26th Annual Meeting

North Carolina Chapter of the American Fisheries Society

February 24-25, 2015

Courtyard Marriot Carolina Beach Hotel
Carolina Beach, North Carolina

Schedule and Abstracts

Thanks to Our Sponsor:

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Tuesday, February 24th

Continuing Education Workshop

8:00 am: **Crayfish 101: An Introduction to Crayfish Biology and Identification,** Tyler Black and T. R. Russ, North Carolina Wildlife Resources Commission.

9:30 – 9:45 am: **Break** (snacks provided)

9:45 am - 11:30 am: **Continuing Education Workshop** (continued)

11:30 am – 12:45 pm: **Lunch** (on your own)

12:45 – 1:00 pm: **Welcome and Orientation**, President Brena Jones and President-Elect Kim Sparks

Session 1: Managing the Fisheries of Eastern North Carolina's Big Rivers
Moderator: Ryan Heise, NCWRC (* Student Presenters)

1:00 pm: **Effectiveness of a Rock Arch Rapids for Fish Passage at a Lock and Dam on a Large Coastal River**, Joshua K. Raabe, Timothy A. Ellis, Chip Collier, and Joseph E. Hightower

1:20 pm: **Evaluating the Cape Fear River Striped Bass Endemic Stocking Program**, Michael Fisk and Justin Dycus

1:40 pm: **Evaluation of Recovery Efforts of Striped Bass in the Lower Neuse River**, Caitlin Bradley*, James A. Rice, and Derek D. Aday

2:00 pm: **Assessment of Striped Bass Spawning Stock Mortality in the Neuse River**, 1994–2014, Kyle T. Rachels

2:20 pm: **15 Year Review of American Shad in the Neuse River: Where We Are Now and Where We Are Heading**, Benjamin R. Ricks and Kyle T. Rachels

2:40 pm: **Largemouth Bass Population Response Following Hurricane Irene in the Chowan River in Coastal North Carolina**, Kathryn M. Potoka, Jeremy W. McCargo, Benjamin R. Ricks

3:00 – 3:20 pm: **Break** (Snacks Provided)

Session 2: **Fisheries Management and Conservation Issues in Western North Carolina**
Moderator: Judy Ratcliffe, NC Natural Heritage Program (* Student Presenters)

3:20 pm: **Approaches to Monitoring Trout Populations in Western North Carolina**, Amanda Bushon, David Goodfred, Kevin Hining, Kin Hodges, Jake Rash, Powell Wheeler, and Chris Wood

3:40 pm: **Adapting IUCN Criteria for Determining the Conservation Status of Aquatic Species in North Carolina**, Todd Ewing

4:00 pm: **Mortality and Dispersal of Stocked Juvenile Muskellunge in a Successful and Unsuccessful Fishery in Western North Carolina**, Dylan P. Owensby*, James A. Rice, and D. Derek Aday

4:20 pm: **Contribution of Black Crappie Fingerlings Stocked into Lake Hickory, 2007–2012**, Kevin Hining, David Yow, and Kin Hodges

4:40 pm **Swimming Ability of Sicklefin Redhorse Early Life Stages and Implications for Conservation of an Imperiled Species**, Tomas J. Ivasauskas*; Thomas J. Kwak, and Patrick L. Rakes

5:00 – 6:00 pm: **Break**

6:00 pm: **Social**

6:30 pm: **Dinner**

7:30 pm – 9:00 pm: **Social and NCSU Student Fisheries Society's Raffle**

Wednesday, February 25th

Session 3: **The Science of Nongame Rare Species and Rare Habitats**
Moderator: Benjamin R. Ricks, NCWRC

8:00 am: **An Index of Biotic Integrity for Wadeable Streams in the North Carolina Sand Hills**, Bryn H. Tracy

8:20 am: **Influence of Landuse Change on Sensitive Aquatic Biota in the Upper New River Drainage, North Carolina**, Gary Pandolfi*, M. Worth Pugh, Thomas Franklin, Daniel Mason, Jason Selong, and Michael M. Gangloff

8:40 am: **Status Assessment of *Orconectes virginiensis* (Chowanoke Crayfish) in North Carolina**, Tyler R. Black and Robert B. Nichols

9:00 am: **Fish Collecting in the Peruvian Amazon**, Fritz Rohde and Ani Popp

9:20 am – 9:50 am**: Break and Check-out** (Snacks Provided)

Session 4: Toxicology and Water Quality
Moderator: Emilee Wooster, NCSU (* Student Presenters)

9:50 am: **Water Quality and Intersex Fish in the Yadkin-Pee Dee River**, Casey Grieshaber*, Tiffany Penland, Thomas Kwak, Gregory Cope, Ryan Heise, Forrest Sessions, Jesse Fischer, Jeremy Leonard, Crystal Lee Pow, Jennifer Archambault, Frank Weber, Damian Shea, Mac Law, James Rice, Seth Kullman, and Derek Aday

10:20 am: **Relating the Incidence of Intersex in Centrarchid Fishes to Estrogenic Contaminant Concentrations across North Carolina**, Crystal Lee Pow*, Mac Law, Thomas Kwak, Damian Shea, Gregory Cope, James Rice, Seth Kullman, and Derek Aday

