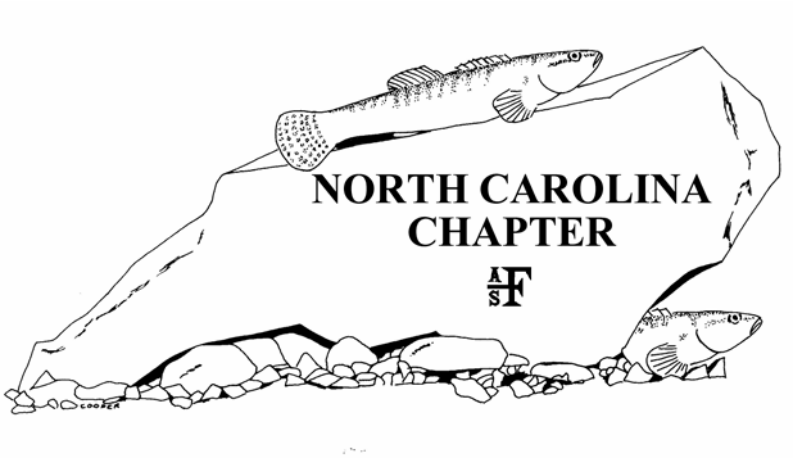
North Carolina Chapter
American Fisheries Society



2008 Annual Meeting
Program

February 18 – 20, 2008

City Hotel
Greenville, North Carolina

Meeting Support Provided By:

Duke Energy®

Progress Energy

2008 Annual Meeting – North Carolina Chapter American Fisheries Society
City Hotel, Greenville, North Carolina
February 18 – 20, 2008

Monday, February 18, 2008

3:00 – 6:00 Registration

6:00 – 8:00 **Welcome Reception**

Tuesday, February 19, 2008

8:00 – 1:00 Registration

8:00 – 10:00 **Continuing Education Short Course**: *Fish Consumption Advisories: Sampling to Implementation*

10:00 – 10:20 Break

10:20 – 12:00 **Continuing Education Short Course**: *Fish Consumption Advisories: Sampling to Implementation*

12:00 – 1:00 Lunch

1:00 – 1:10 **Welcome and Introductions**
Kent Nelson, North Carolina American Fisheries Society President

Technical Session I
Moderator: Vann Stancil

1:10 – 1:30 Monitoring the effects of stream restoration activities on trout in two western North Carolina streams.
Kevin Hining *North Carolina Wildlife Resources Commission*

1:30 – 1:50 Dillsboro Dam: removal plans and challenges for fish and mussel restoration at the Tuckasegee River.
Mark A. Cantrell *U.S. Fish and Wildlife Service*

1:50 – 2:10 Catawba River Habitat Enhancement Program.
Hugh Barwick *Duke Energy*

2:10 – 2:30 North Carolina trout angler opinion survey.
Doug Besler and Mallory Martin *North Carolina Wildlife Resources Commission*, and Mark Duda *Responsive Management*

2:30 – 2:50 More than just striped bass: a year-long survey of the Roanoke River recreational fishery.
Jeremy W. McCargo, Kevin J. Dockendorf, and Chad D. Thomas *North Carolina Wildlife Resources Commission*

2:50 – 3:10 Lake Norman recreational angling survey.
Brian J. McRae and Christian T. Waters *North Carolina Wildlife Resources Commission*

3:10 – 3:30 Break

Technical Session II
Moderator: Reid Garrett

3:30 – 3:50 Where are they now? 2007 mussel distribution surveys in the upper Yadkin River.
Brena Jones and Ryan Heise *North Carolina Wildlife Resources Commission*

3:50 – 4:10 The distribution of darters (Percidae) in Mecklenburg County, North Carolina.
Anthony J. Roux *Mecklenburg County Water Quality Program*

4:10 – 4:30 The fish community of Paddy Creek, 1922 – 2007.
Bryn H. Tracy *North Carolina Division of Water Quality*

4:30 – 4:50 Ten year monitoring plan for the spotfin chub in the Little Tennessee River, North Carolina 2007 progress report.
T. R. Russ *North Carolina Wildlife Resources Commission*

4:50 – 5:10 Status assessment of the Carolina madtom.
Chris J. Wood *North Carolina Wildlife Resources Commission*

5:10 – 5:30 Puerto Rico stream fishes: sampling, distribution, and influential factors.
Patrick B. Cooney, Thomas J. Kwak, Christin H. Brown, and Kenneth H. Pollock *North Carolina State University*, and Craig G. Lilyestrom *Puerto Rico Department of Natural and Environmental Resources*

6:30 – 10:00 **Dinner/Social and Raffle**

Wednesday, February 20, 2008

Technical Session III
Moderator: Win Taylor

8:00 – 8:20 The feeding ecology of juvenile white and yellow perch in a coastal oligohaline estuary.
Jason Clermont[1] and Anthony S. Overton *East Carolina University*

8:20 – 8:40 Fishery management and tag-return estimates of fishing mortality: an example in the NC southern flounder fishery.
William Smith[1] and Fred Scharf *University of North Carolina Wilmington*, and Joseph E. Hightower *North Carolina State University*

8:40 – 9:00 Effects of temperature and feed energy on the performance of juvenile red drum.
Lance P. Fontaine, Kasey W. Whiteman, Peng Li, Gary S. Burr, Kenneth A. Webb, Jonathan Goff, Delbert M. Gatlin III, and William H. Neill *Texas A&M University*, Kenneth B. Davis *U.S. Department of Agriculture*, and Robert R. Vega *Texas Parks and Wildlife Department*

