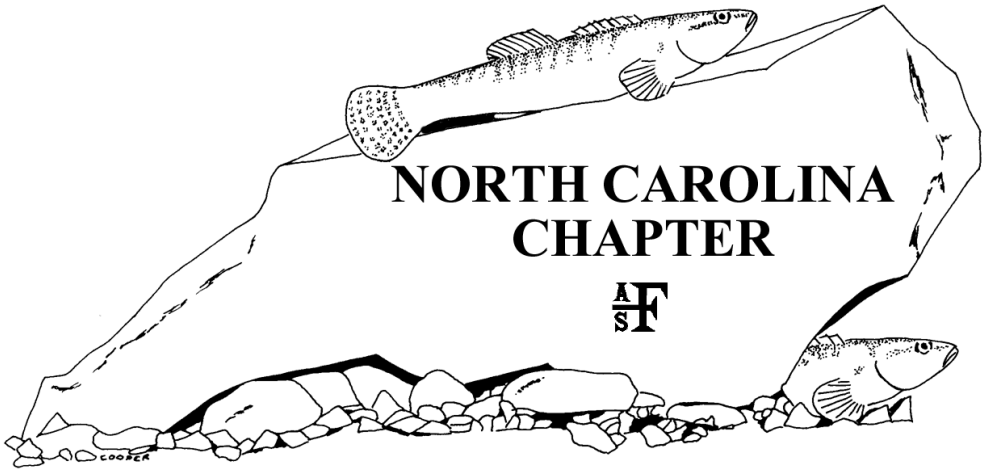


25th Annual Meeting

North Carolina Chapter of the American Fisheries Society

February 17-19, 2014

The Millennium Hotel
Durham, North Carolina

Schedule and Abstracts

Presented with thanks to:

DUKE ENERGY®

Monday, February 17th
(Falls Lake)

Continuing Education Workshop (optional field component)

1:00 – 5:00 pm: **Techniques For Fish Habitat Monitoring Using Side-Scan Sonar** (1-hr. time slots), Dr. Joe Hightower, U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, Campus Box 7617, North Carolina State University, Raleigh, NC 27695, jightower@ncsu.edu.

Tuesday, February 18th
(Millennium Hotel)

Continuing Education Workshop

8:00 am**: Techniques For Fish Habitat Monitoring Using Side-Scan Sonar,** Dr. Joe Hightower, North Carolina Cooperative Fish and Wildlife Research Unit.

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 Greg Cope and President-Elect Brena Jones

Session 1: Management of Fisheries
Moderator: John Boreman (*Student Presenters)

1:00 pm: **Evaluation Of Genetic Markers To Improve Striped Bass Age Assignment In North Carolina's Coastal Rivers**, Justin Dycus

1:20 pm: **Effects Of Tournament Displacement On Largemouth Bass In Albemarle Sound,** Daniel T. Brown*, James A. Rice, and D. Derek Aday

1:40 pm: **Black Bass Population Dynamics In Lake Norman, North Carolina: A Decade After The Introduction Of Spotted Bass,** Lawrence G. Dorsey

2:00 pm: **Estimates Of Fishing And Natural Mortality Rates Of Spotted Seatrout From Tag-Return And Survey Data,** Timothy A. Ellis*, Joseph E. Hightower, Jeffrey A. Buckel, and Kenneth H. Pollock

2:20 pm: **Potential Underlying Mechanisms Behind White Bass Population Declines,** Kelsey Lincoln*, James A. Rice, and D. Derek Aday

2:40 pm – 3:00 pm: **Break** (Snacks Provided)

Session 2: Planning for Future Outreach and Management
Moderator: Andrea Leslie (*Student Presenters)

3:00 pm: **Who's Your Shaddy? An American Shad's Journey From The Classroom To The River,** Danielle Pender, Melissa Dowland, and Megan Chesser

3:20 pm: **Genetic Analysis Of North Carolina's Brook Trout *Salvelinus fontinalis* With Emphasis On Previously Uncharacterized Collections,** Jacob M. Rash, Barbara A. Lubinsk, and Tim L. King

3:40 pm: **Historical And Contemporary Management Of The Dynamic Walleye Fishery In Lake James, NC**, Chris Wood, David Goodfred and David Yow.

4:00 pm: **Ecological Flow Recommendations For North Carolina Water Management Planning,** Chris Goudreau

4:20 pm: **Fun With Cameras: Use Of Trail Cameras To Assess Angler Use On Two Wild Trout Streams In Wilkes County, North Carolina,** Kevin J. Hining and Jacob M. Rash

4:40 – 5:30 pm: **Relaxation Break**

5:30 pm: **Social**

6:00 pm: **Special Presentation Followed By Dinner**

7:00 pm – 10:00 pm: **Social and NCSU Student Fisheries Society's Raffle**

Wednesday, February 19th

Session 3: The Science of Rare Species
Moderator: Kim Sparks (*Student Presenters)

8:00 am: **The Upland Dusky Shiner, *Notropis cummingsae collis* Hubbs & Raney 1951: A Mistaken Collection Locality, A Subspecies Extirpated From Its Type Locality, Or Something Else?,** Bryn H. Tracy and Wayne C. Starnes

