33rd Annual Meeting of the North Carolina Chapter of the American Fisheries Society

&

The North Carolina Freshwater Mollusk Workgroup

Tuesday, May 31st - Thursday, June 2nd, 2022

Morganton Community House
120 N King Street
Morganton, NC 28655

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2022 Meeting of the North Carolina Chapter of the American Fisheries Society and the North Carolina Freshwater Mollusk Workgroup

Tuesday, May 31st — Thursday, June 2nd, 2022

Morganton Community House
120 N King Street
Morganton, NC 28655

Program at a Glance	
Tuesday 31 May	
1000 - 1700	North Carolina Mollusk Workgroup Meeting
1800 - 2130	NC AFS and North Carolina Mollusk Workgroup Evening Social at Fonta Flora Brewing, 317 N Green St, Morganton
Wednesday 1 June	
0800 - 1200	Registration
0800 - 1200	NC AFS Workshop: "*Using Social Science to Foster Sound Management/Conservation*"
1200 - 1330	Lunch – on your own
1330 - 1800	Registration
1330 - 1340	Opening Remarks
1340 - 1410	Plenary Speaker: Todd Amacker, "*Now You See 'Em: Photography as a Conservation Tool*"
1410 - 1557	Contributed Papers - Session #1
1557 - 1620	Afternoon Break
1620 - 1757	Contributed Papers - Sessions #2 and #3
1900 - 2200	Poster Session, Social, Dinner, and NC AFS Raffle
Thursday 2 June	
0800 - 0954	Contributed papers - Session #4
0954 - 1015	Morning Break #1
1015 - 1155	Contributed Papers - Sessions #5 and #6
1155 - 1205	Morning Break #2
1205 - 1252	Contributed Papers - Session #6
1255 - 1430	Lunch – on your own
1430 - 1600	NC AFS Business Meeting

Tuesday, May 31, 2022

TIME	LOCATION
	Morganton Community House
1000 - 1700	North Carolina Mollusk Workgroup Meeting
	Fonta Flora Brewing
1800 - 2130	NC AFS and North Carolina Mollusk Workgroup Evening Social Fonta Flora Brewing, 317 N Green St, Morganton *Sponsored by Duke Energy, Headwaters Engineering, & Dewberry*

Wednesday, June 01, 2022

TIME	LOCATION
	Morganton Community House
0800 - 1800	Registration
0800 - 1200	**NC AFS Workshop**
	Using Social Science to Foster Sound Management/Conservation Kathryn Jewell and Cristina Watkins, Instructors, NCWRC
1200 - 1330	**Lunch** – on your own
1330 - 1340	Opening Remarks - Ryan Heise, NC AFS President, and Andrea Leslie, NC AFS President-Elect
1340 - 1410	**Plenary Session**
	Now You See 'Em: Photography as a Conservation Tool Todd Amacker, https://www.toddamacker.com/
	Session 1: Habitat Alterations, Fragmentation, and Quality - Part I Moderator: TBD
1410 - 1430	**Current Dam Removal Efforts in North Carolina** Chris Goudreau* and Andrea Leslie, NCWRC
1430 - 1450	**Response of Biotic Communities and Habitat in the Watauga River to the Removal of Ward's Mill Dam** Michael Gangloff*[1], Samuel Fritz[2] and Elijah Thompson[1] [1]Appalachian State University, Department of Biology, Boone; [2]Montana State University, Ecology Department, Bozeman, MT
1450 - 1510	**Climbing the Ladder: Taking Steps to Reduce Fragmentation in a Native Brook Trout Stream** Thomas ("TJ") Johnson, NCWRC
1510 - 1517	**Using eDNA to confirm Success of Culvert Removal in the Lower Roanoke River Basin** Chase G. Spicer*, Sara Roozbehi, Erin K. Field, and Aaron J. McCall; East Carolina University

1517 - 1537	**The Impact of Low Head Dams on Fish Community Structure in the Lower Little River** April D. Boggs* and Kyle T. Rachels, NCWRC
1537 - 1557	**Macroinvertebrate Assemblage Assessments as a Measure of Site Quality for Federally Listed Freshwater Mussel Species** Sierra B. Benfield, NCWRC
1557 - 1620	**BREAK** *Sponsored by Jennings Environmental*
	Session 2: Human and Environmental Health and Toxicology Moderator: Mike Perkins
1620 - 1650	**An Update on Harmful Algal Blooms (HABs) Human Health Effects in North Carolina and the Southeastern US** Richard (Rick) W. Smith, Duke Energy
1650 - 1657	**An Examination of Changes to Water Chemistry and the Distribution of Sensitive Aquatic Biota in Southern Blue Ridge Streams** Hannah Woodburn*[1], Michael Gangloff[1], and Gary Pandolfi[1,2] [1]Appalachian State University, Biology Department, Boone; [1, 2]U.S. Fish & Wildlife Service, Austin, TX
1657 - 1717	**Assessing the Toxicity of Sea Salt to Freshwater Mussels: Implications for Sea Level Rise in Coastal Rivers** Joseph K. McIver II*[1], W. Gregory Cope[1], Thomas J. Kwak[2,], Ryan Boyles[3], Amy Maynard[4], Andrew Glen[5], Brian Watson[6], and Michael Fisk[5] [1]Department of Applied Ecology, NCSU; [2]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, NCSU; [3]U.S. Geological Survey, Southeast Climate Adaptation Science Center, Department of Applied Ecology, NCSU; [4]Virginia Department of Wildlife Resources, Charles City, VA; [5]North Carolina Wildlife Resources Commission; and [6]Virginia Department of Wildlife Resources, Forest, VA
	Session 3: Ichthyological Histories Moderator: Todd Ewing
1717 - 1737	**Tapping into the Hidden Sources of Historical Information in North Carolina** Luke Etchison, NCWRC
1737 - 1757	**Re-tracing Edward Drinker Cope's Travels Through North Carolina and His Contributions to North Carolina Ichthyology** Bryn H. Tracy*[1] and Robert E. Jenkins[2] [1]Apex and [2]Roanoke College, Salem, VA
1757 - 1805	Closing Remarks - Ryan Heise & Andrea Leslie

1900 - 2200	**Poster Session**
	Effect of Forest Cover Change in the Upper Little Tennessee River Basin on Fish Index of Biotic Integrity Victoria Annas*[1], Adam Mottershead[2]*, Keith Gibbs[2], and Bill McLarney[3] [1]Department of Biology, WCU; [2]Department of Geosciences & Natural Resources, WCU; and [3]Mainspring Conservation Trust
1900 - 2200	**Social, Dinner, and NC AFS Raffle** *Sponsored by Wildlands Engineering and Three Oaks Engineering*

Thursday, June 02, 2022

TIME	LOCATION
	Morganton Community House
0800	Registration
	Session 4: Aquatic Species - Surveying and Propagating Imperiled Species and Discovering and Naming New Species Moderator:: Rick Smith
0800 - 0820	**Using Presence/Absence Data to Monitor Populations Across a Watershed - A Modeling Approach Comparing Single *vs*. Multiple Surveys** Todd Ewing, Southeast Aquatics Resource Partnership
0820 - 0840	**Cape Fear Shiner Surveys and Species Status Assessment (SSA)** Brena Jones[1] and Sarah McRae*[2] [1]NCWRC and [2]U.S. F&WS
0840 - 0847	**Host Fishes of Two Freshwater Mussels: the Appalachian Elktoe, *Alasmidonta raveneliana,* and the Longsolid, *Fusconaia subrotunda*** Rebekah L. Ewing, ASU
0847 - 0854	**Assessing Propagated Freshwater Mussel Health by Monitoring Multiple Environmental Quality Parameters in the Cheoah River, NC** Chantelle Rondel*[1], Luke Etchison[1], and Rachael Hoch[2] [1]NCWRC, Aquatic Wildlife Diversity Program, Waynesville; and [2]NCWRC, Marion Conservation Aquaculture Center, Marion
0854 - 0914	**Broodstock Collection, Juvenile Propagation, and Release of the Federally Endangered Carolina Madtom, *Noturus furiosus,* into the Upper Tar River Basin** Robert Adams, NCWRC

