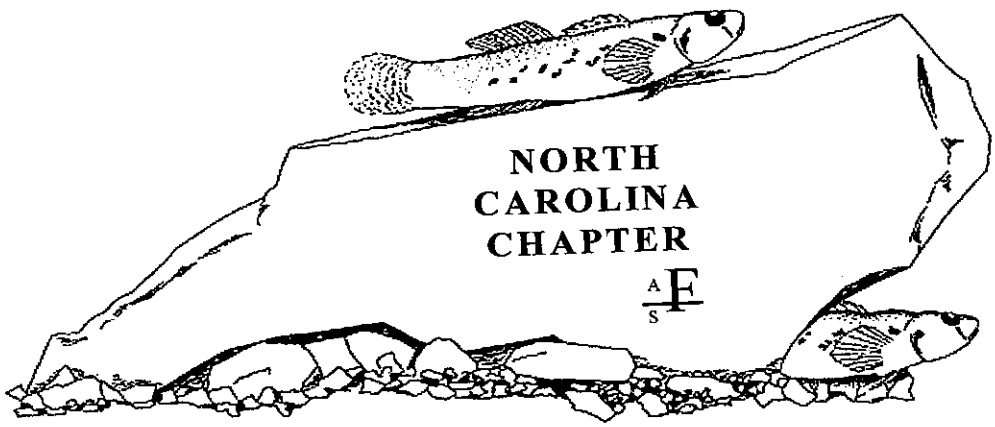
# *North Carolina Chapter*
# *American Fisheries Society*

## *2004 Annual Meeting Program*




American Fisheries
Society

***February 4 – 5, 2004***
***Renaissance Hotel***
***Asheville, North Carolina***

*Meeting Support Provided by:*

**Progress Energy**

**2004 Annual Meeting**
**North Carolina Chapter - American Fisheries Society**
**Renaissance Hotel, Asheville, North Carolina**

**Wednesday, February 4, 2004**

** denotes student presenter*

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| 7:30 – 1:00 | Registration – Ballroom Foyer |
| 8:00 – 11:30 | Continuing Education Workshop: Fisheries Technology – Salon A |
| 10:00 – 10:30 | Break |
| 10:30 – 11:30 | Fisheries Technology Workshop, continued |
| 11:30 – 1:00 | Lunch |
| 1:00 – 1:15 | Brook Trout Genetic Identification in North Carolina - *Doug Besler* |
| 1:15 – 1:30 | A Comparison of Mortality and Growth Rates Between Wild Northern and Southern Appalachian Brook Trout - *Wes Cornelison* |
| 1:30 – 1:45 | The Effect of Stocked Trout on Non-Game Fish Species in the Watauga River - *Helen L. A. Burrell* and Robert P. Creed* |
| 1:45 – 2:00 | A Comparison of Diet Between Native Southern Appalachian and Naturalized Northern Strain Brook Trout - *Christopher D. Dankmeyer* and Wes Cornelison* |
| 2:00 – 2:15 | Monitoring the Effects of Stream Restoration Activities on Trout and Nongame Fish in Sharp's Creek, Watauga County - *Kevin Hining* |
| 2:15 – 2:30 | A Comparison of Age and Condition Between Wild Northern and Southern Appalachian Brook Trout - *Joshua R. Lashley* and Wes Cornelison* |
| 2:30 – 2:45 | NC Division of Water Quality's Fish Community Investigations in the French Broad River Basin, 2001 – 2003 - *Bryn H. Tracy* |
| 2:45 – 3:00 | Overview of Muskellunge Management on the French Broad River - *Scott Loftis and David Yow* |
| 3:00 – 3:30 | Break |
| 3:30 – 3:45 | Distribution of Spawning Activity by Migratory Fishes in the Upper Neuse River Drainage - *Summer M. Burdick* and Joe Hightower* |
| 3:45 – 4:00 | Chowan River Angling Preferences 2001-2002 - *Kevin Dockendorf, Chad Thomas, and Pete Kornegay* |
| 4:00 – 4:15 | Assessment Tool for Identifying American Shad Spawning and Nursery Habitat - *Alesia N. Read* and Joe Hightower* |
| 4:15 – 4:30 | Evaluation of a Denil Fishway on a North Carolina Blackwater Creek - *Benjamin R. Ricks* and Joe Hightower* |

**2004 Annual Meeting**
**North Carolina Chapter - American Fisheries Society**
**Renaissance Hotel, Asheville, North Carolina**

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|---|---|
| 4:30 – 4:45 | The "Carolina Redhorse" (Moxostoma sp.): History of Discovery, Current Knowledge of Distribution, and Preliminary Results of Genetic Investigations - *Wayne C. Starnes, Morgan Raley, John Crutchfield, V. F. Stancil, and Mike Swing* |
| 4:45 – 5:00 | Pigeon River Recovery and Species Re-introduction Efforts: A Review of Progress in Tennessee and a Preview of North Carolina Efforts - *Steve Fraley, Joyce Coombs, Larry Wilson, Jonathan Burr, and Derric Brown* |
| 5:30 – 7:30 | Social – Renaissance Hotel Salon B |