10:40 am: **Controlling Turbidity in Streams: Assessing Polyacrylamide Toxicity to Native Freshwater Mussels**, Sean B. Buczek*, W. Gregory Cope, Richard A. Mclaughlin, and Thomas J. Kwak

11:00 am: **INVITED PRESENTATION -- Dan River Coal Ash Spill Update**, Dianne Reid

11:20 – 11:25 pm: **Stretch Break**

Session 5: Managing the Fisheries in North Carolina's Piedmont Reservoirs*
Moderator: Neil Medlin, NC Department of Transportation
Cancelled Due To Weather Conditions Hampering Presenter Travel

11:25 am: **Blue Catfish in Piedmont North Carolina Reservoirs: Starting from the Ground Up**, Lawrence G. Dorsey

11:45 am: **A New Frontier: Establishing Hybrid Striped Bass in Lake Norman, North Carolina**, N. Corey Oakley

12:05 am: **Trout Population Monitoring within Nantahala Bypass Reach, NC, in Response to Recreational Flow Releases**, Amanda Bushon, Jake Rash, and Chris Goudreau

12:25 am – 12:30 pm**: Stretch Break**

12:30 pm – 1:30 pm**: NCAFS Business Meeting**

ABSTRACTS
(alphabetical by first author)

1. STATUS ASSESSMENT *OF ORCONECTES VIRGINIENSIS* (CHOWANOKE CRAYFISH) IN NORTH CAROLINA

Tyler R. Black and Robert B. Nichols, North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, 1701 Mail Service Center, Raleigh, NC 27699; 919-707-0364, tyler.black@ncwildlife.org

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

Keywords: *Orconectes virginiensis*, crayfish, distribution

2. EVALUATION OF RECOVERY EFFORTS OF STRIPED BASS IN THE LOWER NEUSE RIVER

Caitlin Bradley, James A. Rice, and Derek D. Aday, Department of Applied Ecology, North Carolina State University, Raleigh, NC, 919-810-7223, cebradl3@ncus.edu

Striped bass Morone saxatilis historically supported important commercial and recreational fisheries within the Neuse River system in North Carolina, however, post 1960s abundance greatly declined due to factors including high harvest and habitat degradation. In response, effort has been made to recover the population, including the implementation of strict harvest limits, stocking and dam removal. However, the Neuse River striped bass population has experienced no substantive increase in abundance, size distribution or age structure. To better understand the lack of recovery, mortality and survival estimates at different life stages must be determined. The goals for this project are to use active and passive telemetry techniques, paired with external high reward tags, to estimate survival of different life stages of striped bass in the Neuse River System. Specifically, we surgically implanted acoustic tags into 150 juveniles and we inserted acoustic tags, as well as external high reward tags, into 50 adults. We monitored their monthly mortality as well as seasonal and episodic changes in water quality (e.g., temperature, dissolved oxygen, salinity) for 600 days. We used a multistate capture-recapture model to estimate survival of the juveniles. Monthly discrete survival estimates from December-June ranged from 66-91%, averaging 81.1% (95% CI=71.9-88.5%). Additionally we will use a multistate capture-recapture model to estimate natural, fishing and catch-and-release mortality of sub adult and adult striped bass in the Neuse River.

Keywords: Striped Bass, *Morone saxatilis*, mortality estimates, survival estimates, stocking

3. CONTROLLING TURBIDITY IN STREAMS: ASSESSING POLYACRYLAMIDE TOXICITY TO NATIVE FRESHWATER MUSSELS

Sean B. Buczek[1], W. Gregory Cope[2], Richard A. McLaughlin[3], and Thomas J. Kwak[4]; [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC, 505-249-5223, sbbuczek@ncsu.edu; [2]Department of Applied Ecology, North Carolina State University, Raleigh, NC; [3]Department of Soil Science, North Carolina State University, Raleigh, NC; [4]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC.

Polyacrylamide (PAM) is widely used as a chemical flocculent in many different industries including; wastewater treatment, paper manufacturing, agriculture, and construction. PAM has become an effective tool for reducing suspended sediment and turbidity, which are considered to have significant impacts on aquatic ecosystems and are a leading cause of the continued degradation of North American streams. However, little is known about the effects of PAM on many freshwater organisms, and no information exists on the toxicity of PAM formulations to native freshwater mussels (Family Unionidae). Following ASTM standard guidelines, we exposed juveniles (96-h) and glochidia (24-h) of the Yellow Lampmussel, *Lampsilis cariosa*, an Atlantic Slope species and endangered in North Carolina, Appalachian Elktoe, *Alasmidonta raveneliana*, a federally endangered interior basin species, and Washboard, *Megalonaias nervosa*, a common interior basin species to six different formulations of anionic PAM. The mussels were exposed at concentrations of 5, 50, 100, 200, 500, and 1000 mg/L and assessed for viability. Generally, we found that PAM concentrations typically recommended for turbidity control (1–5 mg/L), regardless of molecular weight or charge density, were not acutely toxic to the mussel species and life stages tested, indicating minimal risk of short-term exposure effects. However, potential chronic and sublethal effects still require additional investigation. This research will aid in improved management and regulatory decision making for turbidity control best management practices.