0914 - 0934	**Crayfishes of North Carolina: Recent Research and Future Directions** Michael A. Perkins*[1], Todd D. Ewing[2], and Bronwyn W. Williams[3] [1, 2]NCWRC and [3]NCSM
0934 - 0954	**What's in a Fish Name and When to Change It?** Bryn H. Tracy, Apex
0954 - 1015	**BREAK** *Sponsored by SEPI*
	Session 5: Habitat Alterations, Fragmentation, and Quality - Part II Moderator: Jennifer Archambault
1015 - 1035	**Aquatic Habitat Restoration: Blending Science, Collaboration and Vision to Meet Conservation Goals** Scott Loftis, NCWRC
1035 - 1055	**Mitigating Impacts of Beaver Activity in Critical Dwarf Wedgemussel, *Alasmidonta heterodon,* Habitat Using Clemson Pond Levelers** Michael Walter, NCWRC
1055 - 1115	**Harris Lake Habitat Enhancement and Reservoir Changes Through the Years** David Belkoski* and Mark Fowlkes, NCWRC
	Session 6: Management of Nonnative and Native Fish Species Moderator: Ben Ricks
1115 - 1135	**Advanced Bluegill Stockings as an Integrated Pest Management Tool for Biocontrol of Common Carp at Lake Mattamuskeet** Kevin J. Dockendorf, NCWRC
1135 - 1155	**Little Lake Norman: Black Bass Population Characteristics Following the Illegal Introduction of Alabama Bass into Moss Lake, North Carolina** David W. Goodfred* and Chris J. Wood, NCWRC
1155 - 1205	**BREAK** *Sponsored by SEPI*
1205 - 1225	**Analysis of B. Everett Jordan Lake Largemouth Bass Mortality and Catch-at-Age Trends, 1989-2016** Seth Mycko, NCWRC
1225 - 1232	**Status of Blueback Herring in the Neuse River, 2021** Todd D. VanMiddlesworth* and Benjamin R. Ricks, NCWRC
1232 - 1252	**GRTS: An Integrated Survey Design and Analysis Toolkit for Spatially Balanced Fisheries Surveys** Kyle T. Rachels* and April D. Boggs, NCWRC
1252 - 1255	Closing Remarks - Ryan Heise & Andrea Leslie
1255 - 1430	**LUNCH** – on your own
1430 - 1600	NCAFS Business Meeting
1600	Closing Comments and Adjournment, Andrea Leslie, 2022 NC AFS President

2021-2022 NC AFS Officers and Committees

OFFICERS

President: Ryan Heise
President Elect: Andrea Leslie
Secretary/Treasurer: Casey Joubert
Past President: Ben Ricks

COMMITTEES

Awards
Co-Chairs: Greg Cope and Corey Oakley

Communications
Chair: Kyle Rachels
Members: Webmaster - Brena Jones; Facebook Administrator - Kevin Dockendorf; Newsletter Review Members - Brena Jones, Morgan Raley, and Bryn Tracy

Education and Outreach
Chair: Seth Mycko
Members: Kevin Hining, Kyle Rachels, Chris Wood, and David Yow

Finance
Chair: Casey Joubert
Members: Lawrence Dorsey and Joe Hightower

Nominations
Chair: Ben Ricks

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Chair: Kevin Dockendorf
Members: Jessica Bauman, Casey Joubert, Neil Medlin, TD Van Middlesworth, Ben Ricks, and Kelsey Roberts

2022 Annual Meeting
Chair: Andrea Leslie
Members: TJ Johnson, Jake Rash, TR Russ, Bryn Tracy, and Chris Wood,

NC AFS Workshop

"*Using Social Science to Foster Sound Management/Conservation*"

Kathryn Jewell and Cristina Watkins, North Carolina Wildlife Resources Commission, Raleigh, NC

North Carolina Wildlife Resources Commission social scientists (Kathryn Jewell and Cristina Watkins) will provide a crash course on social science concepts and tools that we can integrate into our aquatic work, allowing us to design effective educational messages, make better resource management decisions, and foster environmental stewardship – ultimately, pushing the needle towards a net positive for aquatic conservation.

Attendees will learn how to collect and analyze social science data. Real world examples from past projects will be used to demonstrate how social science can benefit traditional population/community surveys. We will only scratch the surface of this discipline, but the workshop should help attendees understand how social science can benefit their work in the future.

"*Now You See 'Em: Photography as a Conservation Tool*"

Todd Amacker
https://www.toddamacker.com/

With all of the challenges facing aquatic biodiversity in the American Southeast, Todd Amacker will encourage attendees to think creatively about how to share their professional work with the public using a variety of storytelling techniques. Though many of his examples take place in the Tennessee River drainage in Tennessee and Alabama, the techniques he employs can be applied anywhere in the world. People can't care about things that they've never seen, and they will never see them unless we show them. Learn how to put the spotlight on aquatic species and their habitats in North Carolina!

Broodstock Collection, Juvenile Propagation, and Release of the Federally Endangered Carolina Madtom, *Noturus furiosus,* into the Upper Tar River Basin

Robert Adams

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Mebane, NC

Carolina Madtom, *Noturus furiosus,* has been declining for decades resulting in an increased effort to combat this decline through conservation efforts. The species is only found in the Neuse and Tar-Pamlico River drainages and has recently been listed as federally endangered. Historically efforts have been primarily focused on habitat restoration, however, recently there has been increased interest in captive propagation as natural recruitment has declined. Broodstock are typically collected in the spring during spawning season with aquarium nets while snorkeling. Sandy Creek in the upper Tar-Pamlico River drainage was selected for broodstock collection. In May 2021, five individuals were captured and transported to Conservation Fisheries Inc. (CFI) in Knoxville, TN for captive breeding. CFI propagated more than 400 individuals during 2021, utilizing broodstock collected from 2018-2021. Captive reared individuals were grown to an approximate length of 5 centimeters. Each fish was elastomer tagged to indicate cohort, and a random selection of 25 fish from each cohort were fin clipped for genetic analysis. From the propagated individuals, 50 of the youngest, smallest individuals remained at CFI for further grow-out, and 90 were transferred to the Conservation Aquaculture Center (CAC) in Marion, NC for additional grow-out. North Carolina Wildlife Resources Commission biologists split the remaining juvenile Carolina Madtoms into Sandy Creek and Fishing Creek in the Upper Tar River basin. Further reintroduction efforts are planned for early 2022 and will involve the release of the additional individuals at the CAC, additional broodstock collections and post augmentation monitoring surveys will be conducted to determine the success of the ongoing augmentations.

Type: Lightning
Student or Professional? Professional
Contact: Robert Adams
Email: robert.adams@ncwildlife.org
Phone: 919-357-0189

Keywords: Carolina Madtom, Captive Propagation, Endangered Species Conservation, Broodstock Collection

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Effect of Forest Cover Change in the Upper Little Tennessee River Basin on Fish Index of Biotic Integrity

Victoria Annas[1]*, Adam Mottershead[2]*, Keith Gibbs[2], and Bill McLarney[3]

*Presenting

[1]Department of Biology, Western Carolina University, Cullowhee, NC

[2]Department of Geosciences & Natural Resources, Western Carolina University, Cullowhee, NC

[3]Mainspring Conservation Trust, Franklin, NC

Our goal was to analyze landscape conversion, specifically from forest cover to agriculture and development over recent years, and its effect on fish index of biotic integrity (IBI). The National Land Cover Dataset (NLCD) was used to tabulate land use change between 2001 and 2019 for multiple watersheds in the Upper Little Tennessee River Basin (ULTRB). Fish assemblages were assessed and IBI scores were calculated by Mainspring Conservation Trust during the same timeframe. We compared forest cover change to average IBI within 30 watersheds in the ULTRB between 2001 and 2019. There was a positive correlation ($R^2 = 0.60$) and significant linear relationship ($p < 0.001$) between forest cover and average IBI. Based on our results, we conclude that fish assemblages are affected by forest cover in watersheds upstream of sample sites. However, our model functioned best with moderately-sized watersheds, whereas sample locations at watershed size extremes did not follow observed linear relationships. Next, we will analyze intra-individual relationships between forest cover and IBI for each sample site by year and determine if land use conversion in riparian zones (100m) differ from results for each watershed in their entirety. Our management recommendations involve maintaining forest cover in least-disturbed watersheds and increasing forest cover in degraded watersheds to improve stream biotic integrity.

