

2023 WILDLIFE DIVERSITY PROGRAM ANNUAL REPORT



NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

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Cover page clockwise from top left: NCWRC Wildlife Diversity technician, Ben Dalton, cradles an adult Eastern Hellbender that was processed for data collection and PIT-tagging (Appalachian State University). Mike Walter, Eastern Region AWD Biologist and NC State University students swabbing mussels in Swift Creek in Johnston County. Aquatic Wildlife Diversity Biologists work up suckers downstream of Redmon Dam prior to translocation (Luke Etchison). Previous page: Aquatic Wildlife Diversity Biologist, Chantelle Rondel, releases a sucker into the upper French Broad River (Dylan Owensby).; Wildlife Diversity Biologist Katherine Etchison tracking radio-tagged little brown bats. Unless otherwise noted, all photos by NCWRC.

The North Carolina Wildlife Resources Commission's (NCWRC) Wildlife Diversity (WD) Program is housed within the agency's Inland Fisheries (Aquatic Wildlife Diversity) and Wildlife Management divisions. Program responsibilities principally include surveys, research and other projects for nongame and endangered wildlife species. Nongame species are animals without an open hunting, fishing or trapping season.

Program Updates - 2023

The Wildlife Diversity Program experienced staff changes and much progress for listed species in 2023. Dr. Jeff Humphries left the program for other opportunities, and Aubrey Heupel Greene was selected to fill the position. Aubrey came to our program from Florida Fish and Wildlife Conservation Commission and began in November 2023. She will mostly focus on herpetofauna in the central region of NC but will help with other needs too. Another staffing change was the transfer of Kacy Cook from the Habitat Conservation Division to Wildlife Management Division to fill a new waterbird biologist position. Kacy will focus primarily on marsh bird species, including the Black Rail, and long-legged wading bird species such as the Wood Stork.

Two Species Conservation Plans were approved in 2023 – the Bog Turtle Conservation Plan and the Southern Hognose Snake Conservation Plan. Also, the Scientific Council on Birds completed its review of listed bird species and proposed changes to the list, as well as several Technical Corrections. These proposed changes were approved by the Commission, but the final approval will be in 2024.

Wildlife Diversity staff were very successful in publishing their work with our partners (see list at end of report), as well as providing many scientific presentations at meetings and conferences. John Carpenter, our landbird biologist in the coastal region and co-coordinator of the NC Bird Atlas, received the 2023 Biologist of the Year Award from peers within the Division of Wildlife Management. The details of our work with various taxa are outlined in this annual report.

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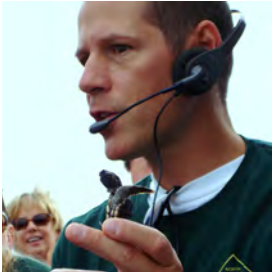


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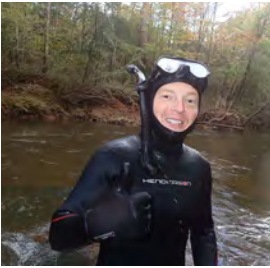
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BIRDS

NC Bird Atlas Enters Its Third Year!

by Scott Anderson, Science Support Coordinator and John Carpenter, Eastern Landbird Biologist

Wildlife Diversity staff continue work on the 5-year Bird Atlas Project. From Hiwassee Lake to Cape Hatteras, volunteers (atlasers) and staff have been scouring fields, forests, and city parks — identifying birds and recording behaviors. These behavior observations will help confirm breeding in each of the 937 survey blocks spread across the state. To date, atlasers have contributed 122,819 checklists, confirming breeding for 203 species. Collectively, these 1,923 atlasers have

made a staggering 5,515,392 species observations since the project started in 2021! In addition to volunteers, each year we hire skilled staff to canvass hard-to-reach corners of the state. These data will be critical to gaining a comprehensive map of distribution and habitat preferences for more than 200 bird species at the end of the project.

Because North Carolina is positioned squarely in the mid-Atlantic region, many bird species only occur here in winter. Departing from most

other Atlases, volunteers and staff collect observations during both the breeding and wintering seasons. In just the past winter (Nov-Feb), atlasers and staff recorded 284,213 species observations.

In the coming months, we'll bring on more staff to collect data and assist atlasers during the 2023 breeding season. We anticipate making significant progress toward our goal to adequately cover all survey blocks in the state by the end of 2025.



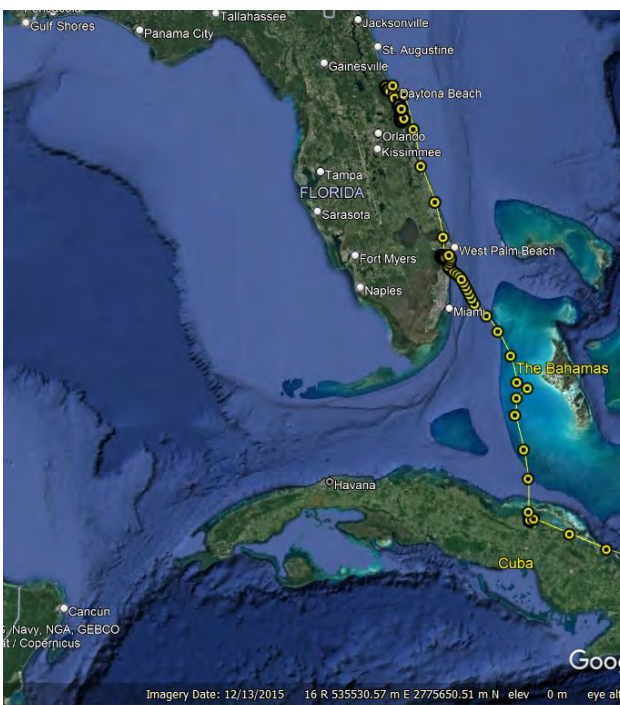
Tagged Snowy Egret Provides Valuable Information on Nesting, Migration