8:20 am: **Sensitivity Of Freshwater Mollusks To *Hydrilla*-Targeting Herbicides,** Jennifer M. Archambault, Christine M. Bergeron, W. Gregory Cope, Rob Richardson, Mark Heilman, Michael D. Netherland, Ryan Heise, and J. Edward Corey

8:40 am: **Genetics Of The Undescribed "Carolina Redhorse" (*Moxostoma* sp.), Another Carolina Endemic,** Morgan Raley and Heather Evans

9:00 am: **Recruitment Phenology of Caribbean Amphidromous Fishes,** Augustin C. Engman*, Thomas J. Kwak, Jesse R. Fischer, and Casey A. Grieshaber

9:20 am: **Research and Conservation Efforts in the Pee Dee River, North Carolina** Ryan Heise

9:40 am – 9:55 am**: Break** (Snacks Provided)

Session 4: Understanding the Status of North Carolina Species at all Life Stages
Moderator: Corey Oakley (*Student Presenters)

9:55 am: **Back To The Basics: Using Changes In Occupancy To Detect Population Declines In Aquatic Species,** Todd Ewing

10:15 am: **Species Of Greatest Conservation Need – Required Element 1 In The Wildlife Action Plan,** Cindy Carr

10:35 am: **Status Of Rare Crayfishes In Western North Carolina,** T.R. Russ and Steve Fraley

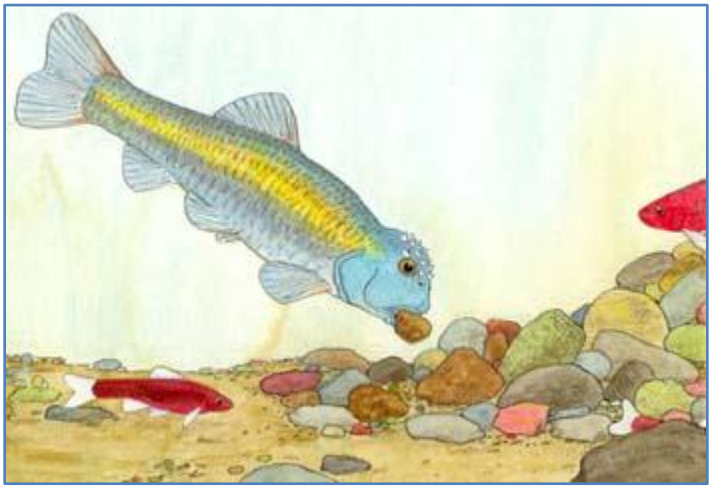
10:55 am: **Preliminary Phylogeny Of The Critically Endangered North American Spinymussels**, Michael Perkins*, Michael Gangloff, Nathan Johnson

11:15 am: **Techniques For Sampling Larval And Juvenile Fishes In Appalachian Mountain Rivers**
Tomas J. Ivasauskas* and Thomas J. Kwak

11:35 am: **Age And Growth Of Scamp, *Mycteroperca phenax*, From The Southeastern U. S. Commercial Fishery,** Michael L. Burton, Claire M. Miller, and Jennifer C. Potts

11:55 am – 12:00 pm**: Break**

12:00 pm – 1:00 pm**: NCAFS Business Meeting**



Drawing courtesy of Anne Runyon (www.annerunyon.com)

THANKS FOR BUILDING A GREAT ORGANIZATION!

ABSTRACTS
(alphabetical by first author)

1. SENSITIVITY OF FRESHWATER MOLLUSKS TO *HYDRILLA*-TARGETING HERBICIDES

Jennifer M. Archambault[1], Christine M. Bergeron[2], W. Gregory Cope[2], Rob Richardson[3], Mark Heilman[4], J. Edward Corey[5], Michael D. Netherland[6], and Ryan Heise[7]; [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC, 919-306-5107, jmarcham@ncsu.edu; [2] Department of Applied Ecology, North Carolina State University, Raleigh, NC; [3]Department of Crop Science, North Carolina State University, Raleigh, NC; [4]SePRO Corporation, Carmel, IN; [5]North Carolina Division of Parks and Recreation, Raleigh, NC., [6]US Army ERDC, Gainesville, FL; [7]North Carolina Wildlife Resources Commission, Raleigh, NC.

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic weed that has spread rapidly throughout the USA, especially in the southeast. A common control method is application of contact and systemic herbicides (e.g., fluridone and endothall). However, little is known about the effects of *Hydrilla*-targeting herbicides on many non-target freshwater species, and no information exists on the toxicity of these herbicides to freshwater mollusks. We exposed juveniles (96-h) and glochidia (24-h) of the unionid mussel *Lampsilis siliquoidea*, and adults (28-d) of *Lampsilis fullerkati* to a formulation grade of fluridone (Sonar – PR®) in laboratory toxicity tests. The early life stages of *L. siliquoidea* were also exposed to a formulation grade of endothall (Aquathol – K®) in separate tests. Juveniles of the freshwater gastropod snail, *Somatogyrus viriginicus* (Lithoglyphidae), were tested (96-h) in exposures of the Sonar – Genesis® fluridone formulation. Endpoints were viability (glochidia), survival (juvenile and adult mussels and snails), and siphoning behavior and foot protrusion (adult mussels). Median effective concentrations (EC50s) for viability of glochidia or median lethal concentrations (LC50s) for juveniles and adults for fluridone were 865 µg/L (95% CI, 729 – 1026 µg/L) for glochidia (24 h), 511 µg/L (309 – 843 µg/L) for juvenile *L. siliquoidea* (96 h), and 500 µg/L (452 – 553 µg/L) for juvenile *S. viriginicus* (96 h). No mortality occurred in the 28-d exposure of adult *L. fullerkati*, and we found no significant effect of fluridone concentration on foot protrusion ($p = 0.06$) or siphoning behavior ($p = 0.08$). The EC50 for endothall was 31.2 mg/L (30.3 – 32.2 mg/L) for glochidia and the LC50 was 34.4 mg/L (29.3 – 40.5 mg/L) for juvenile mussels. Fluridone and endothall concentrations typically recommended for *Hydrilla* treatment (5 µg/L and 1 – 5 mg/L, respectively) were not acutely toxic to the mollusks we tested, and a 28-d exposure to fluridone was not lethal to adult mussels even at the highest concentration (300 µg/L), indicating minimal risk of short-term exposure effects. However, freshwater mollusks were more sensitive to fluridone and endothall than all other species previously tested.