**Thursday, February 5, 2004**

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| 8:00 – 8:15 | Comparing Sampling Effectiveness of Minnow Traps and Seines in Three Piedmont Streams - *Youth Partners of the Museum of Life and Science* and Chad Hallyburton* |
| 8:15 – 8:30 | Assessing the Presence of Estrogenic Chemicals with Sentinel Fish - *W. Gregory Cope, Gerald A. LeBlanc, Larry McMillan, and Scott L. Van Horn* |
| 8:30 – 8:45 | Fishing and Natural Mortality of Reservoir Striped Bass - *Jessica S. Thompson*, Scott Waters, and Jim Rice* |
| 8:45 – 9:00 | Effects of Age-1 Striped Bass Predation on Alosa spp. in Western Albemarle Sound - *Jack E. Tuomikoski*, Jeffrey A. Buckel, Paul J. Rudershausen, and Joe Hightower* |
| 9:00 – 9:15 | Blueback Herring Piscivory and Ovivory in Hiwassee Reservoir - *Andrew P. Wheeler, Scott Loftis, and David Yow* |
| 9:15 – 9:45 | Break |
| 9:45 – 10:00 | Post-Stocking Survival of Phase-I Fingerling Striped Bass - *Winthrop E. Taylor and Douglas A. Besler* |
| 10:00 – 10:15 | Short-term Impacts of Hurricane Isabel on Fish Communities in Northeastern North Carolina - *Chad Thomas and Kevin Dockendorf* |
| 10:15 – 10:30 | Striped Bass Habitat Selection in Badin Lake, North Carolina - *D. Scott Waters, Jessica S. Thompson, and James A. Rice* |
| 10:30 – 10:45 | Assessment of Oxytetracycline Marks on American Shad Stocked in the Roanoke River - *Kevin J. Dockendorf, Chad D. Thomas, and James W. Kornegay* |
| 10:45 – 11:00 | Changes in Walleye Abundance, Growth, and Recruitment Following a Blueback Herring Invasion - *Andrew P. Wheeler, Scott Loftis, and David L. Yow* |
| 11:00 – 12:30 | Business Meeting; Adjourn |

**CONTRIBUTED PAPERS**
**SESSION 1**

**Moderator: David Yow** **February 4, 2004 from 1:00 pm to 3:00 pm**

### Brook Trout Genetic Identification in North Carolina

***Doug Besler*** *(North Carolina Wildlife Resources Commission, 645 Fish Hatchery Rd., Marion, NC 28752; 828/659-8684, FAX 828/652-3279; beslerda@wnclink.com)*

Brook trout *Salvelinus fontinalis* is the only salmonid native to North Carolina and the Southern Appalachian Mountains. The original range of brook trout was reduced by anthropogenic alterations to the landscape and by introduction of nonnative salmonids. Anglers and managers have long suspected that brook trout existing in the southern Appalachians were physically different compared to stocked brook trout of known northern origin. No conclusive diagnostic features are known and genetic analysis is used to conclusively distinguish between brook trout of Southern Appalachian origin and northern hatchery-derived origin. The vast majority of Southern Appalachian brook trout populations are located in North Carolina. To date, approximately 215 populations have been typed, funded primarily by small grants over the last decade. Results from the previous testing indicated that 37% of the populations were of Southern Appalachian origin, 10% northern hatchery-derived origin, and 53% were of mixed genetic origin. The genetic origin of the remaining 200 wild brook trout populations is unknown. The North Carolina Wildlife Resources Commission has initiated a research project designed to genetically identify all remaining populations by June 2005. Long-term protection of those Southern Appalachian strain populations and the preservation of the unaltered native genes they possess can only be achieved after identification has been completed.

### A Comparison of Mortality and Growth Rates Between Wild Northern and Southern Appalachian Brook Trout, *Salvelinus fontinalis*

***Wes Cornelison*** *(Western Carolina University, 315 Natural Sciences Building, Cullowhee, NC 28723; 828/227-3670; wescorn77@hotmail.com)*

The southern Appalachian Mountains are home to an endemic strain of brook trout, *Salvelinus fontinalis.* Protein electrophoretic studies have demonstrated that native Southern Appalachian and northern hatchery-derived wild populations of brook trout are fixed for different alleles for creatine kinase (CK-A2). Populations are now restricted to cool, clean headwater streams above hatchery supported systems. An understanding of any physiological or behavioral differences that exist between these two strains is essential to properly manage and sustain these reduced populations. The specific objectives of this study were to determine 1) absolute, relative, and standard growth rates between strains over an 8-week period, and 2) mortality rate differences between strains. Forty wild brook trout (twenty per strain) were individually tagged and placed in an artificial stream over an 8-week period. Growth rates were almost identical and an analysis of variance showed no significant difference between strains. However, northern strain brook trout showed a significantly lower mortality rate than southern strain brook trout. This may be attributed to the period of naturalization northern strain brook trout have been exposed to over their evolutionary history.

### The Effect of Stocked Trout on Non-Game Fish Species in the Watauga River, NC

***Helen L. A. Burrell**** *(Appalachian State University, Department of Biology, P.O. Box 32027, Boone, NC 28607-2027; 828/262-3025; hb48275@appstate.edu)*

***Robert P. Creed*** *(Appalachian State University, Department of Biology, P.O. Box 32027, Boone, NC 28607-2027; 828/262-3025)*

Trout are stocked in rivers around the world, however their effect on native fish populations is understudied. Introduced trout have the potential to negatively affect native fish populations through consumption, competition or by causing changes in habitat use. We conducted a study to assess the impacts of delayed harvest trout stocking on non-game fish species in the Watauga River, NC. Pre and post-stocking data (three pass depletion electroshocking surveys, snorkeling surveys) were gathered at a

delayed harvest site and an upstream reference site in 2002 and 2003. Almost all non-game fish populations declined at the introduction site; Cyprinid species exhibited the greatest reductions in abundance. Few changes were seen at the reference site. Snorkelling surveys also showed declines in the number of fish present after stocking. Observations made while snorkelling showed that *Campostoma* minnows appeared to be increasing their utilization of shallow habitats. Gut content analyses were carried out on trout removed from the delayed harvest site in June and October 2003; few fish were consumed by trout. The declines in non-game fish populations do not appear to be caused by predation, but appear to be the result of changes in habitat use by fish in the presence of trout.