by Carmen Johnson, Waterbird Biologist, Doug Rouse, Waterbird Technician

As part of a project focused on small herons and egrets nesting in North Carolina, Dr. John Brzorad from Lenoir-Rhyne University, 1000 Herons (non-profit) and Alan Maccarone (retired), deployed a CTT transmitter on an adult male Snowy Egret in May 2022. Since that time, the tag has sent data on the movements of the bird, which appeared to be nesting on one of NCWRC's Waterbird Islands in Core Sound. It likely raised chicks based on the daily trips it made between the island and nearby foraging sites. After the nesting season concluded, the egret flew north into the Neuse River estuary before eventually migrating to Cuba where it spent the winter. The egret has now begun its northbound migration and



recently arrived in Florida. Drs. Brzorad and Maccarone, as well as NCWRC staff, hope the bird will once again return to the same island to nest this spring, and it may be observed during the triennial Colonial Waterbird Survey. Data gathered by this project will be used to better understand the decline in the number of small herons and egrets (including Snowy Egrets) nesting in North Carolina.



Clockwise from top left: Snowy Egret tagged by Drs. Alan Maccarone and John Brzorad (Dr. Alan Maccarone); Rebecca Fox and Shyanne Dixon, students from Lenoir-Rhyne University, hold the tagged Snowy Egret prior to release. A breathable covering over the bird's head helped to keep it calm while the transmitter was attached (Dr. Alan Maccarone).; Northbound migration of the tagged Snowy Egret

Resighting Returning Golden-wings

by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

Is low survival from one breeding season to the next a factor limiting golden-winged warbler populations in the Appalachian Mountains? The NCWRC, along with nearly a dozen other partners across the golden-winged warbler's breeding range, did its part to answer that question by participating in a study entitled, "Estimating the survival rate of Golden-winged Warblers for a range-wide integrated population model." The study, led by the Roth Lab at the University of Maine, enlisted partners to capture and band golden-winged warblers during the 2022 breeding season, fitting some with coded-radio tags (nanotags) and some with only color bands to serve as study controls. In April and May 2022, the NCWRC mountain bird crew captured and banded 22 golden-winged warblers in the Cheoah Mountains of Graham County. Twelve of these golden-wings

were fitted with nanotags and the remaining 10 were color-banded controls. Thus, the mountain bird crew's task for May 2023 — finding these individuals — was laid out for them a year ago.

Resight surveys kicked off in late April 2023 just as the birds were returning from South America. Biologists completed extensive resight surveys, searching for returning individuals with the aid of visual searches, audiolures, and of course a radio-receiver and Yagi antenna to detect nanotag signals. Although the number of golden-winged warblers on territory in the area was similar to recent years, most individuals were unbanded. Overall, the team found five returning birds, two of which were from the 2022 cohort and the other three from earlier cohorts (two from 2021 and one from 2018). One of the two returning individuals from the survival study was a color-banded control bird, a male. The other was a nanotagged female. These numbers are disappointing, but before jumping to conclusions, NCWRC biologists await the University of Maine's analysis of the full range-wide dataset. The survival data are just one piece of a comprehensive Integrated Population Model that partners hope will highlight the critical factors limiting Appalachian golden-wing populations.



Rain or shine, Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist, scans for nanotagged Golden-winged Warblers in the Cheoah Mountains (Christine Kelly).



Golden-winged Warbler (Ray Hennessey)

A Second Motus Station and First Detections on the First Motus Station

by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

During second quarter 2023, the NCWRC put another dot on the [Motus map](#), further strengthening this migration tracking network. The Wildlife Diversity team installed the mountain region's second Motus station at Pond Mountain Game Land (Ashe County) in the very northwest corner of North Carolina. Each Motus receiver station will be a little bit different, customized to fit the site. For this one, the Wilkes wildlife crew from

the Land and Water Access Division installed a 30-foot wood utility pole next to the old airplane hangar. The receiver and battery are sheltered from the elements inside the hanger at Pond Mountain Game Land. This is our first solar-powered station.

Meanwhile, the [first Motus station](#) installed last November at [The Mountain Retreat and Learning Center \(TMRLC\)](#) on Little Scaly Mountain detected some northbound spring

migrants! A Northern Waterthrush tagged in Jamaica on March 11, 2023 by researchers from Georgetown University (DC) was the first detection by the TMRLC Motus station on May 6, 2023. The Northern Waterthrush then traveled 320 miles north at a minimum speed of 13 miles per hour where it was detected on May 7, 2023 at a Motus station in central Ohio managed by the Ohio Division of Wildlife, a fellow partner in the Appalachian Mountains Joint Venture. The TMRLC's second detection was a White-throated Sparrow tagged on Feb. 10, 2023 in Athens, GA by the Georgia Institute of Technology. It passed by the TMRLC receiver on May 7, then a receiver near Bluefield, WV on May 8, another in western Pennsylvania on May 12, and was last detected by a receiver on the northern shore of Lake Ontario east of Toronto on May 15. Finally, a Blackpoll Warbler passed by the TMRLC receiver station on May 27, 2023. This bird was tagged by NCWRC's frequent partner, [SELVA Research for Conservation in the Neotropics](#), on April 12, 2023 in the Andes Mountains of central Colombia, South America as part of its project "[SELVA Colombia](#)." NCWRC biologists are delighted to contribute to these migration studies through the collaborative Motus network.