Keywords: Turbidity, polyacrylamide

4. BLUE CATFISH IN PIEDMONT NORTH CAROLINA RESERVOIRS: STARTING FROM THE GROUND UP

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Blue Catfish were introduced into North Carolina reservoirs in the mid 1960's and self-sustaining populations developed as a result of these introductions. For almost 40 years, little to no sampling for Blue Catfish occurred. Since 2007, we have collected age and growth information from three Piedmont reservoirs: Lake Norman, Badin Lake, and Lake Tillery using gillnetting and electrofishing. These efforts have yielded valuable information on Blue Catfish populations. We have determined that a one size fits all approach to collecting Blue Catfish is not effective and that multiple gear types over several time periods in the year may be necessary. Also, information collected from these surveys suggests that growth and age composition of Blue Catfish differs substantially among these systems. In Lake Tillery and Badin Lake, Blue Catfish reach 800 mm by age 13 while in Lake Norman this length is not reached until age 20. In all systems, fish larger than 700 mm are rarely collected. These efforts in multiple systems have provided needed information on this important species and are the baseline for future management strategies.

Keywords: Blue Catfish, reservoirs, Badin Lake, Lake Norman

5. ADAPTING IUCN CRITERIA FOR DETERMINING THE CONSERVATION STATUS OF AQUATIC SPECIES IN NORTH CAROLINA

Todd Ewing, North Carolina Wildlife Resources Commission, Division of Inland Fisheries, 1721 Mail Service Center, Raleigh, NC 27699-1721, todd.ewing@ncwildlife.org

Most fisheries agencies are charged with determining the conservation status of the species they manage. Perhaps the most widely used protocol for determining conservation status is the protocol developed by the International Union for the Conservation of Nature (IUCN). There are several potential issues that can make using the IUCN protocol problematic for fisheries agencies. The large number of species that most agencies have management responsibility for makes it difficult for to conduct dedicated studies on each species to gather the requisite information needed for a status determination. Additionally, the IUCN protocols were developed to be utilized with all species of plants and animals, terrestrial or aquatic. The way the different factors are determined may not be fully appropriate for aquatic animals. The IUCN protocol uses factors such as population trend, area of occupancy, extent of occurrence, population size, and number of locations to determine a species conservation status. A modified version of the IUCN protocol along with alternative methods for measuring these factors are presented along with conservation status determinations for several aquatic species using the proposed methodology. The proposed alternative methods were simpler to apply than current IUCN methods, relevant to aquatic species, and able to be utilized on large numbers of nongame species efficiently. This protocol is being evaluated by the North Carolina Wildlife Resources Commission to assign conservation status to North Carolina species.

Keywords: Conservation status, state listing, IUCN

6. EVALUATING THE CAPE FEAR RIVER STRIPED BASS ENDEMIC STOCKING PROGRAM

Michael Fisk[1] and Justin Dycus, North Carolina Wildlife Resources Commission, [1]116 Sharpe Rd. Sanford, NC 27332, 919-758-9024, michael.fisk@ncwildlife.org

The Cape Fear River Striped Bass population has been characterized as depressed for several decades as a result of locks and dams inhibiting migration to historic spawning grounds, over-fishing, and degraded water quality. The North Carolina Wildlife Resources Commission initiated a stocking program to enhance the Cape Fear River population in 2001 utilizing Roanoke River broodstock. This approach lasted until 2009 and was deemed unsuccessful at rebuilding the population as demonstrated through low catch rates, especially upstream of Lock and Dam 1 and resulted in a harvest moratorium in 2008. In 2010 endemic broodstock were utilized for spawning with the assumption that these fish may be better suited for conditions within the Cape Fear River. The primary objective of this study was to evaluate this fundamental shift in stocking to determine how utilizing endemic broodstock impacts the Striped Bass population. Population metrics collected during annual spawning electrofishing surveys of Striped Bass for non-endemic stockings (pre-2009) was compared with endemic stockings (2010-present). Hatchery contribution was determined for returning Striped Bass captured utilizing parentage based tags (PBTs) from 2012-present. Comparisons revealed changes in relative abundance were site specific and catch rates were highest downstream of Lock and Dam 1. Analysis of PBTs revealed hatchery contribution is 100%. High contributions of hatchery origin fish coupled with continued low catch rates upstream of Lock and Dam 1 demonstrate that fish passage to historic spawning grounds upstream of the locks and dams and ultimately natural reproduction of Striped Bass are a primary concern for future management efforts.