**A Comparison of Diet Between Native Southern Appalachian and Naturalized Northern Strain Brook Trout *Salvelinus fontinalis***

***Christopher D. Dankmeyer**** *(Western Carolina University, 315 Natural Sciences Building, Cullowhee, NC 28723; 828/586-6885; cdank40@aol.com)*

***James W. Cornelison*** *(Western Carolina University, 315 Natural Sciences Building, Cullowhee, NC 28723; 828/227-3670; wescorn77@hotmail.com)*

The southern Appalachian Mountains are home to an endemic strain of brook trout, *Salvelinus fontinalis*. The genetic uniqueness of this strain has been demonstrated in studies involving allozyme analysis and other molecular genetic techniques. Studies are on-going to characterize behavioral and physiological traits associated with this unique strain of brook trout. An experiment was conducted to look for differences in feeding habits between native Southern Appalachian fish and naturalized brook trout derived from hatchery supplementation of regional streams in the previous century - the hatchery strains established with brook trout from populations in the northeastern United States. A total of 20 native Southern Appalachian brook trout and 21 northern strain brook trout were collected from multiple streams previously identified as to genetic origin. The fish were measured, implanted with PIT tags (passive integrated transponder) for individual identification, and placed in a 100m section of Logan Creek, Jackson County, North Carolina. Fish were sampled via electroshocking one day every two weeks over an 8-week period. On each sample day, fish were collected at night, morning, and afternoon. The fish were identified, and the stomach contents were removed and stored in individual vials. Identification to family of the macroinvertebrates in the gut contents is on-going. Upon completion, data for frequency of occurrence, numerical abundance, time of day, and habitat unit within the stream will be compared between brook trout strains.

**Monitoring the Effects of Stream Restoration Activities on Trout and Nongame Fish in Sharp's Creek, Watauga County**

***Kevin Hining*** *(North Carolina Wildlife Resources Commission; PO Box 322, Boomer, NC 28606 (336) 921-3029 hiningk@wilkes.net)*

Stream restoration activities in North Carolina have increased annually over the past decade, and this trend will likely continue. A review of recent projects has raised questions about the original need for instream restoration and the suitability of the expected effect the projects would have on fish populations. Sharp's Creek, a tributary of the Watauga River in northwestern North Carolina, was selected for monitoring the effect of restoration activities on a fish population. The objective was to measure the changes in trout density, biomass, and size structure, as well as to measure the nongame fish assemblage before and after restoration relative to a control section. Three 50 m sites were selected within the area to be restored and within an upstream control section. All sites were sampled using three-pass depletion backpack electrofishing. The pre-restoration data revealed a brown trout population that appeared to be excellent, with density (1,997/ha) and biomass (146.3 kg/ha) estimates exceeding those found in the control section as well as many wild trout streams within the region. This case study suggests that there is a need for fish and game agencies to critically evaluate the need and type of stream restoration activities prior to implementation, particularly when improvement to fish populations is a goal of the activity. Providing technical assistance to restoration personnel will help to steer intensive instream restorations to places where they are likely to have the greatest impact.

**A Comparison of Age and Condition Between Wild Northern and Southern Appalachian Brook Trout, *Salvelinus fontinalis***

***Joshua R. Lashley**** *(Western Carolina University, Department of Biology, Cullowhee, NC 28723; 828/586-6885; thelash77@aol.com)*

***James W. Cornelison*** *(Western Carolina University, 315 Natural Sciences Building, Cullowhee, NC 28723; 828/227-3670; wescorn77@hotmail.com)*

Protein electrophoretic studies have demonstrated that the southern Appalachian Mountains are home to an endemic strain of brook trout, *Salvelinus fontinalis*. Genetic analysis of wild brook trout populations show northern hatchery derived and southern Appalachian brook trout are fixed for different alleles for creatine release. This experiment was conducted to look at physical differences that may exist between the two species at a given age (length, weight, and condition factor). In correlation with other on going experiments, 90 fish were collected, 45 northern and 45 southern, by electro-fishing in May of 2003 from 8 different previously identified northern or southern stream. The fish were then put through a thermal and acidity tolerance in which they were sacrificed. After the experiments were completed, otoliths were extracted by the up through the gill method. Otoliths were used instead of scales, due to their higher accuracy and more visible annuli. Otoliths were then cleaned with water and mounted on a slide using thermal plastic resin, sanded and read by at least two readers to verify age. Comparisons will be made with age, condition factor, streams and strains upon completion of data analysis.