Type: Poster
Student or Professional? Student
Contact: Keith Gibbs
Email: wgibbs@email.wcu.edu
Phone: 828-227-3817

Keywords: Landscape Alteration, Biotic Integrity, Forest Cover, Fish Conservation

Harris Lake Habitat Enhancement and Reservoir Changes Through the Years

David Belkoski* and Mark Fowlkes

*Presenting

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Raleigh, NC

Harris Lake is a 4,100-acre reservoir located in Chatham and Wake counties, North Carolina. Due to its proximity to downtown Raleigh, the lake is heavily used for outdoor recreation such as fishing and boating. Harris Lake started undergoing changes between 2016 and 2018 resulting in the loss of dense submerged aquatic vegetation. Fish communities have shifted from a diverse assemblage to being dominated by planktivores such as Threadfin Shad, *Dorosoma petenense,* and Gizzard Shad, *D. cepedianum*. Nutrient dynamics will continue to change as a shift towards algal dominance occurs without the presence of dense native vegetation. Aquatic vegetation is essential to reservoir health and can also provide valuable habitat for sport fish and prey fish. In 2018 the NC Wildlife Resources Commission began a habitat enhancement project with the help of stakeholders such as Duke Energy, Harris Lake County Park, NC B.A.S.S. Conservation, NC Division of Environmental Quality, and multiple angler groups. Key objectives were to address aquatic habitat needs by providing artificial and natural structure (fish attractors and felled shoreline trees) and to establish native vegetation through yearly planting. To date, 780 artificial fish attractors have been installed, the highest number in the state, which includes three shallow water coves inundated with attractors. Additionally, 21 shoreline trees were cut and cabled. Native vegetation, including but not limited to, Water Willow, *Justicia americana*, Spatterdock, *Nuphar advena*, American Lotus, *Nelumbo lutea*, White Water Lily, *Nymphaea odorata*, and American Pondweed, *Potamogeton nodosus*, have been established at 84 sites totaling 0.5 acre. The Commission will continue to plant native vegetation until founder colonies become self-sustaining and will continue working with the public and stakeholder group to identify areas in the lake that need habitat enhancement.

Type: Full
Student or a Professional? Professional
Contact: David Belkoski
Email: david.belkoski@ncwildlife.org
Phone: 910-580-2288

Keywords: Fish attractors, habitat enhancements, native aquatic plant restoration, Harris Lake

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Macroinvertebrate Assemblage Assessments as a Measure of Site Quality for Federally Listed Freshwater Mussel Species

Sierra B. Benfield

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Mebane, NC

Unionid mussels are among the most imperiled groups of organisms in the world. Understanding predictors of imperiled mussel presence is essential in locating wild populations and areas that are capable of supporting them. Episodic degraded water quality events can impact sensitive species and can go undetected, resulting in reaches with quality physical habitat but poor mussel diversity. Typical water quality measurements taken in the field are only a snapshot of current conditions and do not reflect long-term conditions. Biological assessments could provide a more complete measure, acting as a predictor of suitable habitat that may support wild or reintroduced populations of imperiled mussels. Mussels are active members of the benthic community, yet their interactions and associations with other members of the benthos are not fully understood and warrant further research. The objectives of this study are to 1) describe macroinvertebrate assemblages in sites that support rare mussels and sites that do not, and 2) determine if any association between groups of insects (feeding or taxonomic) and rare mussels exists. Benthic macroinvertebrate assemblages were assessed at twelve sites: seven contemporary sites where Tar River Spinymussel, *Parvaspina steinstansana*, are known to occur, and five sites that have good physical habitat but *P. steinstansana* no longer occur. Collections were taken with a Surber sampler, with ten samples from the best mussel habitat and ten from the best macroinvertebrate habitat, as well as a sample taken directly from the valves of live mussels. Sites were compared based on calculated biotic indices and diversity measures. These measures may be used to determine threshold values that could indicate a site capable of supporting *P. steinstansana*. This research will help gain a better understanding of the associations between macroinvertebrates and rare mussels, and allow us to make more informed decisions on future augmentations and surveys.

Type: Full
Student or Professional? Professional
Contact: Sierra Benfield
Email: sierra.benfield@ncwildlife.org
Phone: 336-213-2343

Keywords: Unionida, Macroinvertebrates, Water Quality, Aquatic Ecology, Mussel Conservation

The Impact of Low Head Dams on Fish Community Structure in the Lower Little River

April D. Boggs* and Kyle T. Rachels

*Presenting

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Fayetteville, NC

The Lower Little River, a tributary of the Cape Fear River, was stocked with Spotted Bass, *Micropterus punctulatus,* from 1978 to 1981 in an effort to improve sport fishing opportunities. Records and personal communication from retired fisheries biologists suggest the stocked Spotted Bass may actually be Alabama Bass *M. henshalli*. During July and August of 2021, we sampled 15 sites using a canoe equipped with a Smith-Root Apex electrofisher to assess the abundance and composition of black bass and other fisheries resources of the Lower Little River. We collected 37 Spotted Bass (9.7 fish/h) and 23 Largemouth Bass, *M. salmoides,* (6.1 fish/h) over the course of 3.8 h of electrofishing effort. Spotted Bass were not found upstream of an unnamed and partially breached dam at RKM 64, indicating the dam impedes the upstream migration of Spotted Bass. Largemouth Bass abundance declined downstream of the partially breached dam, suggesting Spotted Bass are outcompeting Largemouth Bass in those habitats. Native catfish (Snail Bullhead, *Ameiurus brunneus*, Tadpole Madtom, *Noturus gyrinus*, and Margined Madtom, *N. insignis*) were not encountered in areas where nonnative catfish were observed. Nonnative catfish were not collected upstream of a low-head dam at RKM 52, indicating the dam may serve to protect vulnerable upstream populations of native catfish. Our results provide a glimpse of the impact that nonnative and invasive species have on native fish populations and the benefit existing dams can have in protecting native fish communities.

Type: Full
Student or Professional? Professional
Contact: April Boggs
Email: april.boggs@ncwildlife.org
Phone: 910-309-0683

Keywords: Spotted Bass, Largemouth Bass, Alabama Bass, Catfish, Dams, Invasive Species

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Advanced Bluegill Stockings as an Integrated Pest Management Tool for Biocontrol of Common Carp at Lake Mattamuskeet

Kevin J. Dockendorf

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Elizabeth City, NC

Advanced Bluegill, *Lepomis macrochirus*, stocking has been found in whole-lake experiments to be an effective biocontrol mechanism because Common Carp, *Cyprinus carpio*, eggs and larvae are a preferred food for Bluegill. At Lake Mattamuskeet (16,187 ha), the overpopulation of Common Carp (2018 estimate of 900,000 Common Carp weighing 4 million pounds) has devasted the submerged aquatic vegetation (SAV) that is integral to migratory waterfowl of the Atlantic Flyway and fish and wildlife resources present at Mattamuskeet National Wildlife Refuge. Common Carp may be considered the “feral hog of shallow water ecosystems” through their behavior to feed upon aquatic bugs in the sediment that uproots the existing vegetation (U.S. Fish & Wildlife Service reports 0% SAV coverage in last five years). This overabundance of Common Carp increases the turbidity and exceeds the capability of the existing population of Bluegill and other predators to limit Common Carp abundance. In March 2022, North Carolina Wildlife Resources Commission staff and local volunteers stocked 175,808 advanced sized Bluegill (2-4 inches) prior to Common Carp spawning with the intent for these Bluegill to prey on Common Carp eggs. Coupled with preventative barriers to keep adult Common Carp out and upcoming biomass removal of adult Common Carp in October 2022, these advanced Bluegill stockings are intended to limit the recruitment of Common Carp by eating their eggs and larvae. These integrated pest management approaches are intended to contribute to the overall goal to significantly reduce the Common Carp biomass at Lake Mattamuskeet and improve the SAV abundance to benefit the lake ecosystem.