2. EFFECTS OF TOURNAMENT DISPLACEMENT ON LARGEMOUTH BASS IN ALBEMARLE SOUND

Daniel T. Brown, James A. Rice, and D. Derek Aday; North Carolina State University, Department of Applied Ecology, 127 David Clark Labs, Raleigh, NC 27695, 919-515-3883, dtbrown2@ncsu.edu.

Tournament displacement of Largemouth Bass *Micropterus salmoides* in large, coastal systems has been shown to impact rates of post-release survival, dispersal and return to original capture location. Pembroke Creek flows into Edenton Bay on Albemarle Sound and is frequently used as a tournament weigh-in and release location. Sampling conducted by NC WRC biologists has found evidence of stockpiling of tournament-caught Largemouth Bass near Pembroke Creek

and other popular release locations. We used a telemetry approach to evaluate the effects of tournament displacement on survival, dispersal, and redistribution of Largemouth Bass captured during a simulated tournament. A total of 40 Largemouth Bass were collected from four tributaries of Albemarle Sound (two 15 km away and two 50 km away), transported to Pembroke Creek, implanted with acoustic transmitters and released. We monitored the movement of tagged bass continuously using an array of passive receivers and via monthly active tracking efforts. Displaced Largemouth Bass generally dispersed quickly and more than half of those that moved out of Edenton Bay successfully returned to their original capture location. Our findings indicate little evidence of long-term stockpiling; however, Largemouth Bass displaced more than 15 km may not be able to return to their original capture locations. Blood cortisol levels, an indicator of stress, were similar in bass collected during our simulated tournament and caught in an actual tournament, but elevated relative to a control group. However, cortisol levels were unrelated to survival, post-release dispersal or return of tagged bass to their original capture location.

3. AGE AND GROWTH OF SCAMP, *MYCTEROPERCA PHENAX*, FROM THE SOUTHEASTERN U. S. COMMERCIAL FISHERY

Michael L. Burton, Claire M. Miller, and Jennifer C. Potts, NOAA National Marine Fisheries Service, Beaufort Laboratory, 101 Pivers Island Rd., Beaufort, NC 28516, 252-728-8756, michael.burton@noaa.gov.

We analyzed otoliths of Scamp, *Mycteroperca phenax* (n = 1200), collected between 2006-2008 from the commercial snapper grouper fishery off North Carolina and South Carolina, in order to determine age-growth characteristics. Scamp, a moderate sized grouper inhabiting subtropical reefs, rocky ledges and high relief bottom throughout the U. S. Atlantic and Gulf of Mexico, is valuable to commercial and recreational fisheries of the southeast U. S., with estimated annual landings from headboats averaging 27,238 kg between 1986 and 2011. Private recreational sector landings averaged 25,967 kg annually from 1981-2011. Commercial landings will be analyzed and presented. Sectioned otoliths were moderately easy to read, with average percent error (APE) averaging 7.28% for a subset of 200 otoliths read by three readers. Annulus formation occurred between March and July, with peak formation occurring in May. Sampled fish ranged from ages 3-20 and from 430-870 mm FL. Mean observed sizes at age were 491, 516, 644, 703 and 775 mm FL for ages 3, 5, 10, 15 and 20 respectively. The von Bertalanffy equation describing theoretical growth was $L_t = 833^* (1 - e^{(-0.10^*(t+4.25))})$. While the species has not been assessed, analysis of several data sources suggest declining trends: (1) combined recreational landings have been declining since 2006, from 108,000 kg to 22,500 kg in 2011, and (2) mean weight of headboat-caught fish has declined from an average of 4.55 kg in 1972 to an average of 1.87 kg in 2003 (analyses of headboat data from 2004 to present are underway).

4. SPECIES OF GREATEST CONSERVATION NEED – REQUIRED ELEMENT 1 IN THE WILDLIFE ACTION PLAN

Cindy Carr, North Carolina Wildlife Action Plan Coordinator, North Carolina Wildlife Resources Commission, 1701 MSC, Raleigh, NC 27699-1701, 919-707-0227, cindy.carr@ncwildlife.org.