**NC Division of Water Quality's Fish Community Investigations in the French Broad River Basin, 2001 - 2003**

***Bryn H. Tracy*** *(NC Division of Water Quality, 4401 Reedy Creek Road, Raleigh, NC;* 919/733-6946; *bryn.tracy@ncmail.net)*

Fish community assessments in the French Broad River Basin focused on five areas -- Use Attainability, 303 (d) Impaired Streams, basinwide assessment, impacts of a trout farm discharge, and Watershed Assessment Team projects. In 2001 streams within the Richland Creek watershed warranted amending existing water quality classifications to include the supplemental trout classification. Upper sections of Richland Creek and tributaries draining forested watershed supported reproducing populations of all three species of trout; more residentially developed and agricultural watersheds no longer supported trout. Also in 2001 the fish communities in Clear Creek showed low to moderate levels of impairment from nutrient enrichment and habitat alteration. In 2002, 23 sites were evaluated as part of the Basinwide Assessment Program. Communities rated Good or Excellent were found in forested watersheds where the instream and riparian habitats were of high quality; the converse was true for communities rated Fair or Poor. Streams that will likely be placed on or remain on the Impaired Streams list are Bat Fork and Mud, Richland, Fines, and Jacks Creeks. Improvements at Newfound and Crabtree Creeks were attributable to watershed restoration efforts. The discharge from an aquaculture facility in 2003 continued to stimulate the entire aquatic community resulting in unusually large and abundant brown trout, a degraded benthic community, enriched periphytic growths, and slightly altered physical and chemical characteristics. Streams draining small watersheds in the South Hominy and Bald Creeks watersheds were recently evaluated in November 2003 as potential targets for restoration projects.

**Overview of Muskellunge Management on the French Broad River**

***C. Scott Loftis*** *(NC Wildlife Resources Commission, 20830 Great Smoky Mountains Expressway, Waynesville, NC 28786; 828/452-0422 ext. 22; loftiscs@brinet.com)*

***David L. Yow*** *(NC Wildlife Resources Commission; 57 Hilltop Road, Asheville, NC 28803; 828/274-3646; yowdl@earthlink.net)*

Muskellunge *Esox musquinongy* fisheries are rare in the southeast. Many of the large river systems that once supported native populations have been altered or degraded over the last century by anthropogenic perturbations. To offset these activities, muskellunge stocking began in 1970. From 1970 to 1983, muskellunge were stocked annually, although rates, sizes and sources varied. A habitat and population assessment in 1984 recommended an every-other-year stocking at a rate of 3 fish/ha and fish should be marked to evaluate natural reproduction. From 1985 to 2003 stocking occurred every other year. No

stocking occurred in 1994 or 1995. All muskie stocked since 1996 have been marked using a coded wire tag. Annual population assessment (1995-2002) focused on capture method, source confirmation, and age verification. Capture methods were refined in the first two field seasons and involved two electrofishing boats maneuvered upstream in a parallel fashion followed by a chase boat. The majority of muskellunge captured (N=117) were of hatchery origin. Age estimates from scales did not always correlate with known ages of fish based on mark location. Recent findings suggest the fishery is dependent on hatchery production. Reproduction can occur, but not at a level to support angling. Information gleaned will help better allocate hatchery resources and define future muskellunge management intended to provide a unique-high quality fishery.

**CONTRIBUTED PAPERS**
**SESSION 2**

**Moderator: Chad Thomas** **February 4, 2004 from 3:30 pm to 5:00 pm**

### Distribution of Spawning Activity by Migratory Fishes in the Upper Neuse River Drainage

***Summer M. Burdick**** *(Department of Zoology, North Carolina State University, Campus Box 7617, Raleigh, NC, 27695; 919/515-9772; smburdic@unity.ncsu.edu)*

***Joseph E. Hightower*** *(Department of Zoology, North Carolina State University, Campus Box 7617, Raleigh, NC, 27695; 919/515-8836; jhightower@ncsu.edu)*

In 1998, the Quaker Neck Dam was removed from the Neuse River near Goldsboro, NC, restoring access to more than 120 km of potential spawning habitat. The goal of this study is to examine the distribution of spawning activity by migratory fishes above and below the former dam site. During February-May of 2003, we used plankton sampling at nine locations on the upper Neuse River and five locations on tributaries. In addition, we conducted standardized electrofishing in order to determine the relative abundance of species and to estimate run timing. Evidence of spawning activity was detected upstream of the former dam site for three anadromous species (American shad *Alosa sapidissima*, hickory shad *A. mediocris*, striped bass *Morone saxatilis*) and three resident species (shorthead redhorse sucker *Moxostoma macrolepidotum*, notchedlip redhorse sucker *Moxostoma collapsum*, and gizzard shad *Dorosoma cepedianum*). Eighty-five percent of the American shad eggs and 75% of the larvae were collected in the Neuse River at or upstream of Smithfield. For striped bass, 65% of the eggs and 70% of the larvae were collected from mainstem sites at of upstream of Smithfield. Hickory shad spawning generally occurred further downstream compared to other anadromous species, with only 28% of the eggs collected from mainstem sites at or upstream of Smithfield.