Type: Full
Student or a Professional? Professional
Contact: Kevin J. Dockendorf
Email: kevin.dockendorf@ncwildlife.org
Phone: 252-312-6122

Keywords: Bluegill, Biocontrol, Common Carp, Invasive Species, Lake Mattamuskeet

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Tapping into the Hidden Sources of Historical Information in North Carolina

Luke Etchison

North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program,
Inland Fisheries Division, Waynesville, NC

The recent publication, An Annotated Atlas of Freshwater Fishes of North Carolina (Tracy et al. 2020), documented ~236 indigenous fish species from historical and recent collection data in North Carolina. This valuable source of information highlights the need for understanding why data gaps exist and what legacy impacts (e.g. land use) have shaped current species distributions. The digitization of historical newspapers, photos, and archaeological information improves our ability to fill in knowledge gaps for historical land use, habitat availability/loss, and species distributions that were not captured by historical survey efforts. This paper will focus on sources of alternative historical information that can help shape current day management decisions.

Type: Full
Student or Professional? Professional
Contact: Luke Etchison
Email: Luke.Etchison@ncwildlife.org
Phone: 828-476-6137

Keywords: Historical Fish Distributions, Land Use

Host Fishes of Two Freshwater Mussels: the Appalachian Elktoe, *Alasmidonta raveneliana*, and the Longsolid, *Fusconaia subrotunda*

Rebekah L. Ewing

Appalachian State University, Boone, NC

The Appalachian Elktoe, *Alasmidonta raveneliana,* is a freshwater mussel endemic to western North Carolina and Eastern Tennessee. Currently the only known host fishes for this species are the Banded Sculpin, *Cottus carolinae,* and Mottled Sculpin, *C. bairdii*. My study will look to discover additional host fishes for this species, determine if the Appalachian Elktoe is a specialist or a generalist and compare the growth and survival of transformed juveniles from different host fishes. The Longsolid, *Fusconaia subrotunda*, is a freshwater mussel found in the Ohio, Cumberland, and Tennessee river systems. Host fishes for the Longsolid are currently unknown. Additional objectives are to determine what fish act as host for the Longsolid, and successfully rear this species in captivity. Appalachian Elktoe host trials began in March of 2022, and Longsolid host trials will begin in May 2022. Trials are taking place at the Marion Conservation Aquaculture Center in Marion, NC. Eight host fishes are being tested for each species. Fishes are infested at a glochidia concentration of approximately 4000 glochidia/L. They are kept in 8-gallon tanks and will be held until juvenile drop-off ends. Transformed Appalachian Elktoe will be placed in sediment buckets for grow out, while transformed Longsolids will be placed in mucket buckets and sediment buckets. Results are expected summer of 2022.

Type: Lightning
Student or Professional? Student
Contact: Rebekah L. Ewing
Email: ewingrl1@appstate.edu
Phone: 828-368-2871

Keywords: Mussel, Appalachian Elktoe, Longsolid, Host Fish

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Using Presence/Absence Data to Monitor Populations Across a Watershed - A Modeling Approach Comparing Single *vs.* Multiple Surveys

Todd Ewing*[1], Rebekah Ewing[2], and Mike Gangloff[2]

*Presenting

[1]Southeast Aquatic Resources Partnership, Fuquay Varina, NC

[2]Department of Biology, Appalachian State University, Boone, NC

Monitoring changes in occupancy is often considered an efficient, effective means of monitoring population changes that is less costly than monitoring changes in abundance or density. However, the need to conduct multiple surveys per site because of imperfect detection could potentially offset any efficiencies gained by monitoring presence-absence. It may be useful for biologists to know under what conditions single surveys per site would be adequate versus when multiple visits are necessary. Here, we undertook a modeling approach to determine guidelines for when single surveys per site are adequate and when multiple surveys per site are necessary. We used hypothetical data and modeled data under various combinations of initial occupancy, catchability, and sample size to compare how well single surveys per site compare to multiple surveys in correctly categorizing declines. Results show that under many common combinations of catchability, initial occupancy, and sample size, single surveys per site are adequate to accurately characterize population declines. The results of this study can be used to help guide survey effort for future monitoring efforts.

Type: Full
Student or Professional? Professional
Contact: Todd Ewing
Email: todd@southeastaquatics.net
Phone: 984-212-0768

Keywords: Occupancy Modeling, Detection Probability, Status Surveys

Response of Biotic Communities and Habitat in the Watauga River to the Removal of Ward's Mill Dam

Michael Gangloff[1]*, Samuel Fritz[2] and Elijah Thompson[1]

*Presenting

[1]Appalachian State University, Department of Biology, Boone, NC

[2]Montana State University, Ecology Department, Bozeman, MT

Dam removals are a common practice in stream restoration but there have been few long-term studies to document the response of stream biota and their habitats to these changes. Here we describe biological communities and physical habitat conditions encountered during surveys on the Watauga River in Watauga County, North Carolina during summer and fall of 2020 prior to the removal of Ward Mill Dam and following the removal of the dam in summer and fall of 2021. We surveyed fishes, mussels and Eastern Hellbenders, *Cryptobranchus alleganiensis alleganiensis*, and measured in-stream habitat conditions at 10 sites in the Watauga River including five reference sites located upstream of the dam and five downstream sites. As was expected based on prior surveys, no freshwater mussels were found and Eastern Hellbenders appear to be largely restricted to the river's headwaters. Electro-fishing and visual surveys revealed a low to moderate diversity fish community that was largely intact and did not contain any high conservation concern taxa. Fish richness and community structure did not change substantially following the removal of Ward Mill Dam but depth decreased downstream of the former dam site while substrate size and the proportion of fine sediments decreased. Habitat in the formerly impounded reach changed most dramatically and this site is now a relatively high-gradient reach dominated by boulder and bedrock substrates. These conditions may prove to be attractive to Eastern Hellbenders but the low abundance in the middle reaches of the Watauga River may impede colonization of this habitat. Future monitoring is planned for 2022 and will likely continue on an opportunistic basis in subsequent years.