The State Wildlife Grants (SWG) program was established by the U.S. Congress to provide funding for nongame species not traditionally covered under most previous federal funding

programs. To qualify for SWG funds, each state is mandated to develop conservation strategies with a focus on *Species of Greatest Conservation Need* (SGCN) and to publish this information in a state Wildlife Action Plan (WAP). In North Carolina, SGCN have been defined as species that are currently rare or have been designated as at-risk of extinction; those for which we have knowledge deficiencies; and those that have not received adequate conservation attention in the past. Ranking criteria metrics were developed by a WAP work group as a means to generate a SGCN list for the 2015 revision of North Carolina's WAP and are described in a White Paper published by the work group in 2012. As a step in the evaluation process, taxa teams comprised of species experts were convened in 2013 and were tasked with applying the ranking criteria to evaluate amphibian, bird, crayfish, freshwater fish, freshwater mussel, mammal, reptile, and snail species found in the state. Preliminary results from the freshwater fish taxa team's evaluation will be presented at this meeting.

5. BLACK BASS POPULATION DYNAMICS IN LAKE NORMAN, NORTH CAROLINA: A DECADE AFTER THE INTRODUCTION OF SPOTTED BASS

Lawrence G. Dorsey, North Carolina Wildlife Resources Commission, 31826 Ameron Circle, Albemarle, NC, 28001, 704-986-6109, lawrence.dorsey@ncwildlife.org.

Since the late 1990's, Lake Norman, North Carolina has been plagued with introductions of non-native fish. Spotted Bass, White Perch, Alewives, Blueback Herring, and Striped Bass hybrids have been introduced without the consent of the North Carolina Wildlife Resources Commission. While these introductions have affected all of the fisheries in the reservoir, none has been more impacted than the black bass fishery. Spotted Bass were first collected in 2001 by Duke Energy biologists during annual spring electrofishing surveys. At that time, Largemouth Bass catch rates averaged 9.0 fish / 300 m but by 2010 catch rates had decreased to 2.5 fish / 300 mm. Spotted Bass catch rates in 2010 were 22.0 fish / 300 m. These results suggest that Spotted Bass have become the dominate black bass in the Lake Norman fishery. However, recent data suggests that standardized sampling at historical sites may be misrepresenting the relative abundance of Largemouth Bass in Lake Norman. The standard sampling sites were established in 1993 to collect monitoring information for power plant effects and are located along main lake sections of the reservoir. In 2010 and 2013, additional sampling sites in cove and creek channel habitats were added. Largemouth Bass catch rates were equal to Spotted Bass catch rates in cove/creek habitats in 2010 but Largemouth Bass were three times more abundant that Spotted Bass in the same habitats in 2013. On main lake habitats, Spotted Bass were slightly more abundant than Largemouth Bass in 2010 but in 2013 Spotted Bass were three times more abundant than Largemouth Bass. These data suggest that Largemouth Bass are still thriving in Lake Norman but that they have been displaced from historically used habitats by Spotted Bass. Additional sites will be added in future surveys to further evaluate differences in species composition based on habitat use.

6. EVALUATION OF GENETIC MARKERS TO IMPROVE STRIPED BASS AGE ASSIGNMENT IN NORTH CAROLINA'S COASTAL RIVERS

Justin Dycus, North Carolina Wildlife Resources Commission, 1721 MSC, Raleigh, NC 27699-1721, 910-876-2230, justin.dycus@ncwildlife.org.

Accurate representation of the age structure of migratory Striped Bass populations is critical to the development of stock assessment models and subsequent management of these important

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

7. ESTIMATES OF FISHING AND NATURAL MORTALITY RATES OF SPOTTED SEATROUT FROM TAG-RETURN AND SURVEY DATA

Timothy A. Ellis[1], Joseph E. Hightower[2], Jeffrey A. Buckel[1], and Kenneth H. Pollock[3]. [1]Center for Marine Sciences and Technology, Department of Applied Ecology, North Carolina State University, 303 College Circle, Morehead City, NC 28557, 252-222-6329, taellis@ncsu.edu; [2]U. S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, Campus Box 7617, North Carolina State University, Raleigh, NC, 27695; and [3]Departments of Applied Ecology, Biomathematics, and Statistics, Campus Box 7617, North Carolina University, Raleigh, NC, 27695.

Spotted Seatrout, *Cynoscion nebulosus*, is one of the most economically important sportfish in North Carolina. The state's recent stock assessment concluded the population is overfished; however, the extent to which variability in natural mortality (*M*) affects annual estimates of fishing mortality (*F*) is unknown. This is potentially important because North Carolina is near the species' northern geographical limit, where spotted seatrout are particularly vulnerable to lethal winter conditions. Data from the first comprehensive tag-return study of spotted seatrout in North Carolina, along with fishery-independent gill net survey data collected by the state, were used to estimate *F* and *M*. Both laboratory and field studies were conducted to obtain estimates of auxiliary parameters (e.g., reporting rate, tag retention, and tagging-induced mortality) necessary for the tag-return modeling. There was no measured mortality associated with tagging but non-reporting and loss of internal anchor tags significantly limited returns. From September 2008 through October 2012, our estimates indicate that *M* exceeded *F* and winter severity strongly influenced *M*. Our annual estimates of *F* were lower and *M* higher than those reported for Spotted Seatrout in North Carolina's recent age-based stock assessment, where *M* was fixed using general life-history relationships based on weight and longevity. Effective management of this valuable fishery relies on an accurate understanding of the relative importance of harvest and winterkill on population dynamics. Future assessments of Spotted Seatrout in North Carolina would be improved by consideration of more direct estimates of and annual variability in *M*.