Keywords: Striped Bass, stocking, Cape Fear River

7. Water Quality And Intersex Fish In The Yadkin-Pee Dee River

Casey Grieshaber[1], Tiffany Penland[1], Thomas Kwak[2], Gregory Cope[3], Ryan Heise[4], Forrest Sessions[5], Jesse Fischer[1], Jeremy Leonard[3], Crystal Lee Pow[5], Jennifer Archambault[1], Frank Weber[7], Damian Shea[6], Mac Law[8], James Rice[3], Seth Kullman[6], and Derek Aday[3]; [1] Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University; [2] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University; [3] Department of Applied Ecology, North Carolina State University; [4] North Carolina Wildlife Resources Commission; [5] South Carolina Department of Natural Resources; [6]Department of Biological Sciences, Environmental and Molecular Toxicology, North Carolina State University; [7] RTI International; [8] Department of Population Health and Pathobiology, North Carolina State University; 704-224-6169, cagriesh@ncsu.edu

We examined water and sediment contaminants, occurrence and severity of intersex condition in fish, and survival of juvenile fish in the Yadkin-Pee Dee River (Y-PD) during 2012-2014. Contaminants were measured in water and sediment samples taken longitudinally along the river, and with passive sampling devices (PSD). Estrogenicity was measured in grab samples of water, and concentrations of total estrogen were below the predicted-no-effect concentration of 2.0 ng/L. PSDs were used to measure estrogens in the water column over a 28 day deployment period. Estradiol concentrations were all below the predicted-no-effect concentration whereas concentrations of the synthetic estrogen found in oral contraceptives, ethinylestradiol, were all above the 2.0 ng/L level. These high levels of synthetic estrogen may affect the intersex condition in male fish in the river. One site that was sampled in 2013 revealed 66% incidence of intersex in Largemouth Bass. Results are forthcoming for estimates of intersex for male black basses, sunfishes, and catfishes at 11 sites sampled during 2014. Contaminant concentrations were also measured in fish tissue; mercury ranged from 0.096 µg/g (ppm wet weight) to 0.847 µg/g in bass and from 0.028 µg/g to 0.568 µg/g in catfish. Overall, 13% of the fish collected contained mercury concentrations considered unsafe (> 0.4 ppm wet weight) for consumption by women or children. *In-situ* bioassays were conducted with juvenile fishes at eight sites along the Y-PD in 2014. Largemouth Bass survived a mean of 9.7 days, Robust Redhorse 12.1 days, and Fathead Minnow 22.2 days. Control fish held in hatchery ponds to account for cage effects exhibited a longer survival time (27 days). Our findings of low fish survival rates, intersex occurrence, and contaminant levels are a concern for the imperiled fish populations, as well as the overall health of the river ecosystem.

Keywords: Intersex, bass, mercury, in-situ bioassay, estrogenicity, water quality, Yadkin-Pee Dee River, ethinylestradiol

8. EFFECTIVENESS OF A ROCK ARCH RAPIDS FOR FISH PASSAGE AT A LOCK AND DAM ON A LARGE COASTAL RIVER

Joshua K. Raabe[1, 2], Timothy A. Ellis[1], Chip Collier[3,4], and Joseph E. Hightower[1], [1]North Carolina Cooperative Fish and Wildlife Research Unit, [2]Department of Applied Ecology, North Carolina State University, Raleigh, NC, 27695; [3]North Carolina Division of Marine Fisheries, Wilmington, NC 28405. jhightower@ncsu.edu; [2]Present address: University of Wisconsin-Stevens Point, College of Natural Resources, 800 Reserve Street, Stevens Point, WI; [4]Present address: South Atlantic Fisheries Management Council, North Charleston, SC.

Three lock and dams (LD) on the Cape Fear River, North Carolina, maintain water levels for municipalities and industry but also impede migratory fishes to varying degrees. To improve fish passage, a rock arch rapids fishway was completed in 2012 at LD-1 (river kilometer (rkm) 97). This is the first implementation of this nature-like fishway design for anadromous fishes and along the Atlantic coast. We evaluated fish passage through the LD-1 fishway and via locking procedures at LD-2 (rkm 149) and LD-3 (rkm 186) in 2013 and 2014 using sonic-tagged American Shad, *Alosa sapidissima*, Striped Bass, *Morone saxatilis*, and Flathead Catfish *Pylodictis olivaris*. American Shad passage efficiency at the LD-1fishway (2013: 53%, n=30; 2014: 65%, n = 23) was consistent with current and prior estimates from locking procedures, but they did not pass LD-1 rapidly (mean = 9.2 – 20.4 d). Striped Bass passage efficiency at the LD-1 fishway (2013: 19%, n=42; 2014: 22%, n= 79) was lower than current and past

passage through locking procedures. Flathead Catfish were the most efficient at passing through the LD-1 fishway in 2013 (80%, n=20), but passage efficiency was lower in 2014 (38%, n=16). Flathead Catfish spent the longest durations downstream of LD-1 prior to passage, potentially foraging during these periods. Although the rock arch rapids LD-1 fishway passed each species in both years, it did not meet pre-determined success criteria (80% passage) for anadromous species. Design modifications may be explored to improve passage at this or future sites.