Type: Full
Student or Professional? Professional
Contact: Michael Gangloff
Email: gangloffmm@appstate.edu
Phone: (334)332-1533

Keywords: Stream Restoration, Fish Communities, Eastern Hellbender, Mussel, Substrate

Little Lake Norman: Black Bass Population Characteristics Following the Illegal Introduction of Alabama Bass into Moss Lake, North Carolina

David W. Goodfred[1]* and Chris J. Wood[2]

*Presenting

[1]North Carolina Wildlife Resources Commission, Inland Fisheries Division, Marion, NC

[2]North Carolina Wildlife Resources Commission, Inland Fisheries Division, Morganton, NC

Negative impacts from non-native congener introductions have emerged as an immediate threat to black bass conservation and management. Largemouth Bass, *Micropterus salmoides*, historically comprised the sole black bass fishery in Moss Lake, North Carolina. Alabama Bass *M. henshalli*, were illegally introduced into Moss Lake and were first detected during a 2008 electrofishing survey conducted by the North Carolina Wildlife Resources Commission. Management concerns over the impacts of this introduction to the native Largemouth Bass population encouraged the objective of this study, which was to use annual monitoring to describe black bass population characteristics in Moss Lake after introduction and establishment of Alabama Bass. Since their detection, Alabama Bass rapidly increased in abundance throughout the reservoir, while Largemouth Bass abundance concomitantly declined and reached a low equilibrium, except within cove habitat of the upper reservoir. Although compositionally dominate, Alabama Bass were overall smaller in size and in poorer condition than Largemouth Bass. Alabama Bass mean size exhibited an increasing trend, which correlated to their expanding population. Alabama Bass were smaller than Largemouth Bass at ages 1–2; however, by age 3, growth rates of both species converged and became similar thereafter. Longevity of Alabama Bass appeared to be lower than Largemouth Bass, with corresponding higher annual mortality. Our findings improve understanding of population characteristics changes following the introduction of Alabama Bass to a lentic Largemouth Bass fishery. Fisheries agencies are encouraged to implement preventative and adaptive control measures to both discourage illegal fish translocations and coordinate unified practical management approaches to the ever-present threat of invasive species expansion.

Type: Full
Student or a Professional? Professional
Contact: David W. Goodfred
Email: david.goodfred@ncwildlife.org
Phone: 828-803-6034

Keywords: Alabama Bass, Largemouth Bass, Non-Native Congeners, Population Characteristics

Current Dam Removal Efforts in North Carolina

Chris Goudreau* and Andrea Leslie

*Presenting

North Carolina Wildlife Resources Commission, Habitat Conservation Division, Marion, NC

There are an estimated 26,000 dams in North Carolina ranging in size from small “farm ponds” on headwater tributaries to massive structures on mainstem rivers. These dams have and continue to alter natural stream conditions and processes, including water quality, biological integrity, sediment and wood transport connectivity, and flow regime. Removing dams can be an effective tool for restoring natural conditions, but with so many dams to choose from a strategic approach is critical in focusing limited resources on the highest priority sites.

A dam database (inventory) and barrier prioritization tool (BPT), both developed by the Southeast Aquatic Resources Partnership (SARP), were used to rank dams in the state for possible removal. Metrics used to rank and filter BPT outputs include stream mileage, watershed condition, and removal feasibility, among many others.

Millions of dollars for dam removals have recently become available at the national and state level. The NC Aquatic Connectivity Team, a coalition of many agencies, non-governmental organizations, and stakeholders interested in dam removals, is using the inventory and BPT to identify and remove priority dams. This talk will provide an update on the activities of these dam removal tools and efforts, particularly those lead by the NC Wildlife Resources Commission and Mountain True in the mountain region using a FY 2023 state budget appropriation of $7.2 million.

Type: Full
Student or Professional? Professional
Contact: Chris Goudreau
Email: chris.goudreau@ncwildlife.org
Phone: 828-803-6045

Keywords: Dam Removal, Prioritization

Climbing the Ladder: Taking Steps to Reduce Fragmentation in a Native Brook Trout Stream

Thomas ("TJ") Johnson

North Carolina Wildlife Resources Commission, Inland Fisheries Division, District 7

Habitat fragmentation threatens a myriad of aquatic species. Brook Trout, *Salvelinus fontinalis*, North Carolina's only native salmonid, are not spared from this pervasive issue. In fact, fragmentation exacerbates another common problem for Brook Trout: isolation. The North Carolina Wildlife Resources Commission has initiated an ongoing experimental project in collaboration with the town of Beech Mountain to reconnect disjunct segments of Pond Creek, which is home to a high-value Brook Trout population. There are seven road crossings in the headwaters of Pond Creek. Each crossing utilizes one or more corrugated metal pipes (CMP), and most are total barriers to fish movement. Our project seeks to address the two crossings with the longest upstream segments to generate the greatest possible uplift on the population. The first step in the project was to evaluate baseline fish passage or lack thereof. In summer 2021, prior to any intervention, we marked 48 Brook Trout (98–195 mm TL) with visible implant elastomer and relocated them below the lower focal crossing. A midpoint recapture event was conducted in fall 2021, 120-d post-release, and 16 marked fish (33%) were recaptured upstream of the lower crossing. Of the recaptured individuals, 2 fish (4%) were collected above the upper crossing. An endpoint survey will be conducted in spring 2022. Shortly after the endpoint sample, we will retrofit the existing CMP at the lower crossing with a rubberized fish ladder (Flexi-Baffles) and install a rock cross vane to eliminate the pipe's perch. For the upper crossing, a larger CMP (also fitted with Flexi-Baffles) will replace the existing undersized CMP. Following these modifications, approximately 50 Brook Trout will be collected, marked, and released below the lower crossing, as before. This study will document basic movement patterns among wild Brook Trout, evaluate severity of multiple barriers (CMPs), and assess effectiveness of a novel fish passage product.

Type: Full
Student or Professional? Professional
Contact: Thomas C. Johnson
Email: thomas.johnson@ncwildlife.org
Phone: 828-237-0297

Keywords: Fish Ladder, Brook Trout, Corrugated Metal Pipes (CMP), Flexi-Baffle, Barrier, Fish Passage

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Cape Fear Shiner Surveys and Species Status Assessment (SSA)

Brena Jones[1] and Sarah McRae[2]*

*Presenting

[1]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Creedmoor, NC

[2]U.S. Fish and Wildlife Service, Ecological Services – Southeast Region, Atlanta, GA

The primary goal for the 2020 survey was to provide updated status and distribution information for the federally endangered Cape Fear Shiner (CFS), *Notropis mekistocholas,* to the US Fish and Wildlife Service (USFWS). These data were provided for inclusion in the SSA, ultimately evaluating whether there are any needed changes to management or listing status. Project objectives were to (1) understand the current abundance and distribution of the species and (2) to generate estimates of detection probability for CFS across their range.

The SSA describes the analytical process used by the USFWS to assess the viability of the CFS. During this process, we evaluated the three conservation biology principles of resiliency, representation, and redundancy (or the "3Rs") as they pertain to the species in three stages: 1) During the first stage, we considered CFS life history and the 3Rs to better understand the "needs" of populations and the species to maintain viability. 2) The next stage involved an assessment of the historical and current condition of the species' demographics and habitat. 3) The final stage involved making predictions about future viability while considering the species' responses to anthropogenic and environmental influences that are likely to occur within its range.

Based on our evaluation of the 3Rs, the CFS's current viability, or ability to sustain populations in the wild, while improved since the time of listing, is not currently sufficient for the species to overcome catastrophic events into the future. Improved viability in the future will be reliant on human intervention – by reconnection of habitats via dam removals or passage, through species restoration efforts via captive propagation and augmentation, as well as maintaining adequate water quality and constant vigilance against the spread of invasive species in the upper Cape Fear River basin.

Type: Full
Student or Professional? Professional
Contact: Sarah McRae
Email: sarah_mcrae@fws.gov
Phone: 919-247-9498

Keywords: Cape Fear Shiner, Status Survey, Species Status Assessment, SSA, ESA-Listed Fish Recovery

Aquatic Habitat Restoration: Blending Science, Collaboration and Vision to Meet Conservation Goals

Scott Loftis

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Waynesville, NC

The North Carolina Wildlife Resources Commission has been engaged with state, federal, and non-governmental organizations since the mid 1990's in identifying and conducting aquatic habitat restoration projects. In its infancy, aquatic habitat restoration primarily involved linear stream restoration projects assigned to address stream bank instability and problematic morphological characteristics within the active channel. The science of fluvial geomorphology and a framework to quantify channel form (i.e., pattern, profile, and dimension) laid the groundwork for early restoration practitioners to not only identify and remediate impacted stream segments but also understand channel form and process at the watershed scale. Over the past two and a half decades, aquatic restoration evolved beyond linear stream restoration. To address a broader array of habitat conservation goals, practitioners began targeting aquatic organism passage, floodplain connectivity, and functional uplift of wetlands, riparian buffers and early successional upland habitat types in the restoration design and project implementation process. This presentation will focus on recent aquatic habitat restoration projects with the objective to improve movement of aquatic organisms and connectivity to restored or previously inaccessible habitats. A case study of a large-scale floodplain connectivity effort in Henderson County, NC will highlight restoration methods and techniques used to restore lateral passage of Muskellunge, Esox masquinongy, in the French Broad River to backwater sloughs constructed on the adjacent floodplain. This restoration project tested the hypothesis that Muskellunge and other river fishes would utilize connected off-channel slack water areas for refuge, spawning, and nursery habitats. Completion of this unique approach to aquatic habitat restoration highlights exciting science and speaks volumes to the collaborative involvement that was essential to bring this aquatic habitat restoration vision to reality.