[1] student presenter

9:00 – 9:20 Habitat and cohort specific growth and mortality of larval river herring in the Tar-Pamlico River, North Carolina.
Nicholas A. Jones[1] and Anthony S. Overton *East Carolina University*

9:20 – 9:40 Use of split-beam sonar to estimate anadromous fish runs in the Roanoke River.
Kevin Magowan[1] and Joseph E. Hightower *North Carolina State University*

9:40 – 10:00 Timing, size, and movement of upstream migrating American eels in the Santee-Cooper basin.
David J. Coughlan *Duke Energy*, and Bill Post and Allan Hazel *South Carolina Department of Natural Resources*

10:00 – 10:20 Break

Technical Session IV
Moderator: Kevin Dockendorf

10:20 – 10:40 Abundance, growth, and mortality of Neuse and Tar River flathead catfish: implications for trophy management.
Justin Homan and Robert D. Barwick *North Carolina Wildlife Resources Commission*

10:40 – 11:00 Black bass in Lake Norman: a changing fishery.
Bryan Kalb *Duke Energy*

11:00 – 11:20 Fall electrofishing as a largemouth bass stock assessment technique in three North Carolina coastal rivers.
Robert D. Barwick *North Carolina Wildlife Resources Commission*

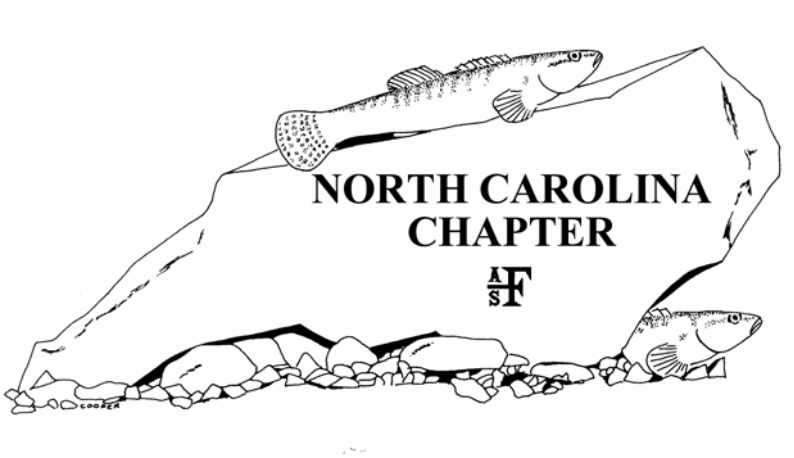
11:20 – 11:40 Assessment of multi-phase largemouth bass stockings in two North Carolina coastal rivers following hurricane-induced fish kills.
Chad D. Thomas *North Carolina Wildlife Resources Commission*

11:40 – 11:50 Break

11:50 – 1:00 **NCAFS Business Meeting**

[1] student presenter

North Carolina Chapter
American Fisheries Society



2008 Annual Meeting
Abstracts

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Monitoring the Effects of Stream Restoration Activities on Trout in Two Western North Carolina Streams

Kevin Hining ***North Carolina Wildlife Resources Commission***
Email: hiningk@charter.net

Stream restoration projects are undertaken primarily to reduce streambank erosion and improve water quality; however, improving fish habitat is often a secondary goal. Despite this, quantitative assessments of restoration projects on stream biota are rare. In an effort to evaluate the impact of stream restoration projects on fish, the North Carolina Wildlife Resources Commission monitored trout populations following restoration work on Sharp and Laurel creeks in Watauga County. The primary objective was to evaluate trends in trout abundance, biomass, and length structure before and after restorations occurred. Streams were sampled one year prior to restoration, and annually for four years after restoration. For both streams, changes in abundance, biomass, and length structure of trout within restored reachs were very similar to changes observed within upstream control reaches. This suggests that variables other than the restoration work (i.e. flow, water temperature, storm events, etc.) were responsible for much of the variation observed. At this time, these restorations do not appear to have improved trout populations within the restored reach of either stream. However, long-term improvements may occur, as both restorations involved the stabilization of several eroding banks and establishment of permanent riparian buffers.

Dillsboro Dam: Removal Plans and Challenges for Fish and Mussel Restoration at the Tuckasegee River

Mark A. Cantrell ***U.S. Fish and Wildlife Service***
Email: Mark_A_Cantrell@fws.gov

In 2007, Federal Energy Regulatory Commission (FERC) issued an Order decommissioning and requiring removal of the Dillsboro Dam. Owned by Duke Energy and licensed by the FERC for production of hydroelectricity, the Dillsboro Dam was constructed in 1913 to supply power to the Blue Ridge Locust Pin Factory. The dam is 12 feet high, 310 feet long and impounds approximately 13.9 acres. It is constructed of concrete at a bedrock shelf at River Mile 31.7 on the Tuckasegee River in Jackson County, North Carolina. Removal of Dillsboro Dam will restore a significant reach of the Tuckasegee River by removal of the impoundment and a barrier that impedes riverine habitats and ecological processes. Dam removal does present some social challenges. Removal of Dillsboro Dam is not without concern or controversy. There are concerns about the potential adverse effects of sedimentation during removal. However, development of a coordinated removal plan can address these concerns.