### Chowan River Angling Preferences 2001-2002

***Kevin J. Dockendorf*** *(NC Wildlife Resources Commission, Elizabeth City, NC 27909; 252/335-9898; dockendorfkj@earthlink.net)*

***Chad D. Thomas*** *(NC Wildlife Resources Commission, Elizabeth City, NC 27909; 252/--335-4961; thomascd1@earthlink.net)*

***James W. Kornegay*** *(NC Wildlife Resources Commission, Camden, NC 27921; 252/338-3607; kornegayjw@mchsi.com)*

Coastal rivers of North Carolina provide ample fishing opportunities, however the most recent angling assessment occurred more than 20 years ago. As a result, an annual creel survey was developed by the North Carolina Wildlife Resources Commission to provide current information on gamefish populations and angling preferences on five coastal rivers. The first of five creel surveys was conducted on the Chowan River from July 1, 2001 to June 30, 2002. During 208 scheduled creel days, 1199 interviews of 2522 anglers were conducted. An estimated 43,747 anglers used the Chowan River over the twelve-month period, with effort estimated at 211,296 angler hours. Estimated catch and harvest of all fish was 355,622 and 195,024, respectively. Largemouth bass were the most popular gamefish on the Chowan River with

40% of anglers targeting this species; estimated effort was approximately 82,000 angler hours. Angler effort, catch, and harvest estimates varied by species and day type. Most anglers fished for largemouth bass on weekends whereas the majority of white perch were caught and harvested on weekdays. Angler fishing preferences varied by species, with catch and release popular among largemouth bass anglers. The majority of striped bass, black crappie, white perch, sunfish, and catfish caught were harvested, with 94% of anglers that harvested fish from the Chowan River consuming their harvest. Overall, Chowan River anglers had a positive angling experience and indicated an additional willingness to pay of an estimated US$1.05 million for similar angling satisfaction.

**Assessment Tool for Identifying American Shad Spawning and Nursery Habitat**

***Alesia N. Read**** *(North Carolina State University, Department of Zoology Campus Box 7617 Raleigh, NC 27695-7617; 919/815-0208; anread@unity.ncsu.edu)*

***Joseph E. Hightower*** *(North Carolina State University, Department of Zoology Campus Box 7617 Raleigh, NC 27695-7617; 919/515-8836; jhightower@ncsu.edu)*

Populations of American shad have declined from historical levels due to overfishing, decreased water quality and habitat loss due to dam construction. One approach for restoring these populations is to identify suitable habitat upstream of dams that could be restored by constructing fish passage devices. A goal of this research is to develop a practical tool for identifying spawning and nursery habitat for American shad in the Roanoke River basin. We measured habitat variables at mid-channel locations once every rkm along five mainstem rivers in the part of the basin above Kerr Reservoir but below the first upstream dams. The Big Otter and Staunton rivers contain areas with gravel, cobble and bedrock substrates that may be good spawning habitat. Monthly sampling "circuits" have also been conducted to compare water quality parameters among sites and rivers. Relative to the other rivers, the Banister River had higher turbidity and lower dissolved oxygen levels in Fall 2003 and may be lower quality spawning or nursery habitat. Coupled with information obtained from a geographic information system (GIS), this approach should be an efficient method for planners and managers working to restore American shad populations.

**Evaluation of a Denil Fishway on a North Carolina Blackwater Creek**

***Benjamin R. Ricks**** *(Fisheries and Allied Aquacultures, Auburn University, Auburn, AL 36849; 334/663-4928; ricksbr@auburn.edu)*

***Joseph E. Hightower*** *(North Carolina State University, Department of Zoology Campus Box 7617 Raleigh, NC 27695-7617; 919/515-8836; jhightower@ncsu.edu)*

Despite the large number of low-head dams on North Carolina streams and rivers, fishways have rarely been used to restore access to habitat upstream of dams. The goal of this study was to evaluate the effectiveness of a prefabricated Denil fishway installed at the low-head Holts Lake dam. Holts Lake is located on Black Creek, a blackwater tributary of the Neuse River downstream of Smithfield. An estimated 167 km of tributary stream habitat is available upstream of the Holts Lake dam. We constructed a trap at the top of the ladder to retain any fish passing over the dam. During March-May 2003, the ladder was used by 949 gizzard shad *Dorosoma cepedianum*, two American shad *Alosa sapidissima*, and one golden shiner *Notemigonus crysoleucas*. Upstream passage of gizzard shad appeared to be related to stream discharge. High discharge levels may induce fish to move upstream or cause the water level to rise within the ladder and facilitate passage. These results illustrate that fish passage should be considered not only for anadromous fishes but also resident fishes that undertake a spring spawning migration. Prefabricated fishways are simple to install and could restore access to the considerable habitat upstream of low-head dams.

**The "Carolina Redhorse" (*Moxostoma sp.*): History of Discovery, Current Knowledge of Distribution, and Preliminary Results of Genetic Investigations**

***Wayne C. Starnes*** *(North Carolina Museum of Natural Sciences Research Laboratory, 4301 Reedy Creek Road, Raleigh, NC 27607)*

***Morgan E. Raley*** *(Conservation Genetics Lab, North Carolina State University College of Veterinary Medicine, Raleigh, NC 27606)*

***John U. Crutchfield*** *Progress Energy Corporation , Harris Energy and Environmental Center, New Hill, NC, 27562*

***V. F. Stancil*** *(Progress Energy Corporation, Harris Energy and Environmental Center, New Hill, NC 27562)*

***J. M. Swing*** *(Progress Energy Corporation, Harris Energy and Environmental Center, New Hill, NC 27562)*

Objectives of our investigations have been and continue to be to determine the current distribution and conservation status of the rare and relatively recently discovered "Carolina Redhorse" based on stream survey results and genetic studies. This redhorse was essentially unknown to science until its existence was detected by Robert E. Jenkins in the mid 1990s and we chronicle the history of its discovery. Incidental and targeted survey results have thus far only yielded evidence of populations in restricted portions of the Pee Dee basin in NC and SC and in the Cape Fear basin of NC and it appears that the species may be effectively extirpated from much of its former range. Currently, best known populations are in the lower Deep River of Cape Fear Basin and in and near the Little River, Pee Dee basin. Preliminary genetic results using DNA (cytochrome b) data indicate little difference between Pee Dee and Cape Fear populations and substantial differences between the "Carolina Redhorse" and its hypothesized nearest relative, the Golden Redhorse (*Moxostoma erythrurum*) of the Roanoke and interior basins. Future efforts will concentrate on further determinations of the present range and status of the species and on finer grained genetic techniques aimed at assembling data essential to conservation of the species, such as effective population size estimates and evidence of subpopulation structure.