Keywords: Anadromous, passage

9. CONTRIBUTION OF BLACK CRAPPIE FINGERLINGS STOCKED INTO LAKE HICKORY, 2007–2012

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Lake Hickory is a 1,660-ha impoundment on Catawba River in western North Carolina and has historically been a popular fishing destination for Black Crappie, *Pomoxis nigromaculatus*. Beginning in 2000, trapnet surveys conducted by the North Carolina Wildlife Resources Commission (NCWRC) began to show a decline in catch rates of Black Crappie, and angler complaints became more common as well. While the reason for the decline is not known, the establishment of Alewife, *Alosa pseudoharengus*, and White Perch, *Morone americana*, coincided with reductions in catch rates of Black Crappie. In an effort to improve the Black Crappie population, NCWRC began an experimental stocking program in 2007. From 2007–2012, Black Crappie fingerlings were marked with oxytetracycline (OTC) and stocked annually into Lake Hickory. Annual assessments of initial post-stocking survival of OTC marked fish (79–98%) and OTC mark efficacy (96–100%) were high. Black Crappie were collected using trapnets (2008–2012), and electrofishing (2008, 2010, and 2011). All captured Black Crappie were aged, and otoliths from fish born during or after 2007 were examined for an OTC mark. Trapnets were more effective at collecting potentially stocked and stocked Black Crappie than electrofishing, possibly as a result of younger recruitment age to trapnets. Year-class contributions ranged from 0%–95%. As of the 2012 trapnet survey, approximately half (48%) of the Black Crappie collected with trapnets that were born during or after 2007 bore an OTC mark. Continued stocking of Black Crappie fingerlings is recommended, along with routine trapnet surveys to verify contributions of stocked fish and overall improvements to the Lake Hickory Black Crappie population.

Keywords: Black Crappie, crappie stocking, Lake Hickory

10. SWIMMING ABILITY OF SICKLEFIN REDHORSE EARLY LIFE STAGES AND IMPLICATIONS FOR CONSERVATION OF AN IMPERILED SPECIES

Tomas J. Ivasauskas[1]; Thomas J. Kwak[2], and Patrick L. Rakes[3]; [1]North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC 27695, 540-250-0301, tjivasau@ncsu.edu, [2]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC, 27695, [3]Conservation Fisheries, Inc., 3424 Division Street, Knoxville, TN 37919.

Effective management of rare or endangered fish species is dependent on a thorough understanding of ontogeny, ecology, and habitat requirements at all life stages. Swimming ability is important in determining patterns of larval and juvenile fish dispersal, distribution, and nursery habitat selection. The Sicklefin Redhorse *Moxostoma* sp. is a sucker (family Catostomidae) that is geographically restricted to the southern Appalachian Mountains and is of particularly high conservation concern. We designed a laboratory experiment to determine swimming ability of larval and juvenile Sicklefin Redhorse. Sustained swimming abilities were assessed by subjecting captive-reared Sicklefin Redhorse (N=102) to fixed-velocity swim trials, wherein fish were subjected to a prescribed water velocity until they became exhausted and unable to maintain position. Trials were performed in a 38-mm-diameter swim chamber capable of producing accurate velocities 0.05 – 0.25 m/s. Fish were subjected to trials approximately 1, 2, 4, 6, and 10 weeks after they exhibited swim-up behavior; mean total lengths were 16.0, 16.1, 20.3,

26.3, and 33.3 mm, respectively. Development classifications included early- and late-stage mesolarva, metalarva, and juvenile. Swimming ability increased monotonically among classes; sustained swimming speeds (30-min) increased from 0.099 m/s to 0.166 m/s across the range of sizes observed. Our estimates indicate that Sicklefin Redhorse larvae exhibit marginally better swimming ability than similarly sized Robust Redhorse *Moxostoma robustum*. The information gained from our findings will be used to develop a more thorough mechanistic understanding of habitat associations observed in concurrent field research and to guide planning and implementation of conservation and recovery efforts.

Keywords: Sicklefin Redhorse; *Moxostoma*; larval; juvenile; swimming; endangered species

11. A NEW FRONTIER: ESTABLISHING HYBRID STRIPED BASS IN LAKE NORMAN, NORTH CAROLINA

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Lake Norman has had numerous introductions of non-native fish. These introductions have had various effects on established fish populations in the reservoir. Alewife, *Alosa pseudoharengus,* and Blueback Herring, *Alosa aestivalis,* (river herring) introductions of the mid 1990s caused a decline in the Striped Bass, *Morone saxatilis,* fishery. Striped Bass foraged on river herring in the hypolimnion of Lake Norman during summer months each year. As the metalimnion becomes hypoxic during the summer, Striped Bass become trapped in the hypolimnion and eventually die when it becomes hypoxic. Striped Bass fish kills have become more frequent and severe since 2004. In 2013, the North Carolina Wildlife Resources Commission began replacing the Striped Bass fishery with a hybrid Striped Bass (*M. saxatilis* X *M. chrysops*) fishery. Biologists expect that hybrid Striped Bass will not inhabit the hypolimnion during summer months and have better growth, condition, and survival than Striped Bass in Lake Norman. Angler and gill net data from 2014 indicate that hybrid Striped Bass are growing rapidly and exhibit average condition during the first two years of life. Fish captured weigh between 1,200–1,700 g. Rapid growth of hybrid Striped Bass has increased the popularity of the new fishery. Growth rates, condition values, severity of fish kills, and frequency of escapement will be the criteria used to determine if the new hybrid Striped Bass fishery is successful at Lake Norman.