Antennas are mounted on the wood pole and the receiver station is housed inside the hangar, safe from the elements (Chris Kelly).

Receiver deployment: The Mountain Retreat and Learning Center (ID# 9270)
Receiver ID: CTT-V30B0154DDDE

List of daily tag detections by this receiver deployment.

Show detections in: [a table](#) | [a timeline](#)

Filter:

100 [results per page](#)

Detection date	Tag deployment	Species	Date deployed	Latitude	Longitude
2023-05-06	Jamaica_Research#16:16.7 M.71798	Northern Waterthrush	2023-03-07	18.0424	-77.9411
2023-05-07	GatechTower#85:38.9 M.66516	White-throated Sparrow	2023-02-10	33.9016	-83.3874
2023-05-27	SELVA#277:21.1 M.74999	Blackpoll Warbler	2023-04-12	3.9733	-73.799

Detections at NCWRC's first Motus station in the mountains during spring migration 2023 (Motus.org)

Biologists and Partners Conduct Triennial Nesting Waterbird Survey

by Carmen Johnson, Waterbird Biologist, Kacy Cook, Waterbird Biologist, Doug Rouse, Austen Smith Waterbird Technicians

During May and June 2023, the Waterbird Project coordinated the 15th North Carolina coast-wide Colonial Waterbird Survey. This triennial survey, conducted by the NCWRC, National Park Service, U.S. Fish and Wildlife Service, North Carolina Coastal Reserve, North Carolina State Parks, U.S. Marine Corps, Audubon NC, Bald Head Island Conservancy, and numerous researchers and volunteers, monitors populations of nesting waterbirds in the state. The survey was first launched by University of North Carolina Wilmington professor Dr. James F. Parnell in 1977 to determine population sizes of breeding waterbirds along the North Carolina coast relative to concerns over use of pesticides such as DDT in previous decades. This coast-wide survey now tracks 21 species known to nest on the state's coast, 19 of which are Species of Greatest Conservation Need. Data from these surveys are stored in the Colonial Waterbird

database maintained by the NCWRC. For the first time, data will also be entered into the Avian Knowledge Network as part of an effort by states and provinces in the Atlantic Flyway to share data and assess wider population and distribution trends. A report will be completed later this year and will be used to guide management decisions in the state.



Staff carefully walk through a Royal and Sandwich Tern colony counting nests. (John Lynch). Below: Approximately 8,000 Royal and Sandwich Tern nests were counted in this colony on a dredge material island in Pamlico Sound (Carmen Johnson).



NC Bird Atlas Confirms 208 Species Breeding in North Carolina

by Scott Anderson, Science Support Coordinator, John Carpenter, Eastern Landbird Biologist, and the NC Bird Atlas Team

The North Carolina Bird Atlas had many accomplishments during the second quarter of 2023. Trained field staff conducted surveys for Cerulean and Kentucky Warblers along remote stretches of the Lower Roanoke River; discovered breeding Swainson's Warblers and Loggerhead Shrikes in under-Atlased areas of the Piedmont; and documented high-elevation specialists like Brown Creeper, Least Flycatcher, Vesper Sparrow, Winter Wren and

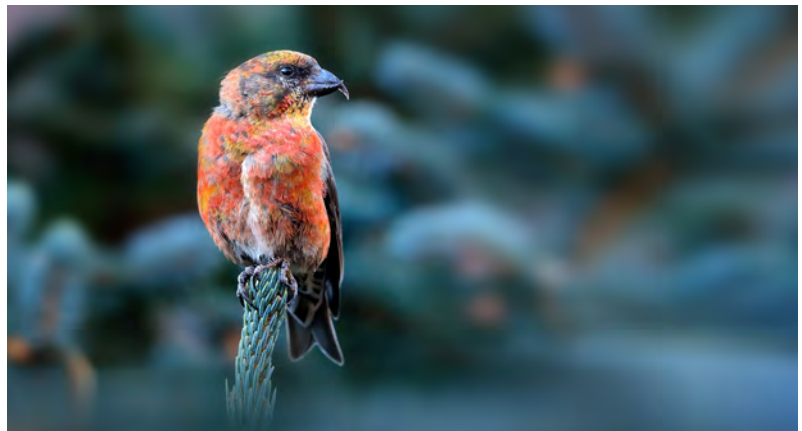
the nomadic Red Crossbill in the mountains. In addition, North Carolina — along with New York, Maryland/DC, Puerto Rico, and two Canadian provinces (Newfoundland & Ontario) — competed in the 3rd Annual Big Atlas Weekend Competition. During early mornings and evenings from June 23-25, more than 170 North Carolina Atlasers contributed 582 hours and identified 173 species from 1,192 survey checklists. Finally, as of early July, we have data in 96% of

our priority blocks and 208 species confirmed as breeding in our state! These results were only made possible from the 2,156 (mostly volunteer) Atlasers who have submitted 146,174 checklists since the project began in 2020. As the summer winds down, we will remain busy preparing for the atlas's third winter season, organizing data and engaging with our volunteers to encourage their continued participation in this growing citizen science project.

If you want to stay up-to-date on the progress of this project, visit ncbirdatlas.org or subscribe to our monthly newsletter at news.ncbirdatlas.org.



Hayley Crews



Wang LiQiang



Ray Hennessy



NCWRC

Among the bird species documented by North Carolina Atlasers (left) this quarter were (clockwise from top): Brown Creeper, Red Crossbill and Loggerhead Shrike.