8. RECRUITMENT PHENOLOGY OF CARIBBEAN AMPHIDROMOUS FISHES

Augustin C. Engman[1], Thomas J. Kwak[2], Jesse R. Fischer[1], and Casey A. Grieshaber[1], [1]North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, Campus Box 7617, North Carolina State University, Raleigh, NC, 27695; [2]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, Campus Box 7617, North Carolina State University, Raleigh, NC 27695. Corresponding author: 787-587-6911, acengman@ncsu.edu.

Amphidromous fishes are a major component of tropical coastal and island lotic fish assemblages. In the amphidromous life-history, adults live and spawn in freshwater streams, their eggs or larvae are transported downstream, larvae develop and grow in the marine environment, and post-larvae recruit to the estuary and undergo metamorphosis during ingress to the river. Dispersal during the marine larval phase and subsequent recruitment by post-larvae allows for population colonization, re-colonization, and replenishment. The post-larval recruitment phase is important for ecosystem services provided by amphidromous fishes. Artisanal fisheries of post-larvae occur on tropical islands globally and have high economic and cultural value. Recruitment peaks are known to be seasonal and periodic by fishers with periodicity often linked to lunar phase. Despite the importance of the larval phase and post-larval recruitment for Caribbean freshwater fisheries and ecosystems, their ecology and management have received little research attention. We quantitatively sampled amphidromous post-larvae at the mouth of the Arecibo River, Puerto Rico, from June to October 2013 and determined the pelagic larval duration of recruits by examining otolith microstructure. We observed peaks in abundance of both post-larval River Gobies and Sirajo Gobies during the last quarter moon phase. The length and age at recruitment of River Gobies increased over the recruitment season, and along with back-calculations, suggests a concentrated spawning period. This study is the first to determine post-larval recruitment phenology and age at recruitment of amphidromous fishes of Puerto Rico, which provides crucial information for the ecology and management of Caribbean amphidromous fishes.

9. BACK TO THE BASICS: USING CHANGES IN OCCUPANCY TO DETECT POPULATION DECLINES IN AQUATIC SPECIES

Todd Ewing, North Carolina Wildlife Resources Commission, 808 Briggs Street NW, Valdese, NC 28690, 828-874-0494, todd.ewing@ncwildlife.org.

A responsibility of most fisheries agencies is determining the conservation status of the species which they management authority. One of the most important pieces of information for determining conservation status is knowledge of a species' population trend. However, determining population trend for most species is problematic for most fisheries agencies because little or no historic information is available on population size nor are resources available for contemporary population estimates. The data often available to managers is presence/absence work done by others. Here I present ways to conduct analyses in changes in occupancy using presence-absence data from multiple sources and give several examples using North Carolina fish species. This type of data can effectively be used to determine population trends for many species in a cost effective and statistically rigorous manner

10. ECOLOGICAL FLOW RECOMMENDATIONS FOR NORTH CAROLINA WATER MANAGEMENT PLANNING

Chris Goudreau, North Carolina Wildlife Resources Commission, 645 Fish Hatchery Road, Marion, NC 28752, 828-652-4360 Ext. 223, chris.goudreau@ncwildlife.org.

An Ecological Flows Science Advisory Board (SAB) was created to assist the North Carolina Department of Environment and Natural Resources (DENR) with developing a scientifically defensible approach to establishing flows that protect the ecological integrity of streams and rivers in North Carolina. Members of the SAB included representatives from agencies, organizations and business sectors. The SAB focused on reviewing ecological flow literature, hearing and discussing presentations from ecological flow experts, and reviewing flow-ecology research conducted in North Carolina. In addition, the SAB worked through informal subcommittees to analyze flow-ecology relations using data (fish and benthic macroinvertebrates) specific to North Carolina streams and to address flow and ecology issues unique to streams in the coastal plain. The SAB recommended that DENR using a two-part strategy to establish ecological flows for most North Carolina streams. Part one is a percentage-of-flow strategy designed to retain 80-90% of the instantaneous flow in the stream, combined with a low-flow component to protect biota during droughts. Part two is a biological-response strategy designed to allow a 5-10% reduction in biological condition based on regressions of fish and macroinvertebrate indices and hydrologic metrics. Other recommendations included using an adaptive management approach to establish ecological flows for headwater, coastal plain and large rivers that are currently underrepresented in the biological datasets.

11. RESEARCH AND CONSERVATION EFFORTS IN THE PEE DEE RIVER, NORTH CAROLINA

Ryan J. Heise, North Carolina Wildlife Resources Commission, 1718 NC Hwy 56, Creedmoor, North Carolina 27522, 919-707-0368, ryan.heise@ncwildlife.org

The Wildlife Resources Commission, along with its partners, is conducting long term studies on freshwater mussels and Robust Redhorse in the Pee Dee River. Since 2010, there have been incremental improvements in water quantity (higher minimum flows) and/or quality (dissolved oxygen) downstream from the mainstem hydropower dams. Beginning in 2009, we conducted biennial mussel surveys downstream of 2 hydropower dams (3rd added in 2011) to document potential changes in mussel diversity and abundance due to these improvements. During our surveys we collected 7 to 13 species at each study sites and densities ranged from 0.018 to 16.1 mussels/m^2 depending on species. The Robust Redhorse is a rare fish that only occurs downstream of the Blewett Falls Dam in North Carolina. In 2014, we will begin a stocking program for the Robust Redhorse. Propagation will take place at the McKinney Lake hatchery and juveniles will be released this fall downstream of Blewett Falls Dam. Future plans include the possible reintroduction upstream in the riverine reach below Tillery Dam.