Type: Full
Student or Professional? Professional
Contact: Scott Loftis
Email: scott.loftis@ncwildlife.org
Phone: 828-558-6012

Keywords: Habitat Restoration, Habitat Connectivity, French Broad River, Henderson County

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Assessing the Toxicity of Sea Salt to Freshwater Mussels: Implications for Sea Level Rise in Coastal Rivers

Joseph K. McIver II[1]*, W. Gregory Cope[1], Thomas J. Kwak[2,a], Ryan Boyles[3], Amy Maynard[4], Andrew Glen[5], Brian Watson[6], and Michael Fisk[5]

*Presenting

[1]Department of Applied Ecology, North Carolina State University, Raleigh, NC

[2]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC

[3]U.S. Geological Survey, Southeast Climate Adaptation Science Center, Department of Applied Ecology, North Carolina State University, Raleigh, NC

[4]Virginia Department of Wildlife Resources, Charles City, VA

[5]North Carolina Wildlife Resources Commission, Mebane, NC

[6]Virginia Department of Wildlife Resources, Forest, VA

Freshwater mussels inhabiting coastal rivers can be negatively impacted by water salinization. Rising sea levels, storm surges, and drought are known to alter salinity concentrations in these systems. Sea salt is largely made up of sodium (Na^+) and chloride (Cl^-) ions, forming NaCl, a known toxicant to freshwater mussels. However, sea salt contains other cations and anions, such as potassium, sulfate, and calcium. The collective impact of these ions on freshwater mussel fitness is not clearly understood. Therefore, we conducted acute toxicity tests on early life stages (glochidia and juvenile) of three freshwater mussel species that inhabit Atlantic Slope drainages ((Tidewater Mucket, *Leptodea ochracea* (from a riverine habitat and a lacustrine habitat), Eastern Pondmussel, *Ligumia nasuta*, and Atlantic Floater, *Utterbackiana implicata*)). Glochidia (larvae) and juveniles of each species were exposed to seven concentrations of Instant Ocean® Sea Salt, a synthetic sea salt. These concentrations were 0, 1, 2, 8.5, 12.5, 17, and 34 parts per thousand (ppt). Glochidia underwent a 48-hour acute toxicity test, where viability was assessed at hour 24 and 48. Juveniles underwent a 96-hour acute toxicity test, where viability was assessed at hour 48 and 96. We calculated the median lethal concentration (LC50) for each of the eight acute toxicity tests and found that glochidia were more sensitive than juveniles to Instant Ocean® Sea Salt. LC50s for glochidia at hour 24 ranged from 0.45 to 3.95 ppt, with the most sensitive freshwater mussel being the *Leptodea ochracea* from the lacustrine habitat, exhibiting a LC50 of 0.45 ppt (95% C.I. = 0.39-0.51). Juvenile freshwater mussels exhibited 96-hour LC50s ranging from 5.04 to 7.90 ppt. Our results show that acute exposure to sea salt negatively impacts freshwater mussel viability, specifically glochidia. This information can be used to enhance freshwater mussel conservation strategies in regions that are impacted by seawater intrusion and inundation.

[a]Deceased

Type: Full
Student or Professional? Student
Contact: Joseph K. McIver II
Email: jkmciver@ncsu.edu
Phone: 919-606-9135

Keywords: Freshwater Mussel, Unionidae, Salinity, Sea Level Rise, Salinization

Analysis of B. Everett Jordan Lake Largemouth Bass Mortality and Catch-at-Age Trends, 1989-2016

Seth Mycko

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Mebane, NC

In 2018, Commission biologists compiled and analyzed historical Largemouth Bass, *Micropterus salmoides*, data collected from B. Everett Jordan Lake (Jordan Lake). Preliminary data exploration indicated variable, yet slower, recruitment of younger age classes to the largest size classes of the population. Age/growth analysis remained constant, yet the oldest age class (6-10) strength appeared to increase with time, as Largemouth Bass seemed to be living longer. Additionally, PSD-P values increased between 2004- 2016 from 33.3% to 47.8%. With these indicators in mind, additional analyses were conducted on the catch-at-age patterns within these data to investigate temporal trends in mortality within the population. Log-normalized catch curves were created for each year of data and mortality rates (Z & A) were estimated using regressions of the catch of each curve's descending limb. Estimated rates of annual total mortality (A) were variable (mean = 32.4 ± 4.4% SE). While early visualizations suggested a change in size distribution and mortality over time, with older/larger individuals surviving longer, these additional analyses revealed that significant changes have not occurred over time. Instead, the changes in proportion of older/larger fish are likely due to large scale changes in fish collection methodology and increased capture efficiency of preferred length individuals through time. These analyses confirm that even with perceived increases in angling effort, the Largemouth Bass fishery at Jordan Lake has remained stable with above average population characteristics

Type: Full
Student or Professional? Professional
Contact: Seth Mycko
Email: seth.mycko@ncwildlife.org
Phone: (336)-534-0019

Keywords: Largemouth Bass, B. Everett Jordan Reservoir, Electrofishing, Long-term trends, Catch Curve, Catch-at-age, Mortality, Survival, Population, Stability, Piedmont

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Crayfishes of North Carolina: Recent Research and Future Directions

Michael A. Perkins[1]*, Todd D. Ewing[2], and Bronwyn W. Williams[3]

*Presenting

[1]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Marion NC

[2]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Raleigh NC

[3]North Carolina Museum of Natural Sciences, Raleigh NC

The southeastern United States supports the greatest biodiversity of freshwater crayfish species in the world. Historically, recognition of North Carolina's unique crayfish fauna has been hindered by the prevalence of several wide-ranging species complexes, which likely contain numerous unknown species endemic to the state. Ongoing collaborative crayfish research in North Carolina, conducted by the North Carolina Museum of Natural Sciences (NCSM), state biologists, and universities, has provided many recent and notable findings. In an effort to better understand the state's crayfish fauna, NCSM and the North Carolina Wildlife Resources Commission have sampled more than 700 locations and generated approximately 1000 genetic sequences since 2016 as part of an ongoing statewide crayfish inventory. This research has resulted in updated distribution records that more-accurately reflect conservation status for most named species in North Carolina, as well as the discovery and description of several new species. Currently, 51 crayfish species are known to occur in North Carolina waters, including four invasive species. Most species throughout the state are apparently stable, however several species appear to be in decline; 12 species are currently considered to be species of greatest conservation need, including 6 species that were recently elevated to state-threatened or state-endangered status. Habitat loss and degradation is a pervasive threat for North Carolina's rare crayfish, but the most imminent danger is likely a ubiquitous and ongoing invasion of Red Swamp Crayfish, *Procambarus clarkii*, throughout the Coastal Plain and numerous waterways beyond. Current research needs include investigations of the potential negative effects from invasive crayfish on native populations, taxonomic assessments within species complexes, and filling in ecological and life history data gaps for most species.