Duke Energy and natural resource agencies have worked to provide the best science, careful planning, and forthright comparison of benefits to demonstrate to others the need for this action on the Tuckasegee River. The removal of Dillsboro Dam will restore the impounded reach (~5,000 feet), and re-establish a river continuum. The free movement of

aquatic life is a primary objective of dam removal. For comparative purposes, sampling immediately downstream of the Dillsboro Dam yielded 29 species of fishes, considerably more diverse than the impounded reach. There are 19.8 river miles of the Tuckasegee River upstream of Fontana Reservoir. Removal of the Dillsboro Dam next year will allow for the unimpeded access to an additional 9.5 miles upstream to the Cullowhee Dam. Recent fish sampling has shown species missing from the fish fauna upstream of the Dillsboro Dam, including several redhorse species. The endangered Appalachian elktoe is a mussel known from the Tuckasegee River both upstream and downstream of Dillsboro Dam. Removal of Dillsboro Dam and restoration of riverine habitat could provide an additional mile of angling opportunities for native smallmouth bass, rock bass, as well as the very popular "delayed-harvest trout" fishery enjoyed just upstream of the impoundment. Although an additional mile of river habitat does not appear to be much of a benefit for fishing, this is a very popular area, and with adequate access, could provide significant opportunities. The removal of the Dillsboro Dam will also increase opportunities for whitewater boating, by providing a continuous float without portage.

Catawba River Habitat Enhancement Program

Hugh Barwick *Duke Energy*
Email: dhbarwick@duke-energy.com

North Carolina's Habitat Enhancement Program is a cooperative initiative by Duke Energy and the North Carolina Wildlife Resources Commission that was developed during the relicensing of the Catawba-Wateree Hydroelectric Project. This program uses fees charged to property owners who want to build private piers and residential marinas in Catawba River reservoirs along with contributions from Duke Energy to fund the creation, enhancement, and protection of fish and wildlife habitat along the Catawba River. Under this program in 2007, about $40,000 was awarded to 5 projects and an additional $100,000 was tentatively awarded to another. Any tax-exempt organization or any individual working through a tax-exempt organization may apply for funding to enhance habitat along the Catawba River.

North Carolina Trout Angler Opinion Survey

Doug Besler and Mallory Martin *North Carolina Wildlife Resources Commission,* and Mark Duda *Responsive Management*
Email: doug.besler@ncwildlife.org

The North Carolina Wildlife Resources Commission (NCWRC) is interested in the views of its angler constituencies; however, a program-wide opinion survey of our trout anglers was lacking. In May 2007, a telephone survey of 1,504 licensed trout anglers was conducted to document opinions regarding current trout management and potential program changes. Of the estimated 131,055 resident trout anglers in 2006, a majority preferred to fish hatchery supported streams (put-and-take or delayed harvest), on public lands, within a 50-mile radius of their home. Wild waters managed for natural reproduction with restrictive size and creel limits (including catch and release) were the second most preferred type of waters to fish. The most common reason cited for trout fishing was for sport (37%) or relaxation (24%) and only a small minority of anglers (10%) indicated they fished primarily for food. The demographics of the traditional trout angler in North Carolina are changing from a rural resident, with minimal education, that prefers to fish locally for stocked trout to one that resides in the urban piedmont, has a college degree, travels significant distances to fish, and practices catch and release angling for wild trout or stocked trout managed under catch and release regulations. Although angler interest in wild trout fisheries appears to be increasing, relatively few North Carolina anglers are members of organized angling groups, such as Trout Unlimited (8%) or Federation of Fly Fishers (2%), that actively promote wild trout fisheries. As angler constituencies change and license sales remain flat, it becomes increasingly important that management agencies collect, utilize, and implement human dimension information in the administration of their coldwater management programs.

More than just Striped Bass: a Year-long Survey of the Roanoke River Recreational Fishery

Jeremy W. McCargo, Kevin J. Dockendorf, and Chad D. Thomas *North Carolina Wildlife Resources Commission*
Email: jmccargo@roadrunner.com

Since 1989, the North Carolina Wildlife Resources Commission has been conducting annual creel surveys to monitor the largely popular Roanoke River striped bass *Morone saxatilis* fishery. Although these surveys closely document striped bass angling effort, catch, and harvest during the spring fishing season, little is known about fisheries for other recreationally important species in the Roanoke River during other parts of the year. NCWRC personnel conducted a year-long creel survey of Roanoke River recreational anglers from 1 July 2005 to 30 June 2006. Project objectives were to estimate angler effort, catch, harvest, demographics, and trip-related expenditures. During 248 scheduled creel sessions, 1,252 interviews of 2,793 anglers were

conducted. Roanoke River anglers expended an estimated 249,389 angler-hours of effort, caught 364,408 fish, and harvested 103,371 fish during the 12-month creel survey period. Anglers reported catching 23 fish species during the creel survey period. Striped bass was the most sought-after sportfish species, comprising 56.3% of the total estimated effort, and largemouth bass *Micropterus salmoides* also was a popular species, receiving 22.4% of the total estimated effort. Directed effort for striped bass was similar in lower and upper portions of the river and mostly occurred during the spring months, whereas the majority of largemouth bass effort occurred in the lower portion of the river and was distributed throughout the year. More striped bass were caught than any other species, but white perch *M. americana* was the most harvested species. The Roanoke River angling community was composed of anglers from 60 of North Carolina's 100 counties and 7 additional states. The majority of Roanoke River anglers rated their trip satisfaction as good (43.4%), followed by excellent (26.9%), fair (19.7%), and poor (10.0%). Estimated total expenditures for all anglers during the creel period were US$2,545,460, and anglers were willing to spend an additional $1,625,421 for a trip of equal satisfaction.