Biologists Use Recording Units to Monitor Golden-winged Warblers

by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

Each spring, ornithologists have a narrow window of about 5 weeks to cram in surveys for Golden-winged Warblers (GWWAs) in the mountains. The window is made even narrower by the duration of the dawn chorus. Exuberant singing - and therefore, a biologist's odds of hearing one - drops off markedly by around 10 AM. Throw curvy mountain roads and long commute times into the mix and field staff can only cover so much survey ground. Commission biologists visit a network of monitoring points where they broadcast the species' song over a speaker and then watch and listen carefully for about 15 minutes before dashing off to the next survey point. This standardized survey protocol using an audiolure is widely used by partners in the Golden-winged Warbler Working Group.



Clifton Avery

But biologists feel constraints when it comes to expanding survey coverage to other areas. This is where Autonomous Recording Units come in to play. Autonomous Recording Units (ARUs) are small electronics that passively record ambient sounds. They can be custom programmed to record during certain hours of the day or night and can even be programmed with a delayed start of several days or weeks. ARUs offer biologists a means of expanding survey coverage when they can't be in two places at once. They also increase survey coverage by recording continuously, long beyond what field staff can complete in one morning through a rushed series of 15-minute audiolure surveys. Once retrieved, it's a matter of reviewing the audio recordings using song recognizers or manual review.

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Chris Kelly

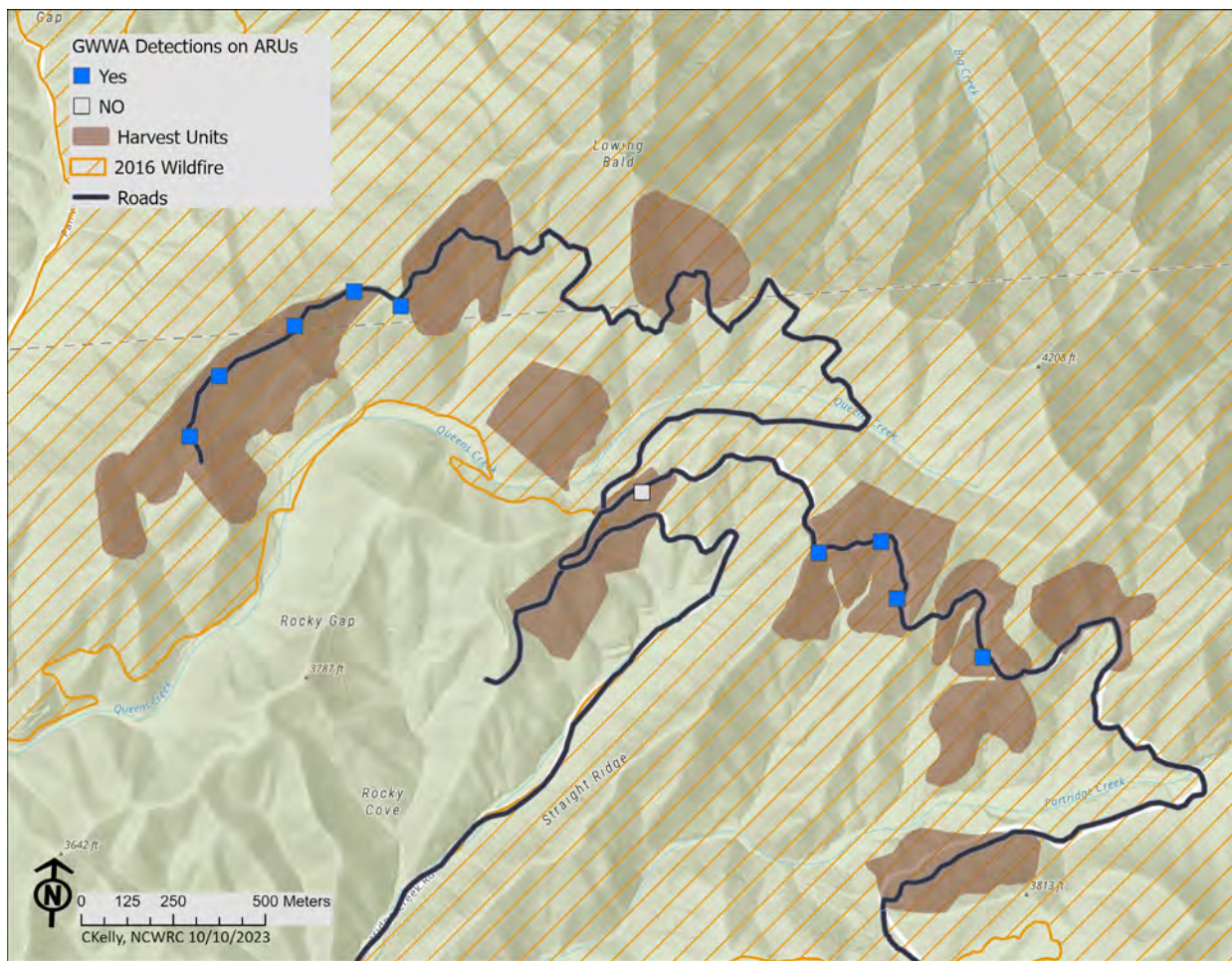


Autonomous Recording Units (ARUs) were aimed at harvest units because Golden-winged Warblers and other birds nest along edges of logging roads adjacent to harvest units. The pink flag in the photo on the Left marks a nearby Wild Turkey nest on this logging road. An AudioMoth ARU by Open Acoustic Devices is shown in the photo on the right (Chris Kelly).

