and were associated with multiple gears (14 recreational hook and line, 8 recreational gig, 19 commercial gig, and 43 commercial gill net). The fraction of fish emigrating from the system each fall ranged from ~25-30% of the total number of individuals in each annual cohort. Currently 15 individuals from the 2016 cohort are assumed to be still at large in the estuary with 4 confirmed surgery-related mortalities and 6 individuals that have not been detected since tagging. Active and passive tracking is ongoing to determine fates of fish from the 2016 cohort still at large in the estuary.

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Trout Fishery Assessment of the Chattooga River, Jackson County, North Carolina

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In September 2016, a study was conducted to determine if the Chattooga River supports a wild and reproducing population of trout and an outstanding fishery, thus supportive of its supplemental water quality classification as Trout waters (Tr) and Outstanding Resource Waters (ORW). The study was conducted because of citizen concerns that the fishery had declined due to eroding stream banks and the accumulation of sediment caused by whitewater recreationalists, thereby no longer meeting the B; Tr;ORW classification.

Standard operation procedures were followed for the collection of physical-chemical data, habitat assessments, and trout assessments at eight sites in the gorge. Brown Trout, *Salmo trutta*, was the only species of trout encountered and all specimens were wild. The number of trout collected ranged from 9 to 51/site; sites upstream from a natural, large woody debris dam had fewer fish than at two sites downstream. The same pattern held true for the catch per unit effort estimates (31.1 and 33.4 fish/hour downstream vs. 15.4-24.8 fish/hour upstream) and generally for the areal estimates. Multiple age classes, including young-of-year, were represented at all sites, indicative that the river supports its current Tr classification. Pooling all the data, there was evidence of successful reproduction throughout the reach and that the population was represented by at least four age groups.

The North Carolina Administrative Code provides no numerical or narrative guidance in as to what defines "*outstanding fish habitat and fisheries*"; it is a subjective value to the user of the resource. Additionally, the code does not specifically state that every linear segment of the the Chattooga River, from its source to the North Carolina-Georgia state line, must satisfy the ORW values. Collectively, the values must be demonstrated, but not individually over the entire reach. Based upon the data collected and applying the NCWRC's Bonner 1983 classification system, the condition of the fishery would be classified as Class B and Class A with one site classified as Class C. The Class B rating is the same rating that the "*outstanding*" fishery received in 1978 and 1988. Thus, one could make the argument that the Chattooga River continues to support "*outstanding fish habitat and fisheries*".

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Evaluating Fish Communities in Urban Streams in North Carolina

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No region of the state has escaped the developmental consequences that have come as a result of North Carolina's transition from a rural to an urban state. Mounting pressures are placed upon the freshwater stream fish communities as a result of this urbanization. Urbanization results in increases in impervious surfaces and stormwater runoff, point and nonpoint source discharges of nutrients, fecal bacteria, sediment, and contaminants, and frequent sanitary sewer overflows. As stewards of our aquatic resources, we must be concerned about what this rapid growth is doing to our stream fish communities. The adverse costs are many, including a loss of vegetated buffers, fragmentation of aquatic habitats, modifications of a stream's hydrology, altered temperature regimes, and a general decline or lack of community respect for the stream and its watershed.

The Division of Water Resources has used the North Carolina Index of Biotic Integrity as one of its water quality assessment tools since the early 1990s to investigate the impacts of urbanization on wadeable stream fish communities. What knowledge have we acquired from monitoring all these streams and is there anything that can be done toward their restoration? We have documented that fish communities respond to increased urbanization by shifts in species diversity and trophic dynamics, domination by tolerant and non-indigenous species, and losses of intolerant and key indicator species.

However, all is not lost. Restoring urban streams by developing stormwater management plans, repairing sewer collection systems, stream bank and channel restoration, and public education can set into motion the recovery of native fish communities and biodiversity, increase property values, offer recreational possibilities, provide *al fresco* dining possibilities, and restore a sense of civic pride. The next generation of Chapter members will be called upon to focus efforts on urban streams and to pursue restoration and protection opportunities wherever and whenever possible.

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The Use of Parentage-Based Tagging to Evaluate Stocking Efforts in The Dynamic Walleye Fishery of Lake James, NC

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Lake James, located in Burke and McDowell Counties, NC, is the uppermost reservoir in the Catawba River chain of Duke Energy Lakes. The North Carolina Wildlife Resources Commission (NCWRC) began stocking Walleye *Sander vitreus* into Lake James in 1949 and established one of the most popular sport fisheries in Western North Carolina. Historical survey results characterized the Lake James Walleye population as having robust natural recruitment, high catch rates, and moderate condition and growth. The introduction of Alewife *Alosa pseudoharengus* and Blueback Herring *Alosa aestivalis* in Lake James was verified in 2010. Both invasive species are known threats to Walleye populations and have been responsible for substantial negative impacts in other NC lakes. In 2012 the NCWRC initiated a study to evaluate the success of stocking Walleye fingerlings and fry at three different locations in Lake James to offset a declining population. Parentage-Based Tagging (PBT) demonstrated 100% hatchery contribution for age-0 through -3 Walleyes from 2012-2015 suggesting a recruitment failure, presumably due to ovivory, fry predation, thiamine inhibition, and/or interspecific competition with Alewife and Blueback Herring. Furthermore, evidence of spatial differential recruitment was demonstrated by tracking genetically unique cohorts. PBT indicated that 100% of collected fish originated from 2 of the 3 stocking locations. Fingerling-sized fish were much more successful than fry, with zero fish stocked as fry recruiting to gill nets. Survey results suggest much lower catch rates than pre-invasion years; however, stocking appears to be successful and promising. Collectively, these results will help determine stocking numbers, locations, harvest regulations, and other management options for Lake James' dynamic Walleye fishery.

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NOTES

Stream Fish Ecology Across an Urban-Rural Environmental Gradient

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Currently, over 50% of the world's population lives in urban areas. As people continue to move into these urban centers the amount of developed land will also continue to expand. Models suggest that by 2030 over 51%, or 21 million hectares, of rural land will be converted to developed land. As these urban centers continue to grow in both population and physical size, it is increasingly important to understand the relationship between urbanization and surrounding ecosystems. Specifically, our research will focus on the relationship between urban centers and freshwater stream ecology through the evaluation of fish populations. The objective of this study is to compare the effects of land use changes on native fish communities in freshwater streams.

We will sample five urban streams within Raleigh-Durham and five rural streams in the surrounding counties. These rural sites will serve as unaltered freshwater systems. At each stream site we will collect individuals from a 50-m reach of the stream to document and compare the fish community composition at each stream. Additionally, we will use collect age and growth data to further quantify the effects on the fish communities. This data will be used to advise urban planners and conservation managers to reduce the impact of urbanization on the surrounding natural ecosystems.

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