12. FUN WITH CAMERAS: USE OF TRAIL CAMERAS TO ASSESS ANGLER USE ON TWO WILD TROUT STREAMS IN WILKES COUNTY, NORTH CAROLINA

Kevin J. Hining[1] and Jacob M. Rash[2]. [1]North Carolina Wildlife Resources Commission, 1556 Big Flatts Church Rd, Fleetwood, NC 28626, 336-877-1087, kevin.hining@ncwildlife.org. [2]North Carolina Wildlife Resources Commission, 645 Fish Hatchery Road, Marion, NC 28752.

Western North Carolina has thousands of miles of streams capable of providing angling opportunities for salmonids. Many of these resources are managed by the North Carolina Wildlife Resources Commission (NCWRC) with an emphasis on maintenance and enhancement of self-sustaining wild trout populations. Recent NCWRC trout angler opinion data indicated that a majority (68%) of trout anglers fish wild trout waters. Given the popularity of wild trout angling, it would benefit managers to increase understanding of angler use levels and patterns on wild trout resources. Very little is known about angler use on these waters in North Carolina primarily because obtaining angler use information from remote streams can be labor intensive and costly. This can be especially true for waters that have multiple angler access points. In contrast, streams with limited access may be easier to obtain information by focusing data collection efforts at these limited points of entry. Recent advances in digital camera and motion detection technology provide a potential, low-manpower alternative to more intensive creel surveys. In an effort to obtain angler use information for wild trout streams in North Carolina, two limited entry streams in Wilkes County were identified and angler use was determined via trail cameras stationed along each stream. This information will be useful when describing general trends about usage of wild trout resources. These data may also aid in making future management decisions and attempts to obtain angler access to resources that are currently closed to public fishing.

13. TECHNIQUES FOR SAMPLING LARVAL AND JUVENILE FISHES IN APPALACHIAN MOUNTAIN RIVERS

Tomas J. Ivasauskas[1] and Thomas J. Kwak[2]. [1]North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC 27695, 919-513-2469, 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.

We sampled larval and juvenile fishes from sites located along the Valley River, a major tributary to the Hiwassee River in Western North Carolina, April – November, 2013, to compare efficiency of multiple techniques. A diverse fish assemblage composed of 51 species representing 10 families, including six species of redhorse (genus *Moxostoma*), inhabit the Valley River and use it for spawning. Techniques used to sample larval and juvenile fish included drift netting, light trapping, dip netting, and backpack electrofishing. The sampling approach was adjusted over the sampling season to accommodate changes in capture vulnerability due to fish growth, physiology, and behavior. As expected, the size and size range of sampled fish increased over time. Drift nets were most effective when set after dark and provided a reliable index of larval drift when set for 30-minute increments, but resulted in a high rate of mortality. Light traps were deployed as benthic-set and floating and were effective at capturing a variety of larval fish species. Dip netting was especially efficient for sampling larval and juvenile fish, and accurate habitat measurements could be obtained at the point-of-capture. Electrofishing was useful for sampling juvenile fish that had achieved swimming ability to evade capture with a dip net and was most effective using an unpulsed DC waveform at high voltage

(400-500 V). Samples are being identified using published keys and genetic barcoding. These findings may guide fisheries scientists in planning seasonal sampling to most effectively characterize the early life stages of the riverine fish assemblage.

14. POTENTIAL UNDERLYING MECHANISMS BEHIND WHITE BASS POPULATION DECLINES

Kelsey Lincoln, James A. Rice, and D. Derek Aday. Department of Applied Ecology, Campus Box 7617, North Carolina State University, Raleigh, NC 27695, 919-515-3883, kjlincol@ncsu.edu

Little is known about fundamental aspects of the life history, ecology and population dynamics of reservoir White Bass *Morone chrysops*. Lack of fundamental knowledge about this common reservoir species has made management difficult, particularly in the context of current concerns about perceived declines in reservoir White Bass populations. Mechanisms associated with these perceived declines are not well understood. Our study aimed to address those knowledge gaps through quantification of two potential mechanisms: Mortality (both fishing, F, and natural, M) and potential interactions with invasive White Perch *Morone americana*. We created a multi-state model using telemetry data collected by monitoring fish tagged with acoustic transmitters (N=75) to estimate instantaneous monthly natural and fishing mortality rates. Our annual estimate of F was exceptionally high, and both F and M peaked in spring 2012 and 2013 as White Bass made their spawning run. We used stable isotope and stomach content analysis to examine the potential for competition and trophic overlap between White Bass and White Perch. We found moderate diet overlap and moderate trophic overlap in the spring, mainly between large White Perch (> 160 mm) and juvenile White Bass (< 220 mm), suggesting competition may occur when resources are limited. Overall, our research indicated that high fishing mortality and potential competition with White Perch could be mechanisms underlying declining White Bass populations. Adjusting harvest limits during the spawning season may be a potential management strategy for this species