**Pigeon River Recovery and Species Re-introduction Efforts: A Review of Progress in Tennessee and a Preview of North Carolina Efforts**

***Steve Fraley*** *(NC Wildlife Resources Commission, Division of Inland Fisheries, Clyde, NC 28721)*

***Joyce A. Coombs*** *(Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN)*

***J. Larry Wilson*** *(Department of Forestry, Wildlife and Fisheries, University of Tennessee, Knoxville, TN)*

***Jonathan Burr*** *(Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Knoxville, TN)*

***Derric Brown*** *(Blue Ridge Paper Products, Canton, NC)*

The Pigeon River arises in NC and flows north into TN. For most of the 20th Century, the Pigeon River was severely degraded by industrial and municipal wastes, primarily paper mill effluent. Following improvements in wastewater treatment, the Pigeon River is recovering. These water quality improvements prompted state, federal, and private entities to work cooperatively to re-introduce several aquatic species to the river. Successful re-introduction of two snail species in 1996 into the lower Pigeon River in Tennessee led to serious consideration of a wider reintroduction effort. Since 2001, eight fish species and sixteen mollusk species have been re-introduced into the lower Pigeon in Tennessee. Students and staff from UTK, with support from the various cooperators, have conducted much of the re-introduction and monitoring efforts. Monitoring in 2002 confirmed survival of two of three fish species initially stocked in 2001 and suggested reproduction among one of those. Re-introduction of five more species began in 2002 and 2003. In early 2003, Blue Ridge Paper and the NCWRC convened a committee to examine the feasibility of re-introductions in NC. Additional assessment of habitat conditions and fish distributions was accomplished during summer 2003. Planning is on-going for an initial reintroduction of at least three species into NC waters in spring 2004.

**CONTRIBUTED PAPERS**
**SESSION 3**

**Moderator: Dave Coughlan** **February 5, 2004 from 8:00 am to 9:15 am**

### Comparing Sampling Effectiveness of Minnow Traps and Seines in Three Piedmont Streams

***Youth Partners of the Museum of Life and Science**** *(Museum of Life and Science, 433 Murray Avenue, Durham, NC 27704; 919/220-5429 ext. 353; chadh@ncmls.org)*

***Chad Hallyburton*** *(Museum of Life and Science, 433 Murray Avenue, Durham, NC 27704; 919/220-5429 ext. 353; chadh@ncmls.org)*

Sampling effectiveness of minnow traps and seines were compared for collecting fishes in three small streams of the Piedmont, NC. 200-meter sections of each stream were seined and trapped, and compositions of each sample analyzed. Primary objectives were to determine the suitability of minnow traps and seines for documenting the presence of various fish species in streams. In all samples, significantly greater numbers of individuals, species, and families were captured using seines as compared to minnow traps. However, the relative proportions of specific families captured by each method differed, with seines being more effective at capturing minnow species, and traps being more effective at capturing species in the sunfish/bass and catfish families. Youth Partners also found that susceptibility to capture by each method varied within species of sunfish/bass, with bluegills and largemouth bass more effectively sampled with seines, and traps more effectively capturing green sunfish and redbreast sunfish. Youth Partners concluded that seining is a more effective method of documenting general fish population characteristics in small streams, while minnow traps may be effective when exploring questions concerning specific sunfish and catfish species.

### Assessing the Presence of Estrogenic Chemicals with Sentinel Fish

***W. Gregory Cope, Gerald A. LeBlanc*** *(Department of Environmental and Molecular Toxicology, NC State University, Box 7633, Raleigh, NC 27695)*

***Larry McMillan*** *(Public Utilities Department, City of Raleigh, P.O. Box 590, Raleigh, NC 27602)*

***Scott L. Van Horn*** *(NC Wildlife Resources Commission)*

Recent studies have shown that some chemicals found in the environment associated with municipal and industrial wastes and agricultural activities can mimic the activity of natural hormones such as estrogen. The ubiquity of these estrogen-like chemicals in the environment has raised concern that humans may be exposed through their drinking water and/or food supplies and may result in a variety of ailments ranging from breast cancer to learning dysfunction. Likewise, the potential for these estrogen-like compounds to cause adverse effects on fish and wildlife populations has been documented. Because of the direct and indirect linkages between environmental conditions and human health, wildlife species can serve as valuable sentinels of pollutants that may ultimately affect human health. We used the common carp *Cyprinus carpio* to evaluate the presence of estrogenic chemicals in Falls Lake, the drinking water supply reservoir for the City of Raleigh, North Carolina. Resident carp (n = 37) were collected from four sites in Falls Lake and samples of blood from each fish were analyzed for the egg yolk precursor protein vitellogenin by enzyme-linked immunosorbant assay (ELISA). Because vitellogenin is usually produced in the liver of female fish (induced by the estrogen 17β-estradiol) at concentrations two to three orders-of-magnitude greater than those in male fish, the detection of elevated vitellogenin in the blood of male fish is diagnostic of exposure to estrogenic chemicals. Mean plasma vitellogenin concentrations were 0.025 mg/mL in male fish and 10 mg/mL in female fish and were consistent with the concentrations expected in normal, sexually mature male and female fish of the species. Moreover, there were no significant differences in plasma vitellogenin among fish of the same sex sampled at the different sites (ANOVA, $p > 0.05$). These results indicate that carp sampled from Falls Lake were not exposed to estrogenic chemicals. The measurement of vitellogenin in carp with the ELISA technique used in this study was a sensitive biomarker of potential exposure and would be a useful tool for assessing the presence of estrogenic

chemicals in other aquatic systems in the state because of the carp's wide distribution and relative ease of collection.