This quarter, we finished reviewing a set of recordings from ARUs that Commission biologists used to survey a section of the Nantahala National Forest during the breeding season without having to actually go there during the busy month of May. In mid-April, before the GWWAs had even returned from their wintering grounds in South America, 10 ARUs were deployed (programmed with a 2-week delayed start to save battery) at what looked like promising

GWWA habitat. The project site, Partridge Creek, consisted of several young logging units that had burned in a severe wildfire in autumn 2016. The wildfire set vegetation succession back, effectively extending the useability of this part of the forest for species like the GWWA. Commission biologists had documented GWWA in one part of the project area, but time and logistics prevented field staff from reaching other sections for breeding season surveys. With

the ARUs, biologists confirmed the presence of GWWAs at 9 of 10 survey sites. By sub-sampling the raw recording files from early May and mid-May, they found evidence that GWWAs had remained on territory and weren't just passing through the area on migration. In addition, they documented other species of interest to the Commission and the U.S. Forest Service, including the Eastern Whip-poor-will and Wood Thrush.



Detections of Golden-winged Warblers on Autonomous Recording Units in a forest management area on the Nantahala National Forest that burned in the 2016 wildfires.

NC Bird Atlas Focuses on Fall Outreach

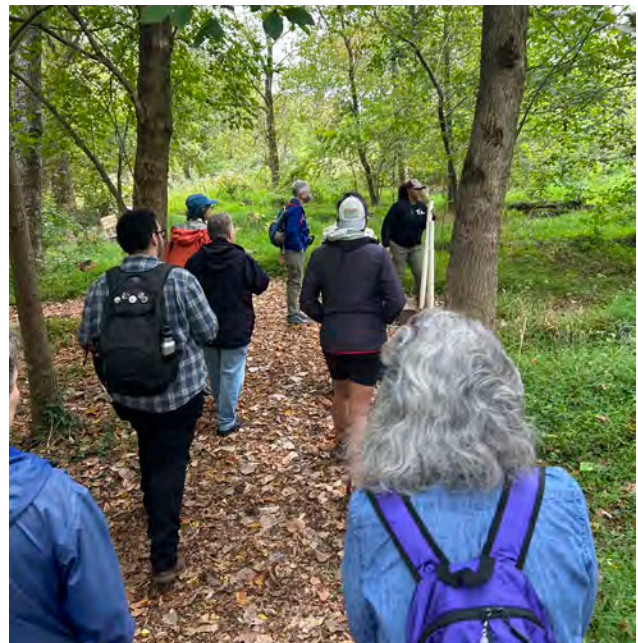
by CC King, Science Support Specialist

With fall migration underway, the NC Bird Atlas team turned its attention to outreach events, preparation for winter atlasing, and hiring the new round of technicians. Inviting more people to participate in counting birds works well in the fall season. Recording presence often comes easier than documenting breeding behaviors, making this time of year a gentler introduction for those just getting started with atlasing. Outreach efforts introduce participants to the work of NCWRC, and the tools of community science in terms of birds. Program participants learn to use the phone apps of Merlin and eBird to record their observations. From there, the most engaged choose to participate in data collection through the NC Bird

Atlas portal, following protocols to help record bird diversity, abundance, and breeding status across the state.

Upcoming winter atlasing efforts will soon be augmented by the return of long-term technicians who reach under-birded priority blocks and help with landowner outreach. North Carolina hosts many overwintering birds. As we document these species, we simultaneously gear up for the arrival of the breeding season, the returning migratory species, and the summer technicians who come to help count them. After three years of data collection, the atlas has touched over 96% of the priority blocks. Now we face the high bar of completing 20 hours in every block during the breeding season

and 5 hours in the winter—for hundreds of blocks. That goal drives the ongoing recruitment and support of volunteers and explains our request to hire additional technicians this summer. We are two-thirds through the project with many rural areas still in need of significant effort. Most volunteers tend not to leave their comfort zones to bird, increasing the need for skilled technicians in less populated areas. Through the tiered entry approach to the project, the NC Bird Atlas makes room for anyone to participate at any level; this partnership of volunteers and technicians allows the recording of both presence and breeding confirmations while ensuring that we reach every area of the state.



Outdoor Afro and Let's Go Birding Together: Beginning Birder Program - a partnership among Wake Audubon, Field Inclusive, Walnut Creek Wetland Center, and the NC Bird Atlas.