Type: Full
Student or Professional? Professional
Contact: Michael Perkins
Email: michael.perkins@ncwildlife.org
Phone: 828-559-7202

Keywords: Crayfish, Crustaceans, Biodiversity

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GRTS: An Integrated Survey Design and Analysis Toolkit for Spatially Balanced Fisheries Surveys

Kyle T. Rachels* and April D. Boggs

*Presenting

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Raleigh, NC

A fundamental tenant of scientific inquiry is ensuring the survey design is sufficient to answer the research or management question. However, traditional survey designs (e.g., Simple Random Sampling, Stratified Random Sampling, and Systematic Sampling) taught in most statistics and fisheries science classes were developed for laboratory or agricultural research and are often difficult to employ in ecological studies, leading to the widespread use of fixed-station and opportunistic survey designs. Several spatially balanced survey designs have been developed specifically for ecological studies, yet they have not been widely adopted. Herein, we propose the Generalized Random-Tessellation Stratified (GRTS) survey design for widespread adoption because it provides balanced spatial coverage of the sampling area, can incorporate non-uniform sampling probabilities (i.e., prior knowledge of the sampling frame), and use of a local neighborhood variance estimator that results in reduced variance compared to designs that assume independence among sample elements. In addition to its superior performance compared to traditional survey designs, it is easily implemented using R package “spsurvey” and commonly available GIS software. Finally, we present case studies in both lotic and lentic systems describing the implementation and analysis of data produced using a GRTS survey design that resulted in less variability in electrofishing catch-per-unit effort compared to a Simple Random Sampling design. Using a GRTS survey design can result in better data, improved knowledge of the population of interest, and eliminate criticisms associated with the use of fixed station and opportunistic survey designs.

Type: Full
Student or Professional? Professional
Contact: Kyle Rachels
Email: kyle.rachels@ncwildlife.org
Phone: 252-548-4938

Keywords: Survey Design, Sampling, Spatial

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Assessing Propagated Freshwater Mussel Health by Monitoring Multiple Environmental Quality Parameters in the Cheoah River, NC

Chantelle Rondel[1]*, Luke Etchison[1], and Rachael Hoch[2]

*Presenting

[1]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Waynesville, NC

[2]North Carolina Wildlife Resources Commission, Marion Conservation Aquaculture Center, Marion, NC

Freshwater mussels are sensitive filter feeders that are directly impacted by water quality and pollutants they are exposed to. Understanding the role that environmental factors have on growth and survival of freshwater mussels is important to consider when performing population risk assessments. In 2004, hurricanes throughout western North Carolina resulted in high amounts of sedimentation within many streams. Surveys for Appalachian Elktoe, *Alasmidonta raveneliana*, in the Little Tennessee River the following year documented an 80% decline in the number of mussels found per person hour. Surveys over the last ten years have indicated that Appalachian Elktoe numbers remain very low. While many factors could be responsible for this crash, no definitive cause has been found. In efforts to recover Appalachian Elktoe in the Little Tennessee River basin, they have been propagated and stocked in the Cheoah River along with three other freshwater mussel species. Since 2012, over 4,500 Appalachian Elktoe have been stocked in the Cheoah, but numbers remain low and there are limited signs of natural reproduction. Additionally, surveys in 2021 found hundreds of shells from fresh-dead Wavyrayed Lampmussel, *Lampsilis fasciola,* suggesting a recent mortality event. To better understand the low success of Appalachian Elktoe and recent decline of Wavyrayed Lampmussel in the Cheoah, we plan to monitor multiple environmental quality parameters and the health of propagated individuals of these species. At all study sites propagated *A. raveneliana* and *L. fasciola* will be placed into both concrete silos and mesh cages. These enclosures will be pulled monthly and individual mussels will be sent for a health analysis. Continuous water quality data will be collected for pH, dissolved oxygen, temperature, and cyanotoxins at each site. This study will provide insight about environmental factors impacting mussel health in the Cheoah River.

Type: Lightning
Student or Professional? Professional
Contact: Chantelle Rondel
Email: chantelle.rondel@ncwildlife.org
Phone: 919-717-9553

Keywords: Appalachian Elktoe, Wavyrayed Lampmussel, Survival of Propagated Mussels, Cheoah River

An Update on Harmful Algal Blooms (HABs) Human Health Effects in North Carolina and the Southeastern U.S.

Richard (Rick) W. Smith

Duke Energy Progress, Environmental Health & Safety Dept., Water Resources Unit, New Hill, NC

Cyanobacteria or blue-green algae blooms are becoming more prevalent, sustained and widespread throughout the southeastern US, as well as the continental US and globally. These blooms may be toxic, but prediction of their toxicity is extremely difficult due to the number of physical, chemical and environmental variables leading to the production of cyanotoxins. Cyanobacteria blooms can pose human health risks, however the reported frequency with which this happens is quite low. Potential serious health risks associated with toxin exposure cannot be ignored and extreme caution should be exercised by anyone working or recreating near any suspected blooms. This talk will discuss some cyanobacteria bloom occurrences in North Carolina, toxins of concern that can be produced and their health effects, and some mitigation and personal protective equipment that can be utilized to minimize risk from exposure.

Type: Full
Student or Professional? Professional
Contact: Richard (Rick) W. Smith
Email: Rick.smith4@duke-energy.com
Phone: 919-801-3842

Keywords: Harmful Algal Blooms, HABS, Cyanobacteria, Blue-Green Algae, Cyanotoxins, Microcystins, Human Health Effects, EPA Recreational Criteria, Southeast U.S.

Using eDNA to confirm Success of Culvert Removal in the Lower Roanoke River Basin

Chase G. Spicer*, Sara Roozbehi, Erin K. Field, and Aaron J. McCall

*Presenting

East Carolina University, East 5th St, Greenville, NC

From Roanoke Rapids Dam to the Albemarle Sound the Roanoke River has 1400 barriers of ecological importance. These barriers have severe negative impacts on water quality and impede fish movements. One barrier is the use of culverts to aid travel through low-lying areas. An area of high priority is located on the Roanoke and Tar River Gun Club. In 2019 with the help of The Nature Conservancy, phase one of restoration began by removing three culverts determined to be of high importance on the property. These culverts were replaced with bridges that restored flow to Ware Gut. By restoring flow to the system and allowing water to drain from the swamps, the risks of fish kills are diminished by eliminating the risk of trapping fish after water levels drop drastically. It also eliminates the risk of harming water quality by holding back water and then discharging of hypoxic water during high water events. Bridges are more beneficial for landowners as they require less maintenance compared to culverts which require frequent cleaning and unblocking. One year after restoration landowners confirmed through their catches that anadromous fish such as Striped Bass, *Morone saxatilis*, and Hickory Shad*, Alosa mediocris*, now have the ability to move through the system once again. This spring using eDNA sampling we confirmed that river herring (Alewife, *A. pseudoharengus,* and Blueback Herring, *A. aestivalis*), threatened anadromous species, can pass through all three restoration sites once again. eDNA levels were measured in nanograms per liter and were highest above the first bridge which is furthest downstream, and concentration lowered at the second and third bridges upstream confirming herring are once again able to reach historic spawning areas. The Nature Conservancy hopes to identify more areas of high ecological importance to remove barriers and restore flows within the lower Roanoke River Basin which we hope to confirm through eDNA counts.

Type: Lighting
Student or Professional? Student
Contact: Chase Spicer
Email: Spicerc21@students.ecu.edu
Phone: 336-984-1781

Keywords: Habitat Fragmentation, Culvert Replacement, Anadromous Fish, River Herring

What's in a Fish Name and When to Change It?