15. WHO'S YOUR SHADDY? AN AMERICAN SHAD'S JOURNEY FROM THE CLASSROOM TO THE RIVER

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American Shad have ecological, economic, and historical importance to North Carolina and much of the eastern coast of the U.S. The Shad in the Classroom program provides a hands-on real-life science learning opportunity. Similar programs have existed in the Potomac River basin since 1996, setting the groundwork for the Shad in the Classroom program in North Carolina. What began in 2009 as a pilot study in North Carolina involving three schools has grown to 25 classrooms at 20 schools served by the program each year. Students and teachers become involved in the program several weeks prior to receiving American Shad eggs spawned in NC Wildlife Resource Commission and U.S. Fish and Wildlife Service hatcheries. Students learn how to set up and tend their shad eggs in special rearing systems as well as covering background information on American Shad natural history and management. For one week during the spawning period, each classroom receives, monitors, and cares for a batch of shad eggs as part of this hands-on approach to learning about water quality, fisheries science,

ecology, and history. Fry hatch within 4-5 days and are then released by the students in their river basin of origin. Through their observations and experiences, students learn concepts related to the shad's survival, the species cultural and biological importance, its ecological connections to other species, and the significance of genetic integrity to population studies. The program heightens knowledge and awareness in future generations of an important migratory fish, the American Shad.

16. GENETIC ANALYSIS OF NORTH CAROLINA'S BROOK TROUT *SALVELINUS FONTINALIS* WITH EMPHASIS ON PREVIOUSLY UNCHARACTERIZED COLLECTIONS

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Salmonid fishes inhabiting lower latitudes present significant challenges to fishery managers that attempt to maintain ecological and evolutionary processes within and among populations. Brook Trout *Salvelinus fontinalis* is the only salmonid native to the southern Appalachian region and functions as a keystone species in some headwater streams. The dramatic decrease in the range of Southern Appalachian Brook Trout combined with the historic use of hatchery-reared fishes for supplemental and restorative stocking throughout the species' range underscores the need to recognize the ecological and evolutionary relationship among stream populations. Although the North Carolina Wildlife Resources Commission (NCWRC) routinely monitors Brook Trout populations to evaluate population characteristics, genetic and evolutionary relationships among most populations have not been extensively investigated using contemporary molecular methods. To address this research need an extensive survey of genetic diversity and variation at 13 microsatellite loci is being conducted. This research effort, focused initially on previously uncharacterized stream collections, indicated the presence of highly significant differentiation at all hierarchical levels (collection, stream, and watershed). Moreover, these findings have allowed NCWRC to: 1) resolve the evolutionary relationships at the population and phylogeographic scales; 2) shed light on the historical demography of each collection; 3) assess the degree to which collections have been impacted by supplemental or restorative stockings; and 4) provide long-term guidance in management of the genetic resources identified. Future research will attempt to determine whether the genetic divergence observed reflects adaptive differences (e.g., natural selection), variation due to stochastic processes (e.g., random genetic drift), or some quantifiable combination of the two evolutionary processes.

17. PRELIMINARY PHYLOGENY OF THE CRITICALLY ENDANGERED NORTH AMERICAN SPINYMUSSELS

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The spinymussels (Unionidae: *Elliptio steinstansana, Elliptio spinosa, and Pleurobema collina*) are critically endangered and endemic to the Southeastern Atlantic Slope. Although often characterized by the presence of conspicuous external spines, the spinymussels continue to be a source of taxonomic confusion. Key diagnostic features within the Pleurobemini (*Elliptio* and *Pleurobema*) are notoriously plastic, and at least two of the spinymussels (*E. steinstansana* and

P. collina) share remarkably similar life history traits. Molecular analyses could improve characterization of these species, however genetic data is severely limited. We sequenced a 569 bp region of the ND1 mtDNA gene from Tar (*E. steinstansana* n=22), Altamaha (*E. spinosa* n=8), and James (*P. collina* n=55) spiny mussels using standard Sanger techniques. Preliminary phylogenetic analyses suggest *E. steinstansana* and *P. collina* form a distinct clade separate from any known *Elliptio* or *Pleurobema* taxa and likely warrants recognition as a new genus. Furthermore, these species are very closely related and may be members of the same species. Additionally, *E. spinosa* forms a clade separate from *Elliptio* and may constitute a monotypic genus. These preliminary results suggest a need to revise both taxonomic and evolutionary paradigms. Ongoing research will characterize the COI mtDNA region for these taxa as well as develop microsatellite markers for *E. steinstansana* and *P. collina.* The results of this research will provide conservation agencies with data needed to refine and develop more effective population management strategies for these threatened taxa.

18. GENETICS OF THE UNDESCRIBED "CAROLINA REDHORSE" (*MOXOSTOMA* SP.), ANOTHER CAROLINA ENDEMIC

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The "Carolina Redhorse" is a relatively rare, undescribed catostomid restricted to the Pee Dee and Cape Fear River drainages in North and South Carolina. R. E. Jenkins recognized the species in 1995 and proposed it as sister to the Golden Redhorse, *M. erythrurum*, a much more widely distributed species occurring throughout North America. Preliminary genetic evidence contradicted this, however, placing the species sister to the Notchlip-Silver Redhorse clade. While the "Carolina Redhorse" shares several features suggesting affinities to both clades of these distinctive Redhorse groups (Golden and Notchlip clades), several anatomical and fixed genetic differences attest to its distinctiveness and validity as a separate taxon. Here, we describe the genetic affinities of the "Carolina Redhorse" and present the results of population genetic data generated to date and suggest potential units for management if merited for the species.