Lake Norman Recreational Angling Survey

Brian J. McRae and Christian T. Waters ***North Carolina Wildlife Resources Commission***
Email: mcraebj@nc.rr.com

A creel survey was conducted at Lake Norman, North Carolina from 1 September 2006 to 31 August 2007. The primary objectives of this survey were to estimate angling effort, catch, harvest, and trip-related expenditures at Lake Norman. Two roving creel clerks travel along a fixed circuit in selected areas of the lake and counted and interviewed both boat and bank anglers. A total of 1,829 interviews were conducted during 410 scheduled creel sessions. Anglers expended an estimated 322,768 angler-h of effort, caught 253,976 fish, and harvested 79,951 fish during the 12-month creel period. Boat-based anglers accounted for 80% of the total estimated effort. Of the fish harvested, 64% were harvested from boat-based anglers who launched from public boating access areas, 28% were harvested from bank anglers, and 8% were harvested from anglers who launched from private access areas. Largemouth bass *Micropterus salmoides* was the most sought-after species receiving 42% of the total estimated effort, while striped bass *Morone saxatilis* and crappie *Pomoxis* sp. received 16% and 10% of the estimated effort, respectively. Estimated trip related expenditures for all anglers during the 12-month creel period were US$4,270,630. These results reaffirm the importance of this fishery to the region and these data will be used to develop a Lake Norman fisheries management plan.

Where Are They Now? 2007 Mussel Distribution Surveys in the Upper Yadkin River

Brena Jones and Ryan Heise *North Carolina Wildlife Resources Commission*
Email: brena.jones@ncwildlife.org

During the summer of 2007, NC Wildlife Resources Commission personnel conducted mussel surveys in the Yadkin River to update knowledge of the abundance and distribution of mussels in this Piedmont river. The study area consisted of a 122-km reach of the mainstem of the Yadkin River from Kerr Scott Dam to the Hwy 421 bridge crossing. A total of 297 individuals of four different native species were found including the state endangered brook floater and the state threatened creeper. Brook floaters represented 14% of the total mussels located throughout the study. There was a clear trend in both species richness and mussel density, showing a peak in the "big bend" of the Yadkin River from Elkin to just downstream of Donnaha. Mussel populations were patchily distributed, but priority species were present in some areas, highlighting areas for future conservation as well as river reaches in need of improvement.

The Distribution of Darters (Percidae) In Mecklenburg County, North Carolina

Anthony J. Roux *Mecklenburg County Water Quality Program*
Email: Tony.Roux@mecklenburgcountync.gov

Mecklenburg County's Water Quality Program (MCWQP) sampled the fish community of the County's streams at 96 sites between 1995 and 1999. The majority of these sites are being resampled on a 5-year rotation. 5 species of darters were found in Mecklenburg County Streams, including the Carolina darter (*Etheostoma collis*), a Federal and North Carolina Special Concern Species. The other darters found in Mecklenburg County are the Fantail darter (*Etheostoma flabellare*), the Swamp darter (*Etheostoma fusiforme*), the Tessellated darter (*Etheostoma olmstedi*), the Piedmont Darter (*Percina crassa*).

The 1990s distribution of these darters in Mecklenburg County Streams was compared to historical data presented in Don Cloutman and Larry Olmsted's 1979 publication *The Fishes of Mecklenburg County, N.C.* Two of the darters, the Swamp darter and the Piedmont darter were not reported to have been found in Mecklenburg County streams prior to 1980, although the Swamp darter was commonly found in the coves of Lakes Wylie and Norman and Mountain Island Lake, reservoirs in the Catawba River adjacent to Mecklenburg County. Recent samples taken have shown that the distribution of several of the species is increasing with the Tessellated darter being found in both Sugar and Little Sugar Creeks, urban streams that had not supported darters since the 1950s.

The fish data collected by MCWQP has shown that the water quality of Mecklenburg County streams has improved over the past 20 years. The species richness in Mecklenburg County streams has generally increased, especially in Sugar and Little Sugar Creeks.

The Fish Community of Paddy Creek, 1922 – 2007

Bryn H. Tracy ***North Carolina Division of Water Quality***
Email: bryn.tracy@ncmail.net

Paddy Creek flows through eastern Burke County in the Catawba River Basin. As a tributary to Lake James, which was built in the late 1910s, Paddy Creek is a typical Eastern Blue Ridge Foothills stream with large cobble, boulder, and bedrock riffles, runs, and high gradient plunge pools. The fish community was first investigated in 1922 by Dr. Robert Ervin Coker, U. S. Bureau of Fisheries, while on vacation and from whence he collected and described a new species of darter. Since then, the fish community has been sampled in the 1950s, 1960s, 1980s, 1990s, and 2000s by graduate students, North Carolina Wildlife Resources Commission fisheries biologists, and by DWQ staff. What have we learned about the fish community over this 85 year period?