Keywords: Hybrid Striped Bass, Lake Norman, growth and condition, fish kills

12. MORTALITY AND DISPERSAL OF STOCKED JUVENILE MUSKELLUNGE IN A SUCCESSFUL AND UNSUCCESSFUL FISHERY IN WESTERN NORTH CAROLINA

Dylan P. Owensby, James A. Rice, and D. Derek Aday; North Carolina State University, Department of Applied Ecology, 127 David Clark Labs, Raleigh, NC, 828-403-5111, dpowensb@ncsu.edu

Muskellunge, *Esox masquinongy*, is a highly popular sport fish native to the Tennessee River drainage of western North Carolina. After pollution led to its extirpation in the 1950s, the North Carolina Wildlife Resources Commission (NCWRC) began a stocking program in 1970 to reestablish a viable Muskellunge fishery. Although those efforts have resulted in an established Muskellunge fishery in the French Broad River, there is little evidence of success in North Carolina sections of the New River. To address the perceived failure of the New River Muskellunge fishery we initiated a study to investigate dispersal, mortality and habitat use of stocked juvenile muskellunge. During fall of 2013 and 2014, we implanted radio transmitters into 100 age-0, hatchery reared Muskellunge (mean TL 282-307 mm) prior to stocking in the New and French Broad rivers. Preliminary analyses indicate that mortality at three months post stocking was 95% on the New River and 59% on the French Broad River. On the New River, the average dispersal was 10.2 km, with a maximum individual dispersal of 67.4 km. Lower dispersal was observed on the French Broad River; the average dispersal was 4.7 km, with a maximum individual dispersal of 55.5 km. Information on mortality and dispersal of stocked Muskellunge should be useful in the context of managing these fisheries.

Keywords: Muskellunge, telemetry, mortality, dispersal, stocking

13. INFLUENCE OF LANDUSE CHANGE ON SENSITIVE AQUATIC BIOTA IN THE UPPER NEW RIVER DRAINAGE, NORTH CAROLINA

Gary Pandolfi, M. Worth Pugh, Thomas Franklin, Daniel Mason, Jason Selong, and Michael M. Gangloff; Department of Biology, Appalachian State University, Boone NC, 828-262-7790, pandolfigs@appstate.edu

The upper New River drainage (UNRD) in North Carolina supports 50+ fish taxa including 9 endemic taxa of conservation concern, an isolated population of Green Floater mussels (*Lasmigona subviridis*) and a large Eastern Hellbender population. Additionally, high proportions (~50%) of fish taxa are considered introduced. The UNRD has recently experienced widespread changes in landuse/land cover (LULC) associated with ex-urban development. During 2014 we re-sampled 39 historically-sampled sites and measured physical habitat parameters across the upper New River drainage to examine how LULC changes between 1992 and 2011 at the riparian and sub-catchment scale influence the distribution of sensitive biota. Mussel distributions have changed dramatically over this period and green floaters were only found at one site in the South Fork New River. Headwater fish communities were characterized by low diversity and high proportion of non-native trout and endemic or pollution-intolerant fishes were largely restricted to larger tributaries and forested reaches of the mainstem North and South Fork New rivers. Occurrence of the endemic Kanawha Darter (*Etheostoma kanawhae*) was negatively correlated with proportion of disturbed LULC and temporal data suggest this species persists only at sites with little to no LULC change from 1992-2011. Hellbenders were detected at 16 of 39 sites and several large populations were discovered including one in downtown Boone, North Carolina. Ongoing analyses with other basin endemics are confounded by rarity of these species but overall trends are worrisome and suggest that landuse-derived stressors associated with ex-urban development are contributing to changes in aquatic communities.

Keywords: Endemic taxa, Eastern Hellbender, forest cover, Unionidae, New River

14. LARGEMOUTH BASS POPULATION RESPONSE FOLLOWING HURRICANE IRENE IN THE CHOWAN RIVER IN COASTAL NORTH CAROLINA

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After landfall of Hurricane Irene on 27 August 2011 near Cape Lookout, North Carolina, portions of the Chowan River experienced significant declines in dissolved oxygen resulting in a widespread fish kill. To monitor initial impacts and population recovery following Hurricane Irene, the Largemouth Bass, *Micropterus salmoides,* population was surveyed with boat mounted electrofishing gear in fall 2011, spring and fall 2012, and spring 2013. Anoxic and hypoxic conditions were documented from Wiccacon River upstream to Virginia tributaries, spanning roughly 50 river km. The lower Chowan River was largely unaffected by Hurricane Irene and by spring 2013 relative abundance of Largemouth Bass greater than 200 mm surpassed the benchmark for coastal North Carolina rivers (25 fish/h) with a mean CPUE of 28 fish/h (SE=2). The middle Chowan River Largemouth Bass population experienced significant declines in relative abundance following Hurricane Irene. However, Largemouth Bass in the middle Chowan River nearly recovered to the relative abundance coastal benchmark; mean CPUE in spring 2013 was 18 fish/h (SE=5.4). Relative abundance of Largemouth Bass in the upper Chowan River did not reach pre-hurricane levels by spring 2013, with a mean CPUE of 5 fish/h (SE=3.3). The Meherrin River, a major tributary to the Chowan River, Largemouth Bass population was also impacted by hypoxic waters; however, relative abundance increased during the study period and reached 14 fish/h (SE=2.8) by spring 2013. In general, Largemouth Bass in the Chowan River have the capacity to naturally recover to pre-hurricane levels. Successful reproduction in spring 2012 was apparent throughout the Chowan River and was evident by the large numbers of sub stock-length Largemouth Bass collected in fall 2012. The Largemouth Bass population was also found to be shifting toward larger individuals. Spatial patterns in Largemouth Bass population recovery following hurricanes will help determine if augmentation to the population is warranted.