Bryn H. Tracy

Apex, NC

Honorific scientific names have recently received intense scrutiny because societal values have changed. Across disciplines groundswells of support for renaming species have occurred; specifically those named after dishonorable people or with culturally inappropriate common names. Fishes have not been immune to this attention, but changes have come slowly. Now is the time for AFS to confront this controversial topic. The renaming processes can be aided by examining what other organizations have done. First, AFS should develop procedures for renaming species epithets and common names for species named after people who advocated racist and/or sexist views, used derogatory names in their writings, or did reprehensible things. Second, this process should include input from fisheries professionals who have to work with these names within the context of fisheries management, the AFS Diversity, Equity, and Inclusion Committee, and Indigenous peoples. Third, ichthyologists should change how their newly described species are named. As descriptions are written, an opportunity presents itself to name species with names of Indigenous peoples or after people that more closely represent the value sets of our society and profession. North Carolina, with its specious freshwater fish fauna, can serve as an illustrative case study of controversial fish names that warrant this discussion.

Type: Full
Student or Professional? Professional
Contact: Bryn H. Tracy
Email: bryntracy12558@att.net
Phone: 919-518-3923 (c)

Keywords: Scientific Names, Common Names, Changing Controversial Names,

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Re-tracing Edward Drinker Cope's Travels Through North Carolina and His Contributions to North Carolina Ichthyology

Bryn H. Tracy[1]* and Robert E. Jenkins[2]

*Presenting

[1]Apex, NC

[2]Roanoke College, Roanoke, VA

Since 1870, ichthyologists have pondered Edward Drinker Cope's two publications: "*On some Etheostomine Perch from Tennessee and North Carolina"* and *"A Partial Synopsis of the Fishes of the Fresh Waters of North Carolina*", along with letters to his father while traveling in North Carolina. Transcriptions and annotations of these letters were searched for further knowledge regarding his field notebook(s) and original data (meristics, morphometrics, life coloration, etc.) from his travels during Summer and Fall 1869. Insights into who assisted with his collections were not achieved. The loss of some of larger specimens, e.g., *Carpiodes, Ictiobus, and Moxostoma,* lead us to question if Cope hastily wrote some of the descriptions in the field, or wrote them from memory afterwards in his lodging, or did he write them in a field notebook? We did not discover the existence of his field notes.

How was he able to successfully publish his results shortly after his trip? We concluded Cope must have been extremely impatient and consumed by his more important paleontological interests when writing two fish manuscripts within such a short time period. These publications laid a foundation for all ensuing studies of North Carolina's freshwater fish fauna for the past 151 years. Of the 242 described species of freshwater fish in North Carolina, Cope described 45 of them between 1865-1871. Cope described 25 species from North Carolina of which 15 are considered valid. Cope recounted collecting 91 described and undescribed species during his trip and we accounted for all of the species and specimens he had collected. 139 lots, representing 63 species and 943 specimens were subsequently curated at Academy of Natural Sciences of Drexel University, the National Museum of Natural History, and the University of Michigan Museum of Zoology. Various type specimens are represented in 49 lots, with the remaining 89 lots representing non-type specimens.

Type: Full
Student or Professional? Professional
Contact: Bryn H. Tracy
Email: bryntracy12558@att.net
Phone: 919-518-3923 (c)

Keywords: Edward Drinker Cope, North Carolina, Historical Ichthyology

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Status of Blueback Herring in the Neuse River, 2021

Todd D. VanMiddlesworth* and Benjamin R. Ricks

*Presenting

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Greenville, NC

Blueback Herring, *Alosa aestivalis*, in Core and Village creeks, tributaries of the Neuse River, were sampled using boat electrofishing during spring 2021. A total of 179 Blueback Herring were collected. In Core Creek, Blueback Herring weekly CPUE (fish/h) ranged 0.0-63.4 in 2021 and Blueback Herring weekly CPUE (fish/h) ranged 0.0-32.6 in Village Creek during 2021. Mean total length in Core Creek was 262 mm for males and 283 mm for females in 2021 and mean total length in Village Creek was 266 mm for males and 281 mm for females in 2021. Spawning potential ratio analysis for female Blueback Herring increased since monitoring began in 2007. Despite increasing trends in relative abundance, size-structure, and spawning potential ratio, future studies will be needed to evaluate if these increases are indicative of population recovery. Continuation of annual sampling is imperative to monitor population trends and inform management decisions regarding river herring management in the Neuse River.

Type: Lightning
Student or a Professional? Professional
Contact: Todd D. (T.D.) VanMiddlesworth
Email: todd.vanmiddlesworth@ncwildlife.org
Phone: 919-210-4320

Keywords: Blueback Herring, Neuse River, Boat Electrofishing

Mitigating Impacts of Beaver Activity in Critical Dwarf Wedgemussel, *Alasmidonta heterodon,* Habitat Using Clemson Pond Levelers

Michael Walter

North Carolina Wildlife Resources Commission, Inland Fisheries Division, Mebane, NC

The federally endangered Dwarf Wedgemussel, *Alasmidonta heterodon*, has been extirpated from the majority of its range along the Atlantic Slope drainage. Historically, the species ranged from the Petitcodiac River in New Brunswick, Canada, to the Neuse River in North Carolina. However, their current distribution is limited to a small number of remnant populations throughout the Atlantic Slope drainage. Within this range, the native North American Beaver, *Castor canadensis,* has made a remarkable comeback following extirpation from the eastern United States in the late 1800's. Reduced flow, increased temperature and sedimentation upstream and reduced water quality downstream of beaver dams directly threatens several of the last remaining populations of Dwarf Wedgemussel in the Upper Tar River basin in North Carolina. Trapping and dam removal efforts have proven to be effective methods for restoring flow regimes to impounded streams though the benefits of these efforts are often short-lived and expensive. Beavers are observed to recolonize and resume dam building within one year of removal rendering these efforts time intensive and cost prohibitive. Flow through devices such as the "Clemson Pond Leveler" allow water to pass through beaver impoundments and restore flow to the reach. This study aims to explore the use of these devices to mitigate the impacts of beaver dams in reaches where Dwarf Wedgemussels occur. To detect changes in freshwater mussel habitat quality, 10 monthly site visits have been conducted in 2021 to collect physical habitat data and water quality data prior to the installation of the flow through devices. Monitoring visits and data collection will continue following installation of the flow through devices in 2022 to determine their effectiveness as habitat restoration aids in systems where beaver recolonization threatens critical mussel habitat.

Type: Full
Student or Professional? Professional
Contact: Michael Walter
Email: Michael.walter@ncwildlife.org
Phone: 984-227-3017

Keywords: Dwarf Wedgemussel, Beaver, Habitat Restoration, Pond Leveler

An Examination of Changes to Water Chemistry and the Distribution of Sensitive Aquatic Biota in Southern Blue Ridge Streams

Hannah Woodburn[1], Michael Gangloff[1], and Gary Pandolfi[1,2]

[1]Appalachian State University, Biology Department, Boone, NC

[1,2]U.S. Fish & Wildlife Service, Austin, TX

The health of freshwater, which makes up <2.5% of all water on Earth, is becoming increasingly altered by abiotic and biotic factors. The Southern Blue Ridge (SBR) region is among the most biologically diverse region in North America and is home to the forested headwaters of the Tennessee and Ohio drainages. Water quality is dependent on a balance of physical and chemical characteristics which can influence species distribution, alter ecosystem health, and create challenges for resource management. Some of the most vulnerable taxa to changes in water quality include freshwater mussels, amphibians, crayfish, and fish. Changes to land use and other anthropogenic stressors are widely understood to drive alteration of freshwater ecosystems and may be responsible for changes to water quality parameters such as pH, salinity, and specific conductance in SBR streams. We are using long-term water quality and land use change data to examine how these factors are related to changes in the distribution of sensitive aquatic species including several state and federally-listed species within SBR watersheds. Preliminary data suggest that temperature, pH, and specific conductance regimes have changed substantially during the last several decades within the New and Watauga rivers and these trends may shed light on enigmatic declines observed among aquatic taxa in these watersheds.

Type: Lightning
Student or Professional? Student
Contact: Hannah Woodburn
Email: woodburnhc@appstate.edu
Phone: 336-698-6204

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