A Rare Find — A Great Lakes Piping Plover in North Carolina

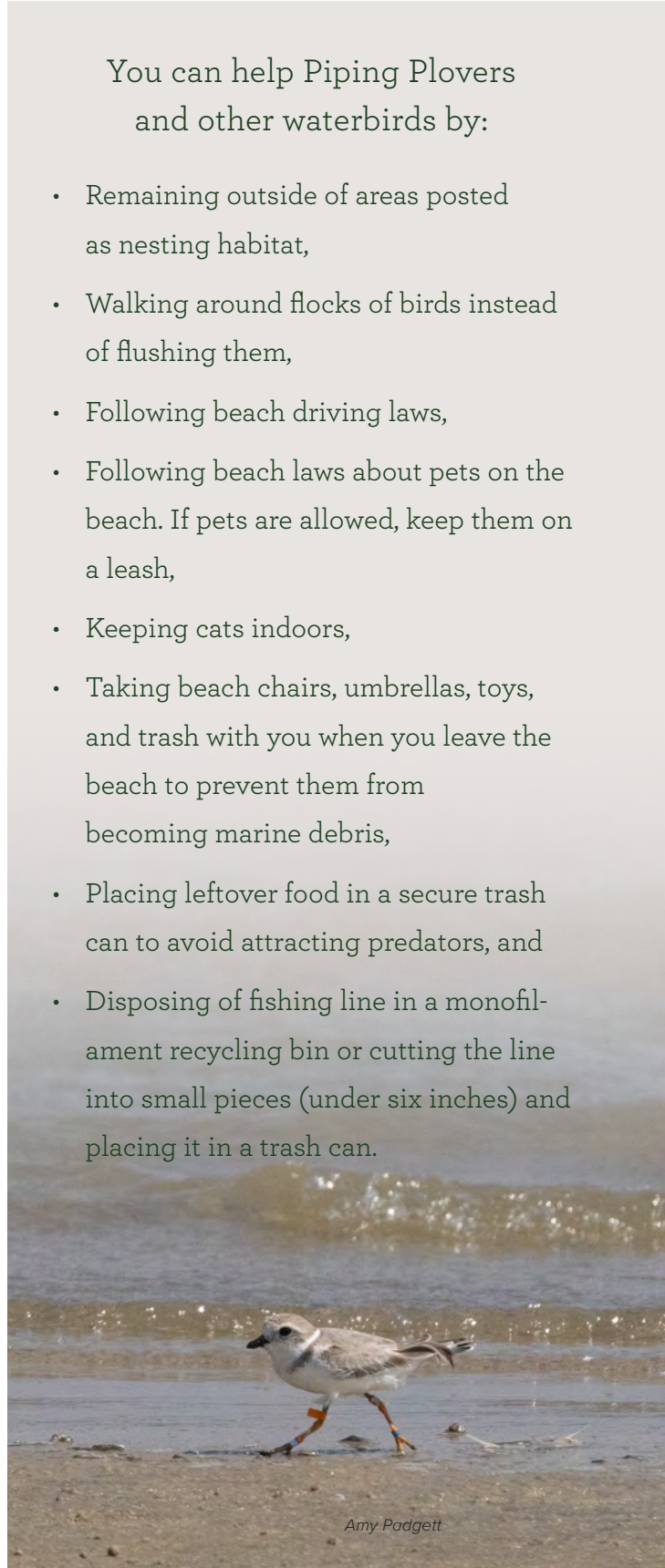
by Carmen Johnson, Waterbird Biologist, Kacy Cook, Waterbird Biologist, Doug Rouse, Waterbird Technician

During a recent International Shorebird Survey in Core Sound, NCWRC staff and volunteers spotted a banded Piping Plover from the species' Great Lakes population. There are three populations of Piping Plovers: Atlantic, Northern Great Plains, and Great Lakes populations. Most Piping Plovers found in North Carolina are part of the federally threatened Atlantic population, but birds from the federally endangered Great Lakes population migrate through and winter along the North Carolina coast. Staff reported the band combination to the Great Lakes Piping Plover Conservation Team and learned that this was a particularly rare bird. Most chicks are raised by one of the approximately 70 pairs of nesting adults that make up the Great Lakes population; however, this bird was captive-reared from an egg during the 2023 nesting season after the female that laid the nest was preyed on by a Merlin. While wild rearing is best, a single Piping Plover is not able to successfully incubate a clutch of eggs, so the eggs were taken to the Conservation Team's captive-rearing facility to give them a second chance. After learning to fly, the chick was released on the east end of Lake Ontario at Montario Point. During August, it was observed in New Jersey, and by early September, the juvenile plover had reached North Carolina. Staff and volunteers will continue to keep an eye out for this Piping Plover during autumn and winter surveys to see whether the young bird overwinters in North Carolina or continues south.

At one time, the Great Lakes population consisted of nearly 800 pairs, but due to disturbance around nesting sites, predation, and loss of high quality nesting habitat the population fell to a low of 13 pairs in 1990. The Great Lakes Piping Plover Conservation Team is working to recover the population through increased nest monitoring, providing information about the plovers to beach goers, predator management, habitat protection, and captive-rearing of eggs and chicks that would otherwise not survive. North Carolina's barrier islands, shoals, and inshore islands provide necessary foraging and roosting habitat that is helping to recover the Great Lakes Piping Plover population outside of the nesting season.

You can help Piping Plovers and other waterbirds by:

- Remaining outside of areas posted as nesting habitat,
- Walking around flocks of birds instead of flushing them,
- Following beach driving laws,
- Following beach laws about pets on the beach. If pets are allowed, keep them on a leash,
- Keeping cats indoors,
- Taking beach chairs, umbrellas, toys, and trash with you when you leave the beach to prevent them from becoming marine debris,
- Placing leftover food in a secure trash can to avoid attracting predators, and
- Disposing of fishing line in a monofilament recycling bin or cutting the line into small pieces (under six inches) and placing it in a trash can.