Landuse data have painted a picture of a watershed that is ~ 90% forested and ~ 10% pasture and developed. Watershed and habitat scores are in the moderately high range, typical of a regional reference site. The entire watershed is classified by DWQ as Class C, Trout waters and the headwater reaches are managed as Wild Trout Waters by the NCWRC. Water quality impacts should be minimal because specific conductance measurements average < 15 µS/cm. Currently, 24 species are known from the watershed. The abundant and resilient community is consistently dominated by six species, especially the herbivorous Central Stoneroller and the omnivorous Bluehead Chub. Other common species include Rosyside Dace, Margined Madtom, Redbreast Sunfish, and Fantail Darter.

However, the creek and its watershed are not a regional fish community reference site. The community is usually rated only as Good-Fair with diversity metrics scoring low and nutrient enrichment metrics scoring high. Seven of the 12 species collected in 1922 still inhabit the creek, but the Eastern Silvery Minnow, Greenfin Shiner, and Sandbar Shiner and the intolerant Thicklip Chub and Piedmont Darter have not been collected since then. Twelve additional species have been collected since 1922, including the nonindigenous Brown Trout, Smallmouth Bass, and Yellow Perch. The intolerant Highback Chub, Fieryblack Shiner, and Seagreen Darter and other common upper Catawba River basin species, such as the Warpaint Shiner, have never been collected from the creek.

Several anthropogenic and natural stressors are hypothesized as being detrimental to the fish community of Paddy Creek – localized habitat and water quality degradation from poor landuse practices in the middle to lower portion of the watershed; displacement of indigenous species by nonindigenous species; hydrologic extremes exacerbated during the past 10 years; and habitat fragmentation and geographical isolation from downstream recolonization refugia. However, this small 7.5 square mile watershed appears to be an ideal candidate for a stream rehabilitation and fish repopulation project. Simple tasks such as excluding the cattle from the stream and stabilizing and re-vegetating the banks could go a long way in restoring the degraded riparian zones. Ultimately indigenous species could be re-introduced or the community could be managed for a more viable cool water fishery.

Ten Year Monitoring Plan for the Spotfin Chub in the Little Tennessee River, North Carolina 2007 Progress Report

T.R. Russ ***North Carolina Wildlife Resources Commission***
Email: thomas.russ@ncwildlife.org

The ten year monitoring plan to assess the Spotfin chub, *Erimonax monachus*, population in the upper Little Tennessee River began August 2007. Ten sites within the 23 mile (37 km) reach from Franklin Dam to the Fontana Reservoir were selected; within each site, permanent transects were established and semi-quantitative, timed, random searches were conducted. The monitoring protocol strives to meet criteria defined in the species Recovery Plan (USFWS 1983) and upon its completion it will be available as a model for population status assessment range-wide. The primary goals of this study are to: 1) assess spatial and temporal distribution and abundance of Spotfin Chub in the mainstem Little Tennessee River over a 10 year period; 2) provide information to guide management decisions, recovery efforts, and further research; and 3) provide any additional life history and habitat use information as observed. In August, 2007, a total of 333 Spotfin chubs were observed in the Little Tennessee River; the majority of these were found in the lower reaches of the river. On average, number of chubs observed per hour and number of chubs observed per 50 m transect were much higher at the lower five sites than the upper fiver sites, 8.2 versus 0.9 and 3.6 versus 0.8, respectively. The Spotfin chub population appeared low; the total observed average for all 10 sites was 4.6 chubs per one hour snorkel time and 2.2 chubs per 50 m transect. The baseline Spotfin chub data obtained in August 2007 will be beneficial in tracking the population characteristics though time.

Status Assessment of the Carolina Madtom

Chris J. Wood ***North Carolina Wildlife Resources Commission***
Email: chris.wood@ncwildlife.org

The Carolina Madtom, *Noturis furiosus*, is a rare fish endemic to the Tar and Neuse River basins, North Carolina. It is listed as State Threatened and a Federal Species of Concern**.** Surveys over the last two decades suggest a decline in historic populations. We conducted 60 surveys at 30 sites with historical records during the spring and summer of 2007 to assess the status of the Carolina Madtom. Data were compared to records from the 1960s to detect any temporal change in occurrence. We also applied a new method to estimate the proportion of sites occupied (occupancy) and detection probabilities for a subset of sites with the computer software package PRESENCE using repeat detection/nondetection data. Additionally, we examined aspects of the general biology and population structure of the Carolina Madtom (e.g., spawning period, size/age structure, CPUE, ect.). Results indicate a significant temporal change in occurrence in the Neuse River basin (X^2= .30, p<.05). Frequencies of occurrence decreased from .67 (SE=.05) to .13 (SE=.04) between the 1960's and 2007 data. Only one site surveyed in the Neuse River basin displayed a robust

population. There was no significant temporal change in the Tar River Basin (X^2= 19.2, p>.05). Occupancy estimates generated from PRESENCE were similar to observed frequencies of occurrence due to high detection probabilities. Availability of nesting locations was an important covariate in estimates of occupancy. Further investigations are needed to determine if estimating occupancy represents an important state variable for long term, large scale monitoring programs.

Puerto Rico Stream Fishes: Sampling, Distribution, and Influential Factors

Patrick B. Cooney, Thomas J. Kwak, Christin H. Brown, and Kenneth H. Pollock *North Carolina State University*, and Craig G. Lilyestrom *Puerto Rico Department of Natural and Environmental Resources*
Email: tkwak@ncsu.edu

Puerto Rico is known for its marine fisheries, but the freshwater habitats of the island also support a substantial number of fishes with fishery values. We conducted research in Puerto Rico streams to (1) evaluate stream fish sampling techniques and develop a standardized protocol, (2) obtain population estimates for stream fishes, and (3) describe patterns in fish populations as related to physical habitat at multiple scales. Electrofishing was much more efficient than seining for sampling stream fishes. Among mark-recapture and removal models, we found a three-pass removal procedure and model to be the most precise relative to practicality for estimating population parameters. Influential environmental parameters on fish catchability were water velocity, stream width, and water conductivity. We proposed a standardized fish sampling protocol employing backpack or barge electrofishing, following a three-pass removal procedure for wadeable streams. We employed this protocol at 81 stream sites to quantify fish and crustacean populations and measured instream and riparian habitat and water quality parameters. We quantified occurrence and density of 24 fish species (10 were native) and 12 crustacean species (11 shrimp and one crab). The most abundant fish species were *Agonostomus monticola* (mountain mullet), *Poecilia orri* (mangrove molly), *Poecilia reticulata* (guppy) and *Sicydium plumieri* (sirajo goby). Mean fish species richness was 5.14 species per site, ranging from one species at three sites to 11 non-native species at one site. Based on our results and habitat measurements at the instream, riparian, and watershed scales, we developed a series of models explaining variation in fish community structure among stream sites and basins. This research is among the most comprehensive to study stream fishes and habitat in Puerto Rico and may facilitate outreach efforts and fishery and ecosystem management to sustain fish communities.

The Feeding Ecology of Juvenile White and Yellow Perch in a Coastal Oligohaline Estuary

Jason Clermont and Anthony S. Overton *East Carolina University*
Email: JJC1222@ecu.edu
*Student presentation

The Albemarle Estuarial System (AES) in eastern North Carolina is a part of one of the largest estuarine systems on the east coast of the United States, and yet the early life history of its resident fishes remains relatively understudied. We examined spatial and temporal feeding habits of juvenile white perch (*Morone americana*) and yellow perch (*Perca flavescens*) in the AES from June through October 2005. The diets of juvenile white and yellow perch were made up entirely of aquatic invertebrates. Copepods were the most numerous prey type in the diet of white perch with the exception of fish sampled from western AES during mid-summer, where cladocerans were numerically dominant. Mysid shrimp and amphipods were the primary source of white perch dietary weight, particularly in late summer and early fall. Juvenile white perch exhibited a marked change in prey with increased size throughout the AES, switching from smaller pelagic prey (e.g. copepods and cladocerans) to larger epibenthic prey (e.g. mysid shrimp and amphipods). Amphipods were the primary source of juvenile yellow perch diet weight, which differs from published data on the diet of juvenile yellow perch in freshwater systems. There was a biologically significant (Schoener's α= 0.61) degree of dietary overlap between larger-sized juvenile white perch (80-100mm TL) and juvenile yellow perch (38-96mm TL). The results of this study provide evidence of possible competitive interactions between white and yellow perch in the AES as white perch alter their forage habits. This is the first study addressing the feeding ecology of juvenile white and yellow perch in the Albemarle Estuarial System, NC.

Fishery Management and Tag-Return Estimates of Fishing Mortality: An Example in the NC Southern Flounder Fishery

William Smith and Fred Scharf *University of North Carolina Wilmington*, and Joseph E. Hightower *North Carolina State University*
Email: wes2316@uncw.edu
*Student presentation

Tag-return programs can generate direct estimates of fishing mortality to compliment traditional indirect approaches that use landings data. Tag-return estimates are relatively unbiased and precise, and with adequate study design, they allow immediate, fine-scale estimates of the temporal and spatial distributions of fishing mortality. A large southern flounder (*Paralichthys lethostigma*) tag-return study was initiated in the New and Neuse Rivers, North Carolina, in order to assess the effects of management changes which were recently enacted to reduce harvest mortality in the fishery. Monthly instantaneous rates of fishing mortality were estimated in each river, after accounting for tag return rate, tag loss,

and tagging-induced mortality, parameters to which the tagging model showed sensitivity. Estimates of annual fishing mortality suggested that the targeted fishing mortality was likely met in 2005 in the New and Neuse Rivers; however, the target was not likely to have been met in all estuaries in 2006. Interannual and interestuary variability in fishing mortality characterized these estimates. The temporal and spatial distributions of fishing mortality illustrate that time and area closures may be an effective tool for reducing statewide fishing mortality. Future NC southern flounder stock assessments can identify the most efficient times and areas for closures by including tag-return estimates of fishing mortality from several estuaries that contribute significant portions of the total annual landings.