19. STATUS OF RARE CRAYFISHES IN WESTERN NORTH CAROLINA

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From 2007-2013 NCWRC Aquatic Wildlife Diversity staff sampled crayfish communities throughout Western North Carolina. Crayfish were collected from crayfish-specific studies and opportunistically during other aquatic surveys. Kicking into seines was the primary technique used; dip nets were also used, generally in smaller streams and shoreline habitats. Priority areas and site selection for field surveys were directed by lack of recent surveys and where large data gaps existed. Particular emphasis was placed in stream reaches where historical data were older than five years. Current, detailed distribution and updated conservation status were obtained for high priority crayfish: Hiwassee Headwaters Crayfish, *Cambarus parrishi*; Chauga Crayfish, *C. chaugaensis*; French Broad River Crayfish, *C. reburrus*; Broad River Stream Crayfish, *C. lenati*; Broad River Spiny Crayfish, *C. spicatus*; and Little Tennessee River Crayfish, *C. georgiae*. Of the six species, no range expansions were noted and three species

should be considered for elevated conservation status. Two new species to North Carolina were discovered in the French Broad River in Madison County: Reticulate Crayfish, *Orconectes erichsonianus* and Surgeon Crayfish, *O. forceps*. The Carolina Needlenose Crayfish, *C. aldermanorum*, was thought to be limited to South Carolina but a population was found in Johns River, in Burke and Caldwell counties. A range-wide assessment was concluded for the New River Crayfish, *C. chasmodactylus*, which found its population to be widespread and often abundant throughout the New River Basin in NC, VA, and WV. A large expansion of the invasive Rusty Crayfish, *O. rusticus* was noted in McDowell County, upstream of Lake James.

20. THE UPLAND DUSKY SHINER, *NOTROPIS CUMMINGSAE COLLIS* HUBBS & RANEY 1951: A MISTAKEN COLLECTION LOCALITY, A SUBSPECIES EXTIRPATED FROM ITS TYPE LOCALITY, OR SOMETHING ELSE?

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The Dusky Shiner, *Notropis cummingsae* Myers 1925 was partitioned by Hubbs and Raney in 1951 into two subspecies, the Lowland Dusky Shiner (*Notropis cummingsae cummingsae*) and the Upland Dusky Shiner (*N. cummingsae collis*). The distribution of the Lowland Dusky Shiner lies east and south of the Fall Zone from North Carolina to Alabama, whereas that of the Upland Dusky Shiner is restricted to two disjunct populations in the upper and lower Piedmont of the Santee River drainage; a zone of intergradation separates the two subspecies. For the upland subspecies, the type locality is Roses Creek, a Foothills stream where the population in the 1940s was separated by six major hydroelectric reservoirs and more than 175 river miles from the next closest population near the North Carolina-South Carolina state line. Currently, the two subspecies and five races designated by Hubbs and Raney are not in general usage by ichthyologists. The Upland Dusky Shiner has not been collected from its type locality since the six original type specimens were collected in 1946. This begs the questions: "Did the specimens actually come from Roses Creek" and "What might have happened to this subspecies since then"? The history of the discovery of the Upland Dusky Shiner, the sleuthing of its type locality, its subsequent fate, and its true identity are baffling stories unto themselves. We will try to make sense of it all.

21. HISTORICAL AND CONTEMPORARY MANAGEMENT OF THE DYNAMIC WALLEYE FISHERY IN LAKE JAMES, NC

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Lake James, located in Burke and McDowell Counties, NC, is the uppermost reservoir in the Catawba River chain of Duke Energy Lakes. The North Carolina Wildlife Resources Commission (NCWRC) began stocking Walleye *Sander vitreus* into Lake James in 1949 and established one of the most popular sport fisheries in Western North Carolina. Historical survey results characterized the Lake James Walleye population as having robust natural recruitment, high catch rates, and moderate condition and growth. The introduction of Alewife *Alosa pseudoharengus* and Blueback Herring *Alosa aestivalis* in Lake James was verified in 2010. Both invasive species are known threats to Walleye populations and have been responsible for substantial negative impacts on other NC lakes. Recent gill-net surveys on Lake James

suggest a recruitment failure, presumably due to ovivory, fry predation, thiamine inhibition, and/or interspecific competition with Alewife and Blueback Herring. In 2012 the NCWRC initiated a study to evaluate the success of stocking 30,000 Walleye fingerlings/year to offset a declining population. Stocked fish were marked with oxytetracycline (OTC) to measure percent contribution of age-0 and age-1 stocked Walleyes to the overall fishery. Survey results from 2012−2013 showed 70% of age-0 and 100% of age-1 Walleyes were from stocking efforts, which is much higher than the established 25% success criterion. Additionally, NCWRC biologists will utilize microsatellite genetic markers to verify origin and assess the efficacy of OTC in Walleye studies. Genetically distinct cohorts will also be utilized to measure recruitment success as a function of stocking location (i.e., riverine verse lake). Collectively, these data will help determine stocking numbers, locations, harvest regulations, and other management options for Lake James' dynamic Walleye fishery.