2013 Annual Meeting of the North Carolina Chapter of the American Fisheries Society
2013 Annual Meeting of the North Carolina Freshwater Mollusk Workgroup
February 26-27, 2013
Best Western Plus Hotel
Burlington, North Carolina

Session 1: Management Of Fishes

Making It Our Plan: Collaborating With Stakeholders To Revise North Carolina's Trout Management Plan, Jacob M. Rash* and Kerry J. Linehan
[Abstract] [Podcast]

The Bridgewater Tailrace Of Western North Carolina: Historical And Contemporary Approaches To Managing A Quality Trout Fishery, Chris Wood*, Douglas Besler, and Jacob Rash
[Abstract] [Podcast]

Evaluation of North Carolina Resident Catfish Anglers' Fishing Participation And Management Expectations: Survey of North Carolina's Resident Catfish Anglers, Kerry Linehan* and Mark Damien Duda
[Abstract] [Podcast]

Movement, Habitat Use, Mortality Rates And Trophic Status Of White Bass In Jordan Lake, NC, Kelsey J. Lincoln*, D. Derek Aday, and James A. Rice, Student Paper
[Abstract] [Podcast]

Flow Strongly Influences Migrations And Diel Activity Of Riverine Fishes, Joshua K. Raabe* and Joseph E. Hightower, Student Paper
[Abstract] [Podcast]

Using Genetic Markers For Evaluation Of American Shad Hatchery Contributions: A Better Tool For The Job, Ben Ricks*, Kevin Dockendorf, and Morgan Raley
[Abstract] [Podcast]

Session 2: The Conservation-Public Interface

Ranking Criteria Recommendations For The 2015 Wildlife Action Plan Revision And Identification Of Priority Species, Cindy Carr*
[Abstract] [Podcast]

Removing A Stream From The 303(d) List – The Richland Creek Fish Re-introduction Project, Bryn Tracy* and Ed Williams
[Abstract] [Podcast]

Effects Of Urbanization On Fish Species Richness In The Upper French Broad River Basin, Nicole Dexter* and David P. Gilette, Student Paper
[Abstract] [Podcast]

Evaluation Of Culverted Road Crossings In The Upper Nolichucky River Watershed As Barriers To Aquatic Organism Passage, Lily Dancy-Jones* and David P. Gilette, Student Paper
[Abstract] [Podcast]

Effects Of Changes In Land Use On Fish Assemblages In The French Broad River Basin, North Carolina, Dylan A. Cipkowski* and David P. Gilette, Student Paper
[Abstract] [Podcast]

Sharing Information With The Public Through Interactive Web Maps, Kim Sparks*
[Abstract] [Podcast]

N.C. Wildlife Federation's Initiatives To Protect Fisheries, Wildlife And Water Quality In North Carolina, Tim Gestwicki*
[Podcast]

Session 3: Aquatic Species: Impacts And Recovery

Tails From The Chowan: A Crayfish Inventory With Notable Fish Records, Tyler Black*
[Abstract] [Podcast]

Molecular And Morphological Examination Of The Cheoah Crayfish (*Orconectes sp cf spinosus*): A Possible Undescribed North Carolina Endemic, Raymond A. Kessler, IV* and Michael M. Gangloff, Student Paper
[Abstract] [Podcast]

Hurricane-Induced Fish Kill Response: Lessons Learned From Hurricane Irene, Justin Dycus* and Justin Homan
[Abstract] [Podcast]

The Road To Recovery: Evaluating Roanoke River Largemouth Bass Population Response To Hurricane Irene Fish Kills, Jeremy W. McCargo* and Benjamin R. Ricks
[Abstract] [Podcast]

Ghost Hunters, NC: A Status Survey For The Ironcolor Shiner In The Southeastern Coastal Plain, Brena Jones*
[Abstract] [Podcast]

Status Of The Rare Fish And Mollusks Of Lake Waccamaw, North Carolina And The Recent Arrival Of Hydrilla, Ryan Heise*, Ed Corey, and Rob Richardson
[Abstract] [Podcast]

Session 4: Freshwater Mussel Biology And Conservation

Beaver And Mill Dams Alter Freshwater Mussel Habitat, Growth and Survival In North Carolina Piedmont Streams, Rachel A. Hoch*, Megan A. McCormick, Chris B. Eads, Michael D. Madritch, and Michael M. Gangloff, Student Paper
[Abstract] [Podcast]

Changes In Burrowing Behavior And Byssus Production Indicate Sublethal Thermal Stress In Freshwater Mussels, Jennifer Archambault*, W. Gregory Cope, and Thomas J. Kwak, Student Paper
[Abstract] [Podcast]

The Use Of Probiotics For Rearing *In Vitro* Propagated Freshwater Mussels, Thomas R. Fox*, Jay F. Levine, Len A. Stefanski, and Korinn Saker, Student Paper
[Abstract] [Podcast]

Putting Some Mussel Into A Catch Curve, Robert B Nichols*, Tyler R. Black, Michael D. Young, and Arthur E. Bogan
[Abstract] [Podcast]

Freshwater Mussel Population Restoration And Augmentation In Western North Carolina, Steve Fraley* and TR Russ
[Abstract] [Podcast]

Abstracts

Making It Our Plan: Collaborating With Stakeholders To Revise North Carolina's Trout Management Plan