Effects of Temperature and Feed Energy on the Performance of Juvenile Red Drum

Lance P. Fontaine, Kasey W. Whiteman, Peng Li, Gary S. Burr, Kenneth A. Webb, Jonathan Goff, Delbert M. Gatlin III, William H. Neill *Texas A&M University*, Kenneth B. Davis *U.S. Department of Agriculture*, and Robert R. Vega *Texas Parks and Wildlife Department*
Email: lpfontaine@dot.state.nc.us

We tested the hypothesis that the growth of fish exposed to high temperatures can be limited by available food energy whereas that of fish exposed to low temperatures can be limited by their metabolic capacity to exploit the available food energy. Under laboratory conditions we evaluated growth (%/d) and marginal metabolic scope (MMS; $L \cdot g^{-1} \cdot h^{-1}$) of juvenile red drum *Sciaenops ocellatus* exposed to two levels of dietary energy, low (LE; ~4.1 kJ/g) and high (HE; ~15.9 kJ/g), and to three temperatures, approximately 19, 25, and 29°C, for a period of 6 weeks. Growth rate and MMS increased with temperature, but only growth rate increased with dietary energy and then only at the higher two temperatures. The simulation model Ecophys.Fish was employed to elucidate experimental results potentially confounded by interactions between fish weight and the controlling effects of temperature on metabolism. The simulated and observed results both showed that performance is enhanced at higher temperatures, especially for fish consuming the HE diet. A subsequent 6-week-long experiment confirmed results for fish fed the two diets at ambient temperature (~26°C) and sought to further resolve responses by examining body condition indices and proximate composition. Additionally, these fish were assayed for differential cortisol response to 15 min of confinement stress. The feed efficiency, hepatosomatic index, intraperitoneal fat ratio, and whole-body fat of fish fed the LE diet were significantly lower than those of fish fed the HE diet, indicating relative energy malnutrition in the LE group. As with MMS, no apparent differential effect of feed energy on the pre- or poststress values of plasma cortisol was observed. These findings support the ideas that red drum obtain greater metabolic capacity when they are exposed to a near-optimal temperature and that their ability to transform that capacity into growth is maximized only when they are provided a nutritious, high-energy diet.

Habitat and Cohort Specific Growth and Mortality of Larval River Herring in the Tar-Pamlico River, North Carolina.

Nicholas A. Jones and Anthony S. Overton *East Carolina University*
Email: NAJ0914@ecu.edu
*Student presentation

We compared instantaneous rates of mortality (M) and growth (G) of larval alewife *Alosa. pseudoharengus* and blueback herring *A. aestivalis* between backwater and mid-channel habitats and among cohorts, in the Lower Tar River, North Carolina. Age was estimated using sagittal otoliths, and was used to back calculate hatch dates and to identify 7-d cohorts. Abundance-at-age and weight-at-age data were used to generate mortality and growth estimates. The physiological mortality rate (M/G) was used to compare recruitment potential between species, between habitats, and among cohorts. Mean Catch-Per-Unit Effort was similar for alewife (28.2 #/100m^3) and blueback herring (26.5 #/100m^3) between April and mid-June. Both species (>90% alewife; blueback herring >80%) were more abundant in the backwater habitats. Instantaneous mortality for both species was higher in the backwater habitats than in the mid-channel habitats. However, instantaneous growth was higher in the backwater habitats than mid-channel habitats for blueback herring (0.156) but higher in the mid-channel habitats for alewife (0.174). Overall, the blueback herring experienced lower recruitment potential (M/G >1) whereas the alewife recruitment potential was greater (M/G <1). There was no clear pattern in cohort-specific M/G ratios for alewife. In contrast, earlier spawned cohorts of blueback herring showed more favorable recruitment potential than later spawned cohorts. Although alewife and blueback herring use similar habitats during their early life history, conditions during our sample period in the Lower Tar River were more favorable to larval alewife.

Use of Split-Beam Sonar to Estimate Anadromous Fish Runs in the Roanoke River

Kevin J. Magowan and Joseph E. Hightower *North Carolina State University*
Email: kjmagowa@ncsu.edu
*Student presentation

Striped bass, hickory shad, American shad, alewife and blueback herring are key anadromous species in the Roanoke River, North Carolina. Striped bass and hickory shad runs are thought to be at or close to all time highs, and both support large recreational fisheries. The American shad population is believed to be extremely low and a substantial restoration program is underway. Alewife and blueback herring populations are also thought to be very low and a moratorium on harvest has been in place since 2007. Fixed location hydroacoustic monitoring of all five species and white perch was done at river kilometer 64 in 2006/2007. In addition to counting upstream migrants with sonar, drift gill netting and boat electrofishing were conducted to estimate weekly species proportions in the mid-channel and shoreline habitat respectively. Daily run-size estimates for each anadromous species were

obtained by applying weekly species proportions from mid-channel and bank habitats to daily counts of upstream migrants. The target species accounted for 85 and 84 % of drift gillnet catches and 29 and 60 % of electrofishing catches in 2006 and 2007 respectively. Conducting fixed-location sonar surveys near the mouth of the Roanoke River for anadromous fish is promising if practical issues in estimating species composition can be addressed.

Timing, Size, and Movement of Upstream Migrating American Eels in the Santee-Cooper Basin

David J. Coughlan *Duke Energy*, and Bill Post and Allan Hazel *South Carolina Department of Natural Resources*
Email: djcoughlan@duke-energy.com

The ability of American eel (*Anguilla rostrata*) to easily access former habitats has been a major focus in the FERC hydro relicensing process. A key component of any restoration effort is knowledge of the timing and size of eels at various locations during their upstream migration. Recent glass eel, elver, and small yellow eel data from three locations (Goose Creek Reservoir, St. Stephen Fish Lock, and Wateree Dam) in the Cooper and Santee rivers were summarized for peak catch and length frequency. An exercise on the possible swimming speed of elvers between two of the locations is presented.