**Fishing and Natural Mortality of Reservoir Striped Bass**

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Having a reliable estimate of fishing and natural mortality is important for effective management of exploited fish populations. Unfortunately, mortality estimation can be difficult, and differentiating between sources of mortality can present an even bigger challenge. This study uses telemetry data to estimate fishing and natural mortality rates for striped bass (*Morone saxatilis*) in Badin Lake, a reservoir in the central piedmont of North Carolina. The fates of fish tagged with sonic transmitters in early spring of 2002 and 2003 were determined during biweekly searches. Fish remaining stationary for successive search occasions were assumed to have died of natural causes while those disappearing from the reservoir were assumed to have been harvested. Models that grouped search occasions to estimate mortality over longer time periods, such as quarter or year, provided the best fit to the data. In 2002, the total instantaneous mortality rate was estimated as 0.7, with the largest contribution coming from fishing mortality (instantaneous fishing mortality rate: 0.65). Fishing mortality was greatest in the spring, but this pattern was not consistent between years. In 2003, fishing mortality was greatest in the summer and fall, although the magnitude of mortality over the year appears similar to 2002.

**Effects of Age-1 Striped Bass Predation on *Alosa* spp. in Western Albemarle Sound**

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Historically Albemarle Sound supported large fisheries for adult river herring (*Alosa pseudoharengus, Alosa aestivalis*) and American shad (*Alosa sapidissima*). Estimates of adult stocks and juvenile recruitment indices for these species have experienced marked declines in recent years. Stock estimates for striped bass (*Morone saxatilis*) have increased 8-fold for the Albemarle Sound-Roanoke River stock since the early 1990s. We are quantifying the predatory impact of age-1 striped bass on juvenile *Alosa* spp. during the summer and fall of 2002 by comparing estimates of total loss rates of *Alosa* spp. to age-1 striped bass predation rates. Striped bass and *Alosa* spp. samples were obtained from 245 beach seine and 63 purse seine hauls from May through October 2002. Catches of American shad were an order of magnitude higher in beach seine than purse seine, with blueback herring showing the opposite pattern. Juvenile *Alosa* spp. were present in age-1 striped bass diet in all months but showed a marked increase from May to October (4 to 64 % by weight). Age-1 striped bass consumption rates were determined from 24-hour gut fullness data and bioenergetic modeling. The results from this study should be useful to managers of river herring and striped bass stocks in Albemarle Sound.

**Blueback Herring Piscivory and Ovivory in Hiwassee Reservoir, NC**

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The invasion of blueback herring *Alosa aestivalis* into Hiwassee Reservoir has raised concerns due to negative impacts of river herrings *A. spp.* on reservoir fisheries in other states. We hypothesized that the spatial and temporal overlap between blueback herring, and gamefish larvae and eggs during spring spawning activities could encourage piscivory and ovivory. We collected blueback herring from two tributaries that historically have been used by spawning runs of walleye *Stizostedion vitreum* and white bass *Morone chrysops*, and timed our sampling to coincide with spring spawning activities. Ovivory occurred in a 19 day period (April 17-May5) in both tributaries and in 55.6% and 32.9% of the diets from Hanging Dog Creek and Hiwassee River respectively. The majority (> 98%) of the 11,028 identified eggs were white bass eggs. Piscivory was rarely observed during this study. Although larval fish predation has been suggested as a mechanism by which river herring may reduce reservoir game fish populations, we found little evidence of larval fish predation by blueback herring in Hiwassee Reservoir during spring spawning activities. However, this study has shown that the predation of blueback herring on fish eggs may be a mechanism by which blueback herring could influence gamefish recruitment.

**CONTRIBUTED PAPERS**
**SESSION 4**

**Moderator: Alesia Read** **February 5, 2004 from 9:45 am to 11:00 am**

**Post-Stocking Survival of Phase-I Fingerling Striped Bass**

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Striped bass (*Morone saxatilis)* fisheries in reservoirs are primarily sustained with annual stockings of juvenile fish. To better develop management objectives and transport techniques, we evaluated the 24-h post-stocking survival of phase-I striped bass fingerlings in three upper Catawba River reservoirs during two successive stocking years. In 2002, survival rates decreased as transport time increased which correlated with total ammonia level accumulation during transport and acclimation water pH levels. Survival rates ranged from 94.3% to 71.9% in 2002. In 2003, total ammonia levels were reduced in the final stocking location tank through a water exchange at the initial stocking location. Survival rates in 2003 ranged from 98.0 to 95.0. Results of this study indicate that water exchange during transport of striped bass fingerlings will mitigate for water quality issues associated with long transport times.

**Short-term Impacts of Hurricane Isabel on Fish Communities in Northeastern North Carolina**

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***Kevin Dockendorf** (NC Wildlife Resources Commission, 1503 Emerald Lake Circle - APT 301, Elizabeth City, NC 27909; 252/335-9898; dockendorfkj@earthlink.net)*

North Carolina's northeastern coastal rivers, previously supporting popular multi-species recreational fisheries, suffered disastrous effects from Hurricane Isabel on September 18, 2003. The influx of high BOD organic matter resulted in widespread hypoxia and extensive fish kills in the Roanoke, Chowan and Pasquotank river basins. Approximately 700 km of shoreline habitats were affected. We electrofished six rivers after dissolved oxygen levels had recovered (3-4 mg/L) to compare pre- and post-hurricane survey

data. Our findings suggest significant mortality and/or displacement of fishes has occurred, with the fish communities in some areas now dominated by eastern silvery minnow and bowfin. In the Roanoke River near Jamesville, the number of fish species collected declined from 33 to 16 after the storm and those remaining showed signs of stress (sores, poor body condition). Catch per unit effort for adult largemouth bass declined from 40 fish/h electrofishing before Hurricane Isabel to 0 fish/h afterwards. Similar declines in gamefish abundance were observed in the Chowan and Pasquotank river basins. Recovery strategies are being formulated, and will include stocking fingerling largemouth bass and bluegill. Post-hurricane sampling will continue in the spring and summer of 2004.

**Striped Bass Habitat Selection in Badin Lake, North Carolina**

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Striped bass *Morone saxatilis* have been introduced in reservoirs across the southeastern United States for over 30 years with mixed results. While many populations have flourished and provide excellent angling opportunities, others have struggled to become established; mainly as a result of poor forage availability, or the combination of high water temperatures and low dissolved oxygen (DO). As part of a larger study to investigate this problem, we implanted and tracked 71 Badin Lake striped bass with ultrasonic tags over a 2-year period, including 39 fish with temperature-sensing tags, and 37 with continuously recording temperature and depth archival tags. During the habitat limited summer period, striped bass consistently occupied deeper water midday and moved shallow after dusk. Seasonally, fish preferred water temperatures in the 19°C to 21°C range as DO levels allowed, and avoided temperatures greater than 25°C, when possible. When DO levels dropped below 2.0 mg/l in the cooler, deeper water, fish were tolerant of water temperatures between 27°C and 30°C for up to 2 months that provided sufficient amounts of oxygen. These results indicate that striped bass stocked in southern reservoirs are tolerant of higher summer temperatures than previously thought, provided suitable DO levels exist.

**Assessment of Oxytetracycline Marks on American Shad Stocked in the Roanoke River**

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Declines in anadromous fish stocks have warranted numerous restoration efforts along the Atlantic coast, including stocking American shad (Alosa sapidissima) in coastal North Carolina. Since 1998, hatchery-reared American shad fry have been stocked in the upper Roanoke River to supplement native reproduction. Number of fry stocked annually ranged from 481,000 in 1998 to just over 2,000,000 in 2003. Using techniques developed by Mike Hendricks of the Pennsylvania Fish and Boat Commission, we evaluated oxytetracycline (OTC) mark retention on hatchery-reared American shad fry and assessed the presence of OTC marks in juvenile American shad collected in the Roanoke River from 2001 to 2003. Fry were marked with single, double, or triple OTC mark specific to the stocking year and location. Beginning in 2001, subsamples of American shad fry were examined before stocking to validate retention of the assigned OTC mark. Retention of an OTC mark within each subsample was high; percent retention varied annually 92-100%. Single mark retention was > 98% for all samples. However, double and triple mark identification was less reliable and more variable (14-66%); therefore our ability to identify the stocking location is limited. A total of 142 juvenile American shad were collected in the fall on the lower Roanoke River between 2000 and 2002. Otoliths removed from 140 juvenile shad were ground to a thin section and checked under UV light for an OTC mark. Two of the 117 juvenile American shad collected in 2002 were

OTC marked but no marked juveniles were collected in 2000 (N=4) or 2001 (N=19). Continued use of the OTC assessment techniques is vital to the American shad restoration program in North Carolina. In addition, advancements in multiple mark techniques (e.g., increase the time between double marks) and sampling protocol (e.g., increase sampling during juvenile outmigration) may enhance American shad restoration assessment.

**Changes in Walleye Abundance, Growth, and Recruitment Following a Blueback Herring Invasion**

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Blueback herring *Alosa aestivalis* were first collected from Hiwassee reservoir in 1997. Their recent appearance has raised concerns due to negative impacts of a similar species, alewife *A. pseudoharengus*, on walleye *Stizostedion vitreum* recruitment in Tennessee reservoirs We began monitoring the Hiwassee Reservoir walleye population with annual bottom-set gillnet surveys in the fall of 2000, and aged all walleye collected using sagittal otoliths. The successive annual surveys allowed us to track the abundance, mortality, and growth of walleye year classes through time. In addition, we used mortality estimates and catch rates to back-calculate estimates of walleye recruitment. Due to low catch rates of recent year classes and sampling variability, estimates of annual mortality rates could only be calculated for the 1996-1998 cohorts and ranged from 32-43%. Total length at age has increased for each consecutive year class. Walleye recruitment declined and then nearly ceased following the blueback herring invasion. The 1996 cohort was approximately four times larger than the 1997-1999 cohorts, and recruitment has essentially failed since 2000. In response to recruitment failure, we recommend experimental stocking of OTC marked walleye in Hiwassee Reservoir in 2004.