Jacob M. Rash[1] and Kerry J. Linehan[2]. [1]North Carolina Wildlife Resources Commission, 645 Fish Hatchery Road, Marion, North Carolina 28752; [2]North Carolina Wildlife Resources Commission, 1721 Mail Service Center, Raleigh, North Carolina 27699. jacob.rash@ncwildlife.org

Between 2010 and 2011, the North Carolina Wildlife Resources Commission (Commission) collaborated with trout anglers and resource management partners to revise the 1989 Trout Management Plan. Diverse groups of anglers utilize commission-managed trout waters and contribute approximately $174 million to North Carolina's economy each year. The Commission recognizes the importance of understanding trout angler activities and views in order to develop appropriate management strategies. Thus, the Commission held five focus groups with trout anglers to receive their thoughts regarding trout management. Focus group participants represented anglers affiliated with organized angling groups (Trout Unlimited, Federation of Fly Fishers, or private fishing clubs), anglers not identified with organized angling groups, and trout angling guides. Selected participants from each of the five focus groups were recruited to serve on an angler advisory committee whose charge was to provide input as the Commission refined program areas and goals. During advisory committee meetings information exchange was aided by presenting background information, clarifying Commission and participants' roles, and explaining the goals and limitations of the process. In addition to stakeholder involvement, the Commission sought to include a variety of management partners throughout the revision process. Input meetings were held with staff representing multiple Commission divisions and other state, federal, and non-governmental resource management partners. Through this collaborative revision process the Commission was able to obtain a suite of qualitative data that provided rich, in-depth information that would not have been captured otherwise, and as a result, five critical program areas and specific goals for each area were identified and incorporated into the Commission's new trout management plan.

The Bridgewater Tailrace Of Western North Carolina: Historical And Contemporary Approaches To Managing A Quality Trout Fishery

Chris Wood[1], Doug Besler[2], and Jacob Rash[3], [1,2,3] North Carolina Wildlife Resources Commission, 645 Fish Hatchery Rd., Marion, NC 28752. chris.wood@ncwildlife.org

Bridgewater Tailrace is a 29-km waterway extending from Lake James to Lake Rhodhiss in western North Carolina. An 18-km reach of the tailrace has been classified as Special Trout Waters by North Carolina Wildlife Resources Commission (NCWRC) and managed as a put-grow-and-take trout fishery. This reach has been stocked annually from 1996–2008 with 25,000–50,000 coded wire tagged fingerling brown trout *Salmo trutta* in an effort to establish a high-quality tailrace fishery. An investigation of the Special Trout Waters from 2000–2002 demonstrated that a high percentage of captured brown trout were derived from fingerling stocking efforts and that growth rates of stocked fish were high. These initial data suggest stocking efforts were establishing and maintaining a quality brown trout fishery. However, subsequent surveys and environmental monitoring from 2003–2009 indicated recruitment of stocked fish and numbers of adult fish were highly variable and negatively correlated to water temperature. NCWRC biologists suspect high annual rainfall totals, which result in increased discharge from Bridgewater Powerhouse, deplete cold water from the hypolimnion of Lake James. This hypolimnetic depletion may have deleterious effects on the extant brown trout population by increasing water temperatures and decreasing dissolved oxygen levels within the tailrace. Recent updates to Bridgewater Powerhouse may alleviate issues that historically hampered the fishery. Increased dissolved oxygen levels, new flow regimes, additional access areas, and a new stocking philosophy by NCWRC may benefit

the brown trout fishery in Bridgewater Tailrace. A 5-year study is planned to assess the impact these changes will have on the fishery.

Evaluation of North Carolina Resident Catfish Anglers' Fishing Participation And Management Expectations: Survey of North Carolina's Resident Catfish Anglers

Kerry Linehan[1] and Mark Damian Duda[2]. [1]North Carolina Wildlife Resources Commission, 1721 Mail Service Center, Raleigh, North Carolina 27699; [2]Responsive Management, 130 Franklin Street, Harrisonburg, VA 22801. kerry.linehan@ncwildlife.org

Catfishes are among the most popular fishes sought by NC anglers, second only to black bass in total number of anglers and in total annual angler days. One of the goals outlined in NCWRC's 2007 Catfish Management Plan was to determine angler expectations for catfish management. The survey objectives were to determine fishing participation and avidity, fishing characteristics, management preferences, participation in commercial sale of catfish and demographic characteristics of NC catfish anglers. Responsive Management completed 1,237 telephone surveys with catfish anglers from a random selection of license holders and achieved a response rate of 41%. Twenty-two percent of license holders fished for catfish during 2011. The majority of catfish anglers were male (84%), had some college or trade school education or greater (51%) and were 45 years or older (56%). Fifty-three percent indicated they ate at least one meal of catfish they caught per month. Anglers were asked about support for or opposition to classifying catfishes as game fish species in NC inland waters before and after explaining that game fish status means that catfish could not be sold. Prior to the explanation, 39% of catfish anglers supported this action, while 38% opposed. After the explanation, support rose to 54% and opposition dropped to 32%. Forty-eight percent expressed concern about the impacts of blue catfish and 49% expressed concern about the impacts of flathead catfish on native fish populations. These data will be used to inform NCWRC catfish management objectives. For example, results will assist fisheries managers develop strategies to manage blue and flathead catfish in waters with recovering populations of shad and river herring, consider game fish status for catfish in NC Inland Waters, and inform the NC Department of Health and Human Services (NCDHHS) about angler consumption rates of catfish as NCDHHS administers fish consumption advisories.

Movement, Habitat Use, Mortality Rates And Trophic Status Of White Bass In Jordan Lake, NC

Kelsey J. Lincoln[1], D. Derek Aday[2], James A. Rice[3]. North Carolina State University, Department of Biology, Campus Box 7617, Raleigh, NC 27695. kjlincol@ncsu.edu

Though white bass *Morone chrysops* are a popular sport fish in North Carolina as well as an important ecological component of many reservoir fish communities, little is known about fundamental aspects of their life history, ecology and population dynamics. This lack of general information in addition to increased concern regarding declining white bass populations in some North Carolina reservoirs has made the management of this species difficult. To address this issue we are using multiple methods to evaluate a variety of life history, ecological, and population characteristics of white bass in Jordan Lake, NC. Acoustic transmitters were implanted into 50 white bass collected at the confluence of the Haw River and Jordan Lake during their spring spawning run in 2012. Tagged fish were continuously monitored using an array of passive receivers throughout the reservoir and located monthly during active tracking surveys. Telemetry data are providing information regarding large-scale movement patterns, habitat use, and seasonal mortality rates of white bass. The size-at-age relationship for white bass in Jordan Lake was determined using otolith analysis. As white perch have been known to compete with white bass for resources, we also are exploring potential niche overlap between the two species. We are using stable isotope analysis to estimate the trophic levels of fish in small, medium, and large size categories of

each species and comparing them to determine overlap between species and size-dependent changes within species. In October 2012 we implanted acoustic tags into 20 white perch to collect data on movement patterns and habitat use for comparison with data from white bass. Results from this study will provide managers with data and insights to inform further development of conservation and management plans for white bass in Jordan Lake, and potentially in other North Carolina reservoirs.

Flow Strongly Influences Migrations And Diel Activity Of Riverine Fishes

Joshua K. Raabe[1] and Joseph E. Hightower[2]. [1]North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Campus Box 7617, Raleigh, NC 27695; [2]US Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Campus Box 7617, Raleigh, NC 27695. jkraabe@ncsu.edu

Water flow has long been considered an important variable to riverine fishes. However, the response and behavior of migratory fishes under different flow conditions has received limited study. Therefore, in the springs of 2009 and 2010, we evaluated migrations and diel activity of migratory fishes relative to flow conditions in the Little River, North Carolina, a tributary to the Neuse River. We used a resistance board fish weir installed near the river mouth combined with passive integrated transponder (PIT) tags and antennas to capture, tag, and track American shad *Alosa sapidissima*, gizzard shad *Dorosoma cepedianum*, and flathead catfish *Pylodictis olivaris*. All three species displayed a positive response between daily flow conditions (i.e., discharge, gage height) and the number of weir captures and antenna detections. American shad and gizzard shad underwent more extensive and rapid migrations during weeks with elevated flows. Diel activity of American shad and gizzard shad at PIT antennas was primarily nocturnal at low flows but shifted to diurnal during high flows. Flathead catfish diel activity at PIT antennas was exclusively nocturnal at the lowest flow conditions, but diurnal activity did increase slightly as flows increased. The responses and behaviors of each species under different flow conditions may be due to a variety of factors including spawning habitat preferences, traversing physical obstructions, feeding behavior and predation avoidance, and swimming capabilities. This study provided empirical evidence that flow is an important variable in the migrations and behaviors of riverine fishes and that flow regimes and annual variability should be considered in management efforts.

Using Genetic Markers For Evaluation Of American Shad Hatchery Contributions: A Better Tool For The Job

Ben Ricks[1], Kevin Dockendorf[2], and Morgan Raley[3]. [1]North Carolina Wildlife Resources Commission, 463 Sawmill Road, Elizabeth City, NC 27909. [2]North Carolina Wildlife Resources Commission, 106 Cayuse Way, Elizabeth City, NC 27909. [3]North Carolina Museum of Natural Sciences Nature Research Center, MSC# 1626, Raleigh, NC 27699. ben.ricks@ncwildlife.org

North Carolina Wildlife Resources Commission (Commission) has been stocking American Shad in the Roanoke River since 1998. Prior to 2010, the assessment method used to evaluate hatchery contribution involved recovering oxytetracycline (OTC) marks absorbed by the otoliths of shad collected in the field. Commission staff recognized problems associated with OTC evaluations during that time. For example, the absorption of OTC was not always 100%, a function attributed to hatchery water quality at the time the fry were marked. OTC mark fading and faint marks were also noted. Finally, the delicate nature of the otolith and its tendency to break during sample preparation often decreased sample size and impeded the ability to evaluate all samples. The use of genetic markers to identify hatchery-produced fish became available to the Commission in 2009 and implementation began in 2011. This technique uses microsatellite markers to establish a permanent and genetically traceable connection between broodfish and returning progeny. American Shad fin clips from field collections can be used to provide the genetic material necessary to compare with discrete batches of hatchery

broodfish. This non-lethal technique is almost 100% accurate in determining if a fish is of hatchery origin. Hatchery contribution in 2011 of juvenile American Shad on the Roanoke River as evaluated by genetics from fin clips (37.7%) was over twice as high as the estimate provided with OTC evaluations from otoliths of those same fish (14.4%). Furthermore, the fin clip sample size was greater for the genetics evaluation than the OTC analysis because 13 sets of American Shad otoliths were damaged during sample preparation; five of which were hatchery origin from genetic analysis. When compared to the parentage analysis provided through genetics, OTC evaluations failed to detect 25% of the hatchery fish in the sample. The use of microsatellite markers to establish a conclusive connection between broodfish and their progeny will be the Commission's current method of choice to evaluate hatchery contributions of American Shad.

Ranking Criteria Recommendations For The 2015 Wildlife Action Plan Revision And Identification Of Priority Species

Cindy Carr, North Carolina Wildlife Resources Commission, 1721 MSC, Raleigh, NC 27699-1721.
cindy.carr@ncwildlife.org

The State Wildlife Grants (SWG) program established federal funding for nongame species not traditionally covered under traditional funding programs. To qualify for SWG funds, each state was mandated to develop conservation strategies with a focus on species of greatest conservation need (SGCN). The 2005 Wildlife Action Plan (WAP) review team developed an iterative process to identify species conservation priorities using ranking evaluations that focused on eight taxonomic groups based on jurisdictional and traditional programmatic boundaries. Ranking criteria included consideration for species that are currently rare or designated as at-risk, those for which we have knowledge deficiencies, and those that have not received adequate conservation attention in the past. Following publication of the 2005 WAP the review team recommended future iterations include a reevaluation of the criteria and methodology. Following this recommendation and others published in a recent best practice guide for revising WAPs from the Association of Fishery and Wildlife Agencies, the 2015 WAP revision technical team formed a work group to review and evaluate ranking metrics and prioritization tools. The work group considered several methods for evaluating and prioritizing species conservation status, including those used by International Union of Conservation Networks (IUCN), NatureServe, American Fisheries Society, and Partners In Flight Species Assessment Process. Recommendations have been developed for a method to identify SGCN and prioritize conservation efforts on behalf of all wildlife in the state. The Work Group is recommending the adoption and modification of selected ranking criteria and scoring metrics modified from Millsap *et al.* (1990), IUCN, and NatureServe combined with creation of original criteria and metrics. The recommended ranking criteria will be used to evaluate conservation concerns and identify SGCN and to identify knowledge gaps and management concerns for use in prioritizing conservation efforts that will be reported in the revised 2015 WAP.

Removing A Stream From The 303(d) List – The Richland Creek Fish Re-introduction Project

Bryn H. Tracy[1] and Ed Williams[2]. [1]North Carolina Division of Water Quality, 1621 MSC, Raleigh, NC 27699.
[2]North Carolina Division of Water Quality, 2090 US Highway 70, Swannanoa, NC 28778. bryn.tracy@ncdenr.gov

The Division of Water Quality, NC Wildlife Resources Commission, University of Tennessee-Knoxville, Haywood Waterways Association, and Evergreen Packaging are working together on an innovative project designed to remove Richland Creek – a tributary of the Pigeon River near Waynesville, North Carolina – from the §303(d) impaired waters list. The project is modeled on the successful bi-state Pigeon River Reintroduction project led by UT-K and NCWRC. Richland Creek had historic and long-term poor water quality, hydrologic modifications, habitat degradation and impaired biological integrity. After a decade of water quality enhancement projects, water quality had improved to a level suitable for the reintroduction of the native fish community to areas

upstream of the Lake Junaluska dam – a barrier to re-colonization since 1913. River Chub, Warpaint Shiner, Saffron Shiner, Mottled Sculpin, Rock Bass, Tuckasegee Darter, and Greenfin Darter are collected, transported to the area above the lake and released twice a year for three years, or until the species establish reproducing populations. Since April 2010, more than 14,000 fish representing these seven species, plus Mirror Shiner and Fantail Darter, have been collected from nearby source populations and reintroduced at multiple sites across Waynesville. Reproducing populations and longitudinal dispersal have already been documented for some species. Results from DWQ's 2012 monitoring of the creek resulted in a Good-Fair rating for the fish community. With the reintroduction of the fish population, removal of the stream from the impaired water list is expected. However, long-term success for the project will require continued habitat improvements, stormwater management and other water quality improvements.

Effects Of Urbanization On Fish Species Richness In The Upper French Broad River Basin

Nicole Dexter and David P. Gillette, University of North Carolina Asheville, Department of Environmental Studies.

Urbanization is having negative effects on streams and rivers on a global scale, and can greatly affect a stream's productivity, water chemistry, physical habitat and species richness. This study examines the effects of urbanization on fish diversity in the French Broad river basin. Data were compiled from state sampling programs, as well as 40 sites that were sampled in summer of 2012. To test whether the effects of urbanization are strongest in small or large watersheds, the relationship between urbanization and species diversity is estimated using species-area curves for both the rural and urban streams. Analyses were also conducted to determine which species were characteristic of rural urban sites.

Evaluation Of Culverted Road Crossings In The Upper Nolichucky River Watershed As Barriers To Aquatic Organism Passage

Lily Dancy-Jones and David P. Gillette, University of North Carolina Asheville, Department of Environmental Studies

The Upper Nolichucky River watershed, part of the French Broad River Basin, is of ecological importance and a high priority focus area for restoration and conservation in part due to its support of rare aquatic species, including the federally-endangered Appalachian Elktoe mussel and native Eastern Brook Trout. An important conservation priority for resource agencies and conservation organizations is identifying and assessing the impact of barriers to aquatic organism passage in streams. Anthropogenic barriers often occur at road-stream crossings, most commonly associated with culverts. Models used to predict the impact of road crossings on aquatic organism passage use physical variables such as the length, slope, and sediment coverage of a crossing, however biological sampling can give insight on how barriers have affected natural communities. The objectives of this research were to examine trends in fish populations, habitat, and water quality associated with culverted road-crossings identified as potential barriers to aquatic organism passage. Four road crossings that were designated as barriers to aquatic organism passage based on existing models were chosen for evaluation; barriers were prioritized in drainages with native brook trout populations. Data collected were analyzed comparing fish species and abiotic characteristics for upstream and downstream sampling locations as well as paired reference locations. Trout biomass and density were also considered. Detailed information on biotic communities and abiotic habitat characteristics offered a more valuable perspective on the decision to remove or alter a barrier than predictive models alone.

Effects Of Changes In Land Use On Fish Assemblages In The French Broad River Basin, North Carolina

Dylan A. Cipkowski and David P. Gillette, Department of Environmental Studies, University of North Carolina at Asheville, One University Heights , Asheville, North Carolina 28804. dacipkow@unca.edu

Human land use has been well documented as an influencing factor in riverine systems, impairing the chemical, hydrological and biotic properties of streams (Warren et al. 2000). This study quantified fish assemblages within 15 different tributaries of the upper French Broad River basin, previously sampled by the USGS in 1997. Fish assemblages were determined to be related to changing land use through a correlation analysis comparing changes in fish metrics since 1997 and land use change over a nine year period. One of the findings of this study was that total fish abundance, being all individuals collected throughout the study, was found to be four times fewer in 2012 than in 1997, describing the rapid and pervasive fish decline that is occurring in western North Carolina. Fish metrics were found to be most significantly affected by increasing high intensity development (>80% impervious surface), characterized by a significant positive correlation with the relative abundance in tolerant species and a negative significant correlation with that of intolerant species. Additionally, it was found that herbivorous species were positively correlated with an increase in grass/herbaceous land, likely stemming from the land's recent agricultural influences promoting algal growth and providing a food resource for populations of the basin's primary herbivore, *Campostoma anomalum.* The findings of this study provide an example of the importance of environmental indicators, such as fish metrics, for identifying effects of anthropogenic land disturbance. The identified relationships between these biological characteristics in streams and land use change can contribute to future land management's ability to mitigate the inevitable effects on streams, followed by biological alterations, in the face of increasing urbanization.

Sharing Information With The Public Through Interactive Web Maps

Kimberly Sparks, North Carolina Wildlife Resources Commission. 1751 Varsity Drive, Raleigh, NC 27606. kim.sparks@ncwildlife.org

Social Media has made it very easy to share information with the public in an almost real time manner, through forums like Facebook, blog posts and online articles. If you are using these kinds of forums, you already know that adding images and links to reference web pages improves the quality of these posts. But did you know that you can also create and share interactive web maps with the public? Google Fusion tables and ArcGIS Online are just two options for free on-line tools that allow you to create and share spatial information with the public via the web. Your data can be formatted with latitude and longitude coordinates, as KML or as shapefiles. You can control the appearance of the map by selecting the map icons and configuring the pop-up windows that open when a user clicks on your map. Even if you're not interested in social media, these tools provide a quick and easy way to share spatial data with colleagues, without having to e-mail a collection of GIS files around. This presentation will walk through examples of how to use these free tools, and provide a discussion of the pros and cons for each method. You'll be posting maps in your press releases and blog posts in no time.

N.C. Wildlife Federation's Initiatives To Protect Fisheries, Wildlife And Water Quality In North Carolina

Tim Gestwicki, Chief Executive Officer, NC Wildlife Federation, 2155 McClintock Rd., Charlotte, NC 28205. tim@ncwf.org

Tails From The Chowan: A Crayfish Inventory With Notable Fish Records

Tyler R. Black, NC Wildlife Resources Commission, 1718 NC Hwy 56 W, Creedmoor, NC 27522.
tyler.black@ncwildlife.org

Prior to 2011, distributional knowledge for crayfishes within the North Carolina portion of the Chowan River basin was relatively limited. Thus, the goal of this study was to assess the distribution of *Orconectes* (*Crockerinus*) *virginiensis* (Chowanoke Crayfish), a state and federal species of concern, and associated crayfishes in the Chowan River basin. One hundred and thirty surveys were conducted at 117 100-m reaches during 2011-12. Crayfishes were collected with minnow traps, backpack electrofishing equipment, seines, and hand excavation. Six crayfish species were collected, representing 5 native species and 1 non-native species. *Orconectes virginiensis* was found at 8 of 57 streams and 19 of 117reaches. Two species, *Cambarus* (*Puncticambarus*) *sp. C* and *Procambarus* (*Scapulicambarus*) *clarkii* (Red Swamp Crawfish), possibly represent new species records for the basin. In addition, noteworthy collections were also made for five species of fish, including *Notropis bifrenatus* (Bridle Shiner), *Notropis chalybaeus* (Ironcolor Shiner), *Enneacanthus chaetodon* (Blackbanded sunfish), *Enneacanthus obesus* (Banded Sunfish), and *Percina roanoka* (Roanoke Darter).

Molecular And Morphological Examination Of The Cheoah Crayfish (*Orconectes sp cf spinosus*): A Possible Undescribed North Carolina Endemic

Raymond A. Kessler IV and Michael M. Gangloff, Appalachian State University, Boone, NC 28608.
kesslerr1@gmail.com

The Cheoah Crayfish (*Orconectes (Procericambarus) sp cf spinosus*) is believed to be an un-described species endemic to the Cheoah River in western North Carolina. Known currently from five creeks in the Little Tennessee River basin, the status of this crayfish is of a conservation concern. With the recent introductions of two other *Procericambarus spp.* (*Orconectes juvenilis* and *Orconectes rusticus*) to western North Carolina, we decided to evaluate the hypothesis that the Cheoah crayfish is a native, endemic species. We collected specimens from five tributaries to Fontana and Santeelah reservoirs. We compared Cheoah crayfish specimens to other *Procericambarus spp.* from western North Carolina and Eastern Tennessee using mtDNA and morphometric analysis of carapace landmarks. Ongoing morphological and genetic analysis suggests that the Cheoah crayfish is morphologically discernible from other *Procericambarus* taxa, but may be genetically different. Additional analysis will address the issues concerning the species and native species status of the Cheoah crayfish.

Hurricane-Induced Fish Kill Response: Lessons Learned From Hurricane Irene

Justin C. Dycus and Justin M. Homan. North Carolina Wildlife Resources Commission, 1721 Mail Service Center, Raleigh, North Carolina 27699. Justin.dycus@ncwildlife.org

Following Hurricane Irene in August 2011, hurricane induced fish kills occurred through the majority of the coastal region and devastated fish populations in coastal North Carolina rivers, including the Tar, Neuse and Northeast Cape Fear rivers. Portions of these coastal river systems experienced anoxic conditions up to 21 days. In response to the fish kill, North Carolina Wildlife Resources Commission (Commission) fisheries staff implemented a post-hurricane monitoring plan in affected areas to evaluate the response by the Largemouth Bass *Micropterus salmoides* population. Sample transects on each river were monitored with boat mounted electrofishers and sampled during fall 2011 and fall 2012. Based on observed increases in CPUE, size structure, and an apparent successful spawn of the 2012 year-class, it appears that the Largemouth Bass population in the

Tar, Neuse and Northeast Cape Fear rivers are recovering within two years following Hurricane Irene and may soon return to pre-hurricane population characteristics. Along with our monitoring, we partnered with local black bass clubs to stock 154 Largemouth Bass greater than 8 inches in the Northeast Cape Fear in November 2012. Largemouth Bass were fin clipped and tagged with coded wire tags in effort to further our understanding of supplemental stocking efforts following hurricane-induced fish kills where natural recovery may be slow. Angler support of research efforts will be a key component in reaching common objectives for restoring fish populations during post-hurricane monitoring efforts.

The Road To Recovery: Evaluating Roanoke River Largemouth Bass Population Response To Hurricane Irene Fish Kills

Jeremy W. McCargo and Benjamin R. Ricks, NC Wildlife Resources Commission, 1701 Mail Service Center, Raleigh, NC 27699-1701, 252-330-4063. jeremy.mccargo@ncwildlife.org

Numerous hurricanes and tropical storms, including Hurricane Fran in 1996, Floyd in 1999, Isabel in 2003, and most recently Irene in 2011, have caused significant fish kills in North Carolina's coastal rivers. As each storm passed, rapid flushing of hypoxic water and organic solids from backwater habitats into tributaries and rivers resulted in increased biological oxygen demand, a subsequent decrease in dissolved oxygen, and in turn, fish kills. Flooding from Hurricane Irene in 2011 created anoxic conditions for up to 30 days in many coastal systems, including the Roanoke River. Results from population monitoring and stocking evaluations following previous hurricane-induced fish kills were used to develop a hurricane response plan that was first implemented following Hurricane Irene. The response plan included monitoring to document the extent of poor water quality and fish kills as well as sportfish population surveys 1 month, 6 months and 12 months following the storm. In addition, approximately 120,000 Largemouth Bass fingerlings were stocked in lower Roanoke River tributaries in May 2012. Surveys of Roanoke River Largemouth Bass populations conducted in fall 2011 and spring 2012 indicated drastic reductions in adult Largemouth Bass abundance from levels found in previous samples; however, results from surveys in fall 2012 documented excellent recruitment of young-of-year Largemouth Bass. Although stocking efforts may have been successful, high abundances of juvenile fish in the fall 2012 sample were found in stocked and unstocked areas. Given the increase in the frequency of cyclones, management of Largemouth Bass in coastal North Carolina now centers on our ability to assess the extent of the kill areas following storm passage, understand natural recovery mechanisms, and consider and implement a wide range of strategies to expedite recovery. It is apparent that recruitment following a hurricane-induced fish kill is a critical component to Largemouth Bass population recovery.

Ghost Hunters, NC: A Status Survey For The Ironcolor Shiner In The Southeastern Coastal Plain

Brena Jones, NC Wildlife Resources Commission, 1718 NC Hwy 56 W, Creedmoor, NC 27522.
brena.jones@ncwildlife.org

Distribution records for NCWRC and NHP priority species of fishes in the southeastern coastal plain of NC remain sparse and dated. As reported at the 2012 NCAFS Annual Meeting, a 2010 survey of 32 sites in the lower Cape Fear, Lumber, and White Oak drainages added updated information for the thinlip chub, broadtail madtom, spotted sunfish, golden topminnow, Everglades pygmy sunfish, blackbanded sunfish, taillight shiner, and ironcolor shiner. However, the thinlip chub, broadtail madtom, and golden topminnow were only found at one site and the ironcolor shiner was only found at two. In the fall of 2011, a follow-up survey of the Lumber River revealed a large population of thinlip chubs that appeared to be both continuous and actively reproducing from the upper end of the State Park to Lumberton. In 2012, 35 sites were sampled in a search for the ironcolor shiner, which was once widespread across the entire coastal plain according to NCWRC fish surveys in the mid-1960's. No ironcolor shiners were found in this region. Several sites did produce new records for the thinlip

chub and the golden topminnow. Reasons for this apparent disappearance of the ironcolor shiner are currently unknown, but several coastal river basins did experience hurricanes, extreme algae blooms and zero-DO conditions during 2011 and 2012 which undoubtedly contributed to the negative data to some degree. Further survey efforts for this and several other priority species such as the banded sunfish and the Carolina pygmy sunfish are warranted.

Status Of The Rare Fish And Mollusks Of Lake Waccamaw, North Carolina And The Recent Arrival Of Hydrilla

Ryan Heise[1], Ed Corey[2], and Rob Richardson[3]; [1] North Carolina Wildlife Resources Commission, 1718 NC Hwy 56, Creedmoor, NC 27522; [2] North Carolina Division of Parks and Recreation, Yorkshire Center Office 305, 12700 Bayleaf Church Road, Raleigh, NC 27614; [3] Crop Science Department, North Carolina State University, Raleigh, NC 27695. ryan.heise@ncwildlife.org

Lake Waccamaw is a 3,615 hectare Carolina bay lake located in North Carolina that is unique because of its water chemistry (near-neutral pH) and large size, as compared to other natural bay lakes. There are 17 species of rare fish and mollusks that have been documented from the lake. Three species of fish, including the federally listed Waccamaw Silverside, are endemic to Lake Waccamaw. In a collaborative effort, NCWRC and State Parks are conducting long-term monitoring surveys. Our catch-per-unit-effort data suggests that fish populations are persisting, except for the Broadtail Madtom (*Noturus sp.*) which is nearly extirpated from the lake. Priority species of mussels and snails persist in Lake Waccamaw as well, though densities of many of these animals are lower than historical surveys. In November 2012, Hydrilla was discovered in the northwestern side of the lake. The current distribution of Hydrilla is 246 hectares, while native vegetation accounts for 1470 hectares. If funding can be acquired, chemical treatment (Fluridone) will begin this spring. Fish and mussel surveys will continue as we refine our management strategy for Lake Waccamaw.

Beaver And Mill Dams Alter Freshwater Mussel Habitat, Growth and Survival In North Carolina Piedmont Streams

Rachael A. Hoch[1], Megan A. McCormick[1], Chris B. Eads[2], Michael D. Madritch[1], and Michael M. Gangloff[1]. [1] Appalachian State University, Biology Department, Boone, NC 28608. [2] North Carolina State University, College of Veterinary Medicine, Raleigh, NC 27606. hoch.rachel@gmail.com

In aquatic systems, anthropogenic and beaver (*Castor spp.*) dam-building activities alter habitats and have profound effects on the availability, quality, and connectivity of resources. Freshwater mussels are imperiled indicator species, perform key ecosystem services and serve as basal resources in stream foodwebs. Understanding the effects of increasing beaver populations and dam removals is imperative to the conservation of freshwater mussels. We examined the effects of beaver and mill dams on freshwater mussel growth and food resource availability and quality. We complemented stream survey data with a common garden experiment conducted in the upper Tar River Basin of North Carolina, USA. We found that mill impoundments improved mussel food quality and significantly ($p< 0.05$) increased growth of freshwater mussels in mill dam tailraces. In contrast, sites with beaver impoundments did not experience enriched food resources or growth. Caged mussel mortality was twofold higher across all beaver reaches (39.9%) compared to mill reaches (20.0%). Patterns in mussel growth and survival were positively correlated with increased total suspended solid (TSS, <250 um) mass and % nitrogen, measures of mussel food quantity and quality. Our research suggests that discontinuities in the flow continuum alter stream energetic pathways with dramatic consequences for the growth and survivorship of freshwater mussels. Increased water retention times resulting from impoundments may decrease nutrient spiraling lengths and increase small particle retention and nitrogen thereby increasing mussel food quality. While dam removals may increase physical habitat connectivity, impoundments also serve as important nutrient sinks especially in nutrient-rich Piedmont streams. Quantifying costs and benefits of restored connectivity to

taxa across multiple trophic levels as well as addressing effects on key small stream and wetland ecosystem services should be considered when prioritizing restoration projects.

Changes In Burrowing Behavior And Byssus Production Indicate Sublethal Thermal Stress In Freshwater Mussels

Jennifer M. Archambault[1], W. Gregory Cope[2], and Thomas J. Kwak[3]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695. Email: jmarcham@ncsu.edu; [2] Department of Environmental and Molecular Toxicology, Box 7633, NC State University, Raleigh, NC 27695; [3] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695. jmarcham@ncsu.edu

Recent research has elucidated the acute lethal effects of elevated water temperature to glochidia (larvae), juvenile, and adult life stages of freshwater mussel species (Order Unionida), but few studies have focused on sublethal effects of thermal stress. We evaluated the sublethal effects of elevated temperature on byssus (attachment filaments) production (in juveniles only) and burrowing behavior of five species (juveniles of *Amblema plicata, Lampsilis abrupta, Lampsilis cariosa,* and *Lampsilis siliquoidea*, and adults of *Lampsilis fasciola*) in acute (96-h) laboratory experiments in sediment, with two acclimation temperatures (22 and 27°C) and two experimental water levels (low water and dewatered treatments) as proxies for flow regime. In additional experiments, we added a vertical temperature gradient to the sediment and evaluated the thermal sensitivities of two species (*Lampsilis abrupta* and *Lampsilis radiata*). Increasing temperature significantly reduced burrowing in all species tested, and the dewatered treatment (a proxy for drought conditions) reduced burrowing in all but *Amblema plicata*. Production of byssal threads was affected most drastically by flow regime, with the probability of byssus presence in *L. abrupta, L. cariosa,* and *L. siliquoidea* reduced by 93 – 99% in the dewatered treatment, compared to the low water treatment (a proxy for low flow conditions). Increasing temperature alone reduced byssus by 17 – 35% in all species evaluated. Our results are highly relevant in the context of climate change, because stream temperature and flow are expected to change with increasing air temperature and altered precipitation patterns.

The Use Of Probiotics For Rearing *In Vitro* Propagated Freshwater Mussels

Thomas R. Fox[1], Jay F. Levine[1], Len A. Stefanski[2], and Korinn Saker[3]. [1]Aquatic Epidemiology and Conservation Laboratory, College of Veterinary Medicine, NC State University, Raleigh, NC 27606. [2]Department of Statistics, NC State University, Raleigh, NC 27695. [3]Department Molecular and Biomedical Sciences, CVM, NC State University, Raleigh, NC 27606. Tom_Fox@ncsu.edu

The *in vitro* propagation of freshwater mussels is a technique that bypasses the need for an obligate fish host and facilitates transformation of juveniles in an artificial media. We have successfully transformed 13 species of freshwater mussels including three federally endangered species using *in vitro* propagation techniques. Although the transformation percent of juveniles cultured in vitro can greatly exceed that of juveniles reared on fish hosts, the physiological health and survival of *in vitro* transformed juveniles is often poor. We developed a method of slow acclimatization to freshwater that increased juvenile survival in the first 24 hours from 38% to 90%. Almost all animals contain beneficial gut flora that promote good health and aid in the digestion of food. Juveniles propagated *in vitro* are held in a completely sterile environment and do not have access to potentially important bacterial species that would colonize their gut. We hypothesized that feeding a species of bacteria that has been isolated from the gut of unionids would serve as a probiotic and increase growth and survival of in vitro propagated juveniles. In this study, a series of experiments were conducted feeding the bacteria *Bacillus subtilis* at four different levels to *Alasmidonta raveneliana*, *Lampsilis fasciola*, and *Villosa delumbis*. Over a 30-

day period the *A. raveneliana* juveniles that were fed algae and a high concentration of *B. subtilis* exhibited increased growth and survival when compared to the other treatments. *L. fasciola* and *V. delumbis* showed a decrease in survival and growth for the juveniles that were fed only *B. subtilis* and no algae. *Bacillis subtilis*, may be a beneficial addition to the diet of captive reared juvenile *A. raveneliana*

Putting Some Mussel Into A Catch Curve

Robert B Nichols[1], Tyler R. Black[1], Michael D. Young[1], and Arthur E. Bogan[2]. [1] North Carolina Wildlife Resources Commission, 1721 Mail Service Center Raleigh, NC 27699; [2]North Carolina Museum of Natural Sciences, 11 West Jones St. Raleigh, NC 27601. rob.nichols@ncwildlife.org

Population dynamic parameters, such as mortality, survival, and recruitment, are difficult, if not impossible, to obtain for endangered mussels. Therefore, our object was to assess year class strength, annual survival, and mortality of *Elliptio steinstansana* (Tar River Spinymussel) by externally aging museum specimens. During 1990, a mussel kill occurred in Swift Creek, Tar River basin, which allowed biologists to collect and voucher numerous specimens of rare mussels. Thus, we worked with the North Carolina Museum of Natural Sciences to assemble *Elliptio steinstansana* lots from multiple museums. Specifically, our catch curve analysis focused on lots collected from Swift Creek during 1990-92. Analysis is currently ongoing.

Freshwater Mussel Population Restoration And Augmentation In Western North Carolina

Steve Fraley and T.R. Russ, North Carolina Wildlife Resource Commission, 645 Fish Hatchery Rd., Marion, NC 28752. stephen.fraley@ncwildlife.org

Improvements in water and habitat quality can restore suitable habitat for freshwater mussels; however, barriers may exist to natural colonization where mussels are extirpated or demographics of relict populations may be less than ideal for population recovery. Multiple opportunities to restore mussel populations were identified and prioritized in western North Carolina, and strategies were developed and implemented for seven species and six stream reaches. Captive propagation conducted at the Conservation Aquaculture Center (CAC) at Marion State Fish Hatchery and by partners at NC State University is a part of the restoration strategy for *Alasmidonta raveneliana, A. varicosa, Lampsilis fasciola, Villosa iris,* and *V. delumbis*. Translocation is used to help restore *A. raveneliana, A. viridis,* and *Elliptio complanata* (complex) populations. The Cheoah River (Little Tennessee R. system), a regulated river recently improved by FERC mandated flow and substrate restoration, is the focus of efforts to both augment an existing relict population of *A. raveneliana* and to reintroduce *L. fasciola* and *V. iris*. A reach of the Pigeon River (French Broad R. system), where historical point source pollution is reduced, was assessed for potential to support *L. fasciola*, and reintroductions are underway there. Only one population of *A. viridis* remains in the upper French Broad River system (Mills River), but its abundance is supporting translocations to establish a second population in the nearby Little River. On the Atlantic Slope, opportunities to restore mussel populations to the upper South Fork Catawba River system were identified in Jacobs and Henry Forks. Translocations of common species began in 2012 and less common species will be propagated at the CAC for reintroductions to both streams.