Abundance, Growth, and Mortality of Neuse and Tar River Flathead Catfish: Implications for Trophy Management

Justin Homan and Robert D. Barwick *North Carolina Wildlife Resources Commission*
Email: justin.homan@earthlink.net

Catfish are a popular target species among recreational anglers, and an increasing number of specialized anglers seem to favor trophy catfish regulations. In order to gauge the effects of harvest or size regulations on catfish populations, managers need estimates of abundance, age composition, and growth rates. We sampled flathead catfish stocks in the Neuse and Tar rivers during the summer of 2007 and investigated relative abundance (electrofishing CPUE, fish/h), precision of relative abundance estimates, age, growth, and mortality. We also evaluated the potential impacts of three maximum length limits on the two populations. Mean CPUE in the Neuse River was 30.6 fish/h and 30.4 fish/h in the Tar River. Coefficient of variation of the mean (SE/mean) was low on the Neuse River (0.07) and Tar River (0.19) and appeared adequate for detecting small changes in total fish abundance over time. Total annual mortality was 19% on the Neuse River and 58% on the Tar River. For all age classes in which flathead catfish were collected from both rivers, estimated length-at-age was always higher for Tar River flathead catfish. Furthermore, Neuse River flathead catfish

(age range 1-14) growth slowed among older age classes, while Tar River flathead catfish (age range 0-8) growth was approximately linear throughout the range of ages collected. The combinations of growth and mortality in the Tar and Neuse rivers suggest that trophy regulations intended to protect fish larger than preferred- or memorable-size would be more feasible for the Neuse River. Although Tar River flathead catfish growth is faster, the absence of older fish precludes the effectiveness of high maximum size limits. The proportion of total mortality attributable to natural mortality is unknown for Neuse and Tar River flathead catfish. In order to predict the effectiveness of potential trophy fish regulations, future research should be directed toward quantifying natural mortality.

Black Bass in Lake Norman: A Changing Fishery

Bryan Kalb *Duke Energy*
Email: bryan.kalb@duke-energy.com

Duke Energy biologists have continually monitored the Lake Norman fishery since 1993. The largemouth bass fishery has undergone changes in size structure and recruitment coinciding with the introduction of alewife, blueback herring, white perch, grass carp, hydrilla, and spotted bass. We examine changes in length, weight, age, and growth indices of the black bass fishery and discuss the role of exotic introductions in shaping these metrics. We also discuss hybridization between largemouth and spotted bass and review black bass tournament catch data and angler perceptions of the fishery.

Fall Electrofishing as a Largemouth Bass Stock Assessment Technique in Three North Carolina Coastal Rivers

Robert D. Barwick *North Carolina Wildlife Resources Commission*
Email: bob.barwick@ncwildlife.org

Because conducting largemouth bass stock assessments is limited by staff commitments to anadromous stock restoration efforts during spring in coastal North Carolina, it is important to determine if alternative seasons are appropriate for surveying largemouth bass populations. To address this concern, we evaluated catch, size, and age of largemouth bass (*Micropterus salmoides*) collected during spring and fall from the Neuse, Tar, and Northeast Cape Fear rivers during 2004 and 2005. Our objectives were to compare catch efficiency and population characteristics between seasons to determine if fall electrofishing was a viable alternative to sampling during spring. We documented significant differences in age class abundance between seasons. In four of six seasonal comparisons of cohorts aged 1-3, young fish were better represented during fall, whereas older fish (age 4+) were always better represented during spring. Even though mean fall catch was 32 to 63 percent higher for two of three rivers, we failed to document significant differences in catch suggesting that a loss of fall

sampling efficiency did not occur. The largest differences in size distributions were among small fish as a result of increased contribution by young-of-year during fall. For fish larger than 200 mm TL, no significant differences in size distributions were detected. Thus, we suggest that fall electrofishing is a satisfactory sampling technique for monitoring largemouth bass in North Carolina's coastal rivers.

Assessment of Multi-Phase Largemouth Bass Stockings in Two North Carolina Coastal Rivers Following Hurricane-Induced Fish Kills

Chad D. Thomas ***North Carolina Wildlife Resources Commission***
Email: thomascd@roadrunner.com

Widespread fish kills were observed in North Carolina's coastal rivers following the passage of Hurricane Isabel in September of 2003. An experimental, multi-phase largemouth bass stocking effort was launched in 2004 to determine whether localized population recovery could be achieved. Largemouth bass stockings included the release of 12,000 age-1 (127-200 mm) hatchery-reared, pellet-fed bass in February, 46,000 young-of-year (51 mm) bass in June, and 8,000 advanced fingerlings (102-127 mm) in September. All fish were injected with coded wire tags, held in numbered batches, and scattered within 28 separate 1-km shoreline reaches in the Roanoke and Chowan rivers. Recapture electrofishing was conducted during spring and fall months of 2004-2007. Results confirmed the findings of earlier pilot studies suggesting that stocking 51-mm bass into riverine habitats has no detectable effects. Similarly, the advanced fingerlings provided no significant contribution. Although we recovered 183 bass stocked at age 1, their presence diminished with each recapture event. Electrofishing catch ratios of stocked age-1 bass to wild bass >200 mm were initially high (0.77 in the Chowan River and 0.17 in the Roanoke River), declined to 0.09 and 0.05 in the spring of 2005, and were <0.01 in 2006. Bass stocked at age 1 were often recaptured several km from their original stocking site, and harvest by anglers was observed as the bass recruited to the fishery (356-mm size limit). However, supplemental stockings were ultimately not necessary as we observed three successive strong year classes of wild bass, and consistent increases in catch rates of wild adult bass.