Keywords: Hurricane Irene, Largemouth Bass, population response, coastal river

15. RELATING THE INCIDENCE OF INTERSEX IN CENTRARCHID FISHES TO ESTROGENIC CONTAMINANT CONCENTRATIONS ACROSS NORTH CAROLINA

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A multitude of chemicals are demonstrated to mimic estrogens, are detected in surface waters around the globe and are linked to adverse effects in fish and wildlife. Male fish exposed to estrogen mimics are susceptible to developing the intersex condition, which is characterized by the presence of testicular oocytes. However, it is unclear which specific estrogenic contaminants play a role in this condition. To investigate the relationship between intersex and exposure to estrogenic contaminants, we conducted a statewide assessment of the occurrence of intersex fish and endocrine disrupting compounds (EDCs) in rivers and streams throughout North Carolina. We targeted two genera in the Centrarchidae family: black bass (*Micropterus*) and sunfish (*Lepomis*), which were sampled from 20 sites throughout the state. Histopathology was conducted on testicular cross sections to determine the incidence and severity of intersex. To assess the levels of EDCs, passive sampling devices were deployed for one month and sediment samples were collected for quantification of steroidal hormones, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, legacy organochlorine pesticides, and current use pesticides. Additionally, water grab samples were collected for assessment of estrogenic activity, using an in vitro bioassay, which ranged between 0.32-1.7ng/L 17β-estradiol equivalence. Intersex was identified in both genera, with the black bass being more susceptible with 60% intersex male fish compared to sunfish (11%). Significant relationships between incidence of intersex and several EDCs were detected. This project sheds light on relationships between intersex and contaminant load, as well as differences in responses between two Centrarchidae genera.

Keywords: Intersex, estrogens, endocrine disruption, black bass, sunfish

16. ASSESSMENT OF STRIPED BASS SPAWNING STOCK MORTALITY IN THE NEUSE RIVER, 1994–2014

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Management of coastal Striped Bass stocks typically incorporate mortality targets to conserve spawning stock abundance while allowing for recreational and commercial exploitation. Accurate and precise estimates of mortality are required to assess harvest regulations and adaptively manage stocks that utilize mortality targets. The Striped Bass stock in the Neuse River, North Carolina, is considered riverine endemic and is not subject to the Interstate Fishery Management Plan for Atlantic Striped Bass. Although the NC Striped Bass Management Plan established exploitation targets, previous catch-curve analyses resulted in imprecise mortality estimates that were considered inadequate for management use. In this assessment, catch-at-age data from annual spawning ground electrofishing surveys conducted 1994–2014 were analyzed using recent recommendations for catch-curve analysis to estimate Neuse River Striped Bass spawning stock mortality. Mortality rates in this assessment using the Chapman-Robson estimator frequently exceeded management targets and were much more precise than estimates derived in previous stock assessments that utilized unweighted linear regression. Catch per unit effort and age-structure data support the high estimated mortality rates. Results of this assessment will aid managers in efforts to adaptively manage the recreational and commercial fisheries.

Keywords: Mortality, Striped Bass, catch-curve

17. TROUT POPULATION MONITORING WITHIN NANTAHALA BYPASS REACH, NC, IN RESPONSE TO RECREATIONAL FLOW RELEASES

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

Keywords: Trout survey, Nantahala River, recreational flow releases, mountain region

18. DAN RIVER COAL ASH SPILL UPDATE

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On February 2, 2014, approximately 39,000 tons of coal ash slurry was spilled into the Dan River when a stormwater pipe collapsed at Duke Energy's Eden facility. In response, the Department of Environment and Natural Resources' Division of Water Resources traveled to the site and began working with the U. S. Environmental Protection Agency on control and assessment of the spill. This presentation will provide an overview of the incident and the Division of Water Resources' assessment results to date.

Keyword: Dan River, coal ash, environmental assessment

19. 15 YEAR REVIEW OF AMERICAN SHAD IN THE NEUSE RIVER: WHERE WE ARE NOW AND WHERE WE ARE HEADING

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Since 2000, the North Carolina Wildlife Resources Commission has conducted annual boat electrofishing surveys of the Neuse River American Shad spawning grounds between Goldsboro and Raleigh. Since 2009, a slight increase in relative abundance over the long-term mean (26.5 fish/h) has been observed, and peaked in 2013 at 53.9 fish/h. Recreational creel data also indicated that more American Shad were harvested in 2013 (1,384) than in 2012 (968) or 2014 (419). Catch-at-age data indicated that above average catches of age-3 (6.9 fish/h) and age-4 (14.5 fish/h) males and age-3 (1.2 fish/h), age-4 (4.1fish/h), and age-5 (8.1fish/h) females occurred in 2013. These observations suggest that robust year-classes from 2008 to 2010 contributed to higher abundances. These strong year-classes coincided with a nearly 20,000 pound decrease in Neuse River commercial harvest in 2008. Currently, the Neuse River American Shad population abundance appears to be stable or growing. Additionally, American Shad have been stocked annually since 2012 and the arrival of returning adults should begin in 2015. Juvenile American Shad hatchery contribution was 3% in 2012 and 6% in 2013 and were incorporated into available models to calculate an annual abundance estimate for 2012 and 2013. Carrying capacity was

calculated for the current available spawning habitat in the main-stem Neuse River. However, these estimates for population abundance and carrying capacity are provisional and further refinement of these metrics is warranted.

Keywords: American Shad, Neuse River

20. FISH COLLECTING IN THE PERUVIAN AMAZON

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In late July 2014, seven intrepid fish biologists from NC, SC, GA, and FL surveyed fishes in the Amazon near Iquitos, Peru. They used dip nets, cast nets, seines, gill nets, and hook and line to collect fishes from a variety of habitats ranging from rain forest streams to sandbars in the Amazon River. Twenty-two collections were completed over a 13-day period. Some 211 species were identified, most to the species level. Catches were dominated by fishes in the orders Characiformes and Siluriformes.

Keywords: Amazon, Peru

21. AN INDEX OF BIOTIC INTEGRITY FOR WADEABLE STREAMS IN THE NORTH CAROLINA SAND HILLS

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Fish community data from wadeable Sand Hills streams have been collected by Division staff since 1990 following existing standard operating procedures. However, metrics and biocriteria were never developed specifically for these unique assemblages which have naturally low species diversity and low biological productivity. Fish assemblages were not rated accurately and consequently, the streams were classified as Not Rated until metrics and biocriteria could be developed. A 7-Metric Sand Hills Index of Biotic Integrity has been developed to identify impairment and to statistically differentiate between highly impacted sites (rated Poor or Fair) and reference and near-reference sites (rated Good or Excellent). Relationships between the seven metrics versus specific conductance, pH, total habitat score, landuse types, and landuse disturbance classes were also evaluated. The metrics and biocriteria were further validated with additional reference and degraded sites data collected in 2013 and 2014. Based upon a dataset of more than 90 samples, reference sites and other least-impacted fish community sites in the Sand Hills should have low specific conductance, low pH, low abundances of fish, and low percentages of tolerant fish; high percentages of Key Sand Hills Species, Key Sand Hills fish, and Invertivore Cyprinids; at least two Intolerant Species; and high quality instream habitat characteristics. Impacted sites would be expected to have the converse of these characteristics. The Sand Hills NCIBI is an additional biological monitoring tool that will be used by the Division in evaluating wadeable streams, complementing the existing benthic macroinvertebrate assessments.

Keywords: Sand Hills, Index of Biotic Integrity, biomonitoring

22. APPROACHES TO MONITORING TROUT POPULATIONS IN WESTERN NORTH CAROLINA

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Although located within the southernmost extent of salmonid distribution in the eastern United States, North Carolina harbors abundant and diverse wild trout resources. Approximately 5,300 miles of trout waters are managed by the North Carolina Wildlife Resources Commission (NCWRC) via its Public Mountain Trout Waters program. These resources are extremely important both ecologically and

economically; however, populations are at risk of extirpation due to a variety of anthropogenic and environmental pressures. Resource managers need to understand the dynamics of trout populations to protect, restore, and maintain these popular resources. From 1989 to 1996, the NCWRC conducted intensive monitoring on 17 wild trout populations in an attempt to investigate population trends within individual streams over a multi-year period. These data represent the bulk of information known about wild trout population dynamics in waters managed by the NCWRC. In 2012, the NCWRC initiated another long-term study to complement these early data and expand our knowledge about wild trout populations. Intensive surveys are being conducted annually on 6 streams using three-pass depletion techniques to robustly describe temporal trends in population parameters (e.g., density, standing crop, mortality, etc.). Additionally, a less intensive approach is being applied concurrently to 45 streams using a new rapid assessment protocol that requires resources to be sampled on a 3- to 5-year rotation to gather baseline data. This effort represents the first attempt by the NCWRC to gather data on wild trout populations across a broad spatial scale using a simplistic sampling technique. This approach will allow NCWRC Biologists to compare and contrast populations across the Mountain Region with reduced manpower, identify areas in need of more intense evaluations, and deliver valuable information to other resource managers and angling constituents.

Key Words: Salmonid, trout, monitoring, density, standing crop