Amy Padgett

Golden-winged Warbler Tracking

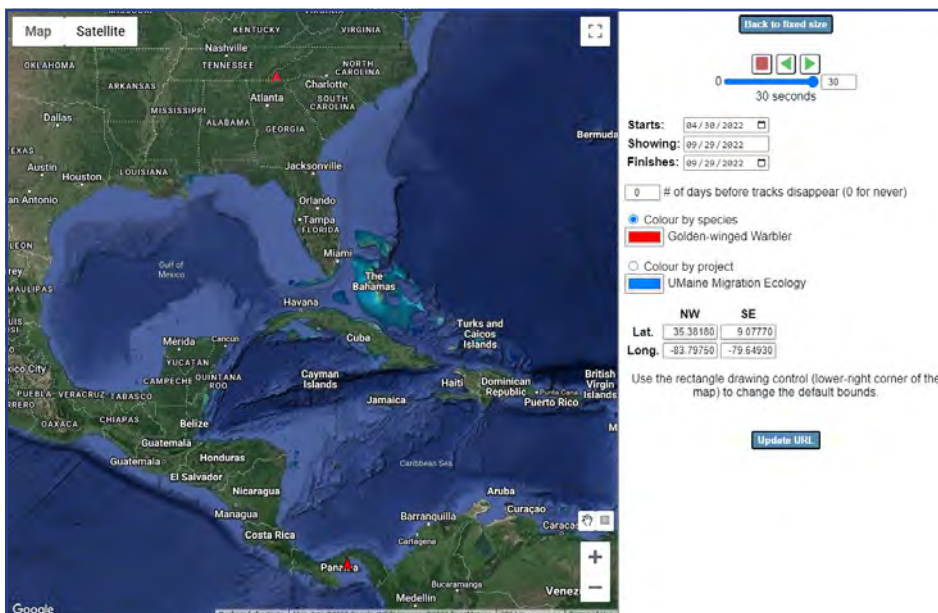
by: Christine Kelly/ Western Bird and Carolina Northern Flying Squirrel Biologist

As reported in our second quarter report, the NCWRC contributed to a rangewide survival study of Golden-winged Warblers, led by the University of Maine. The first part of the study was completed this past spring, when NCWRC biologists and other partners fitted Golden-winged Warblers with tiny radio tags (nanotags).

The second part of the study will take place in spring 2023, when biologists attempt to relocate these individuals on the breeding grounds to determine annual survival. But in the interim, NCWRC biologists

had an opportunity to observe the breeding population in the Cheoah Mountains (Graham County) more closely. The mountain bird crew checked on the tagged and color-banded individuals on a bi-weekly basis throughout the summer. Radio signals led them to tagged females on nests, while males maintained their territory boundaries from favorite song perches. As the summer progressed, staff observed spatial shifts, likely attributed to the adult birds tending to their newly volant offspring. By Aug. 12, only two males could still

be relocated by their radio signals, and by Aug. 23, none were detected. With migration in full swing, biologists were thrilled to discover that one of the birds, a male tagged on his breeding grounds in Graham County on April 30, was alive and on the move. On Sept. 29 at 10:15 p.m., his radio tag “pinged” a Motus Wildlife Tracking receiver station in Panama City, Panama. He is on his way to his wintering grounds in northern South America. Biologists await his return to North Carolina in spring 2023.



The red arrow in North Carolina marks the location where male Golden-winged Warbler #75 was captured on his breeding territory in April 2022. A Motus Wildlife Tracking receiver station in Panama City, Panama (lower red arrow) detected this bird's radio tag on the night of Sept. 29, 2022 (Motus.org website).



A tiny nanotag sits on the back of a male Golden-winged Warbler (Anthony Squitieri).

New Technology Will Help Biologists Track and Study Avian Species of Greatest Conservation Need

by John Carpenter, Eastern Land Bird Biologist

Recently, Wildlife Diversity program staff, along with NC State University and UNC-Wilmington, hosted and attended a Cellular Tracking Technology (CTT) workshop to demonstrate the potential this state-of-the-art equipment has for studying many Species of Greatest Conservation Need. The workshop included both a field demonstration at the Voice of America Game Land and a virtual meeting to discuss data management. CTT is a company offering radio, cellular and satellite telemetry systems that allow researchers to track animals' movements continuously through time. A CTT system includes an array of solar-powered receiver "nodes" spaced 100-200 m apart throughout

the desired habitat in a 1-km² grid, a sensor station and transmitter tags mounted on the target animals. Typically, the sensor station is located at the center of the node array, mounted on a 20- to 30-foot tower topped with an omni-directional antenna and a variety of other antennae aimed along cardinal directions or as needed to support effective communication between nodes and the sensor station. It is powered with a solar panel and battery. Transmitter tags attached to the target animals may be battery powered, solar powered or a combination. Each node will detect an animal's unique transmitter frequency within approximately 200 m and relay its location back to the sensor station.

From there, the station uploads the animal's location data to a central repository, which communicates with a server that displays the data in near real time via the CTT user portal. This automated telemetry system not only produces significantly more accurate and detailed animal space use metrics, allowing for study of habitat utilization, home range size and seasonal movements, but it also frees up field staff from labor intensive manual telemetry methods, allowing staff to allocate more time to other components of their studies. The NCWRC is currently using this technology to study several avian Species of Greatest Conservation Need, including Henslow's and Salt-marsh Sparrows.



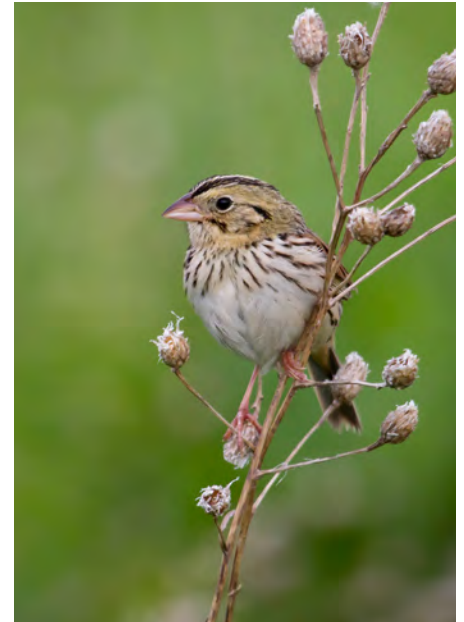
Left: Henslow's Sparrow wearing solar-powered transmitter (Emily Nastase); Attendees at CTT field demo, Voice of America Game Land examine the sensor station (John Carpenter).

Henslow's Sparrow Studies on Voice of America Game Land

by John Carpenter, Wildlife Diversity Biologist

Over the last three summers, through a Cooperative Agreement with NC State University, the Wildlife Diversity Program has studied the state endangered Henslow's Sparrow in eastern North Carolina. The primary study site was at the Voice of America Game Land (VOAGL) where we estimated a current population of 90-140 singing males from 2021-2023. Genetic samples were obtained from VOAGL and VOA Site B and will be used to address migratory connectivity with other Henslow's Sparrow populations across North America. We color banded males and

attached transmitters to measure site fidelity, space use, and determine over-wintering locations. We witnessed a minimum of 22-38% of males returning to VOAGL each summer and discovered that two males migrated to northern Florida/southern Georgia to spend the winter. Lastly, 27 nests were found in 2022, 2023: 67% of eggs hatched with 93% of those chicks surviving to fledge. Final analyses, including grassland vegetation response to current management practices (e.g., controlled burns) will be delivered to NCWRC in July 2024.



Frode Jacobsen

Emily Nastase



Emily Nastase



Two of 27 nests with eggs (left) and chicks (right) found by staff during surveys on VOA Game Land in 2022, 2023.

Nest Data Provide Insight on Population Trends for Coastal Waterbirds

by Carmen Johnson, Waterbird Biologist, and Kacy Cook, Waterbird Biologist

Building on the colonial waterbird surveys completed earlier in 2023, Wildlife Diversity staff recently gathered nest data from partner agencies and organizations in the state to assess the status and distribution of colonial waterbirds in North Carolina. This coast-wide survey, first conducted by University of North Carolina Wilmington professor emeritus, Dr. James Parnell, has been carried out roughly every three years since the late 1970s, providing biologists with a long running dataset that is used to guide species and habitat management.

Counts were conducted at all known colonies and 49,043 nests were detected for 21 species. Species with the greatest numbers of nests were the Royal Tern (12,384), Laughing Gull (12,112), White Ibis (9,003), and Brown Pelican (5,227). To better un-

derstand population changes, counts were compared with the 15-year survey average. While some species, including the Brown Pelican (+36%), Least Tern (+30%), and Black-crowned Night Heron (+16%) increased in 2023, and highlight the success of long-term conservation efforts, other species showed declines. The Common Tern (-91%), Little Blue Heron (-73%), Snowy Egret (-70%), and Gull-billed Tern (-51%) were amongst the species showing the sharpest declines.

Awareness of these downward trends makes it possible for biologists and managers to examine knowledge gaps, prioritize research needs, and focus management decisions. One of the original motivations for Dr. Parnell's first coast-wide survey was to document the populations of nesting waterbirds (especially Brown Pelicans) due to concerns about pesticides

used in earlier decades. Through hard work, the once federally endangered Brown Pelican has increased from approximately 30 nesting pairs in the state to over 5,000 pairs in 2023. Biologists hope that by identifying species currently in decline, similar success stories will be possible for other species.



Above: Common Tern eggs; Below: A Common Tern on a nest (Melissa McGaw)



An adult Brown Pelican feeds its chicks (Melissa McGaw)



See What Our Mountain Motus Stations Have Detected So Far!

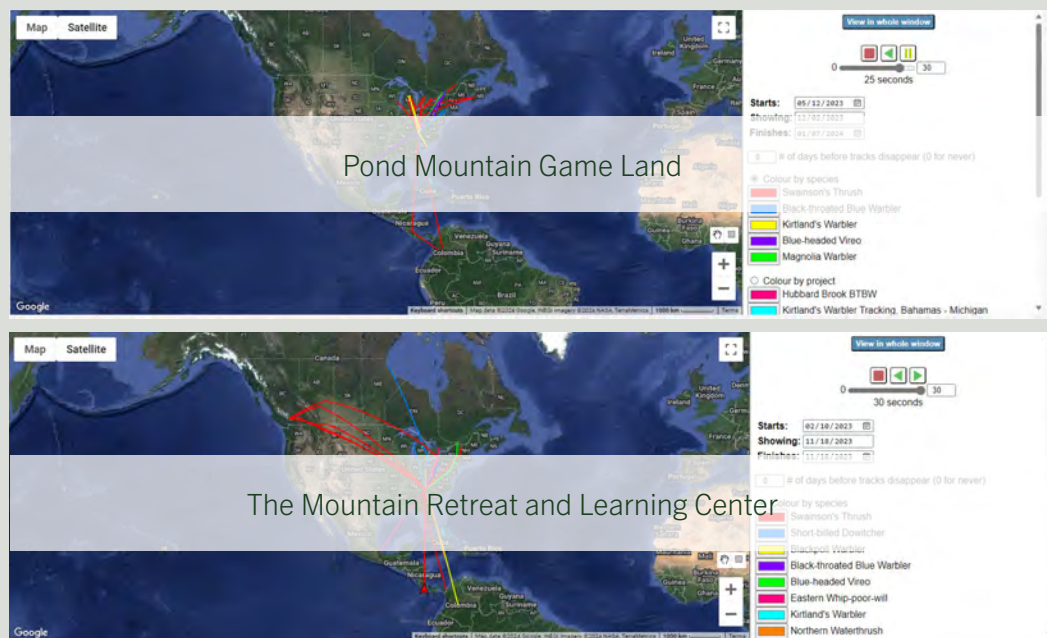
by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

Migration season is extra exciting now that NCWRC has a growing Motus network in the mountains. In 2023, NCWRC's first mountain Motus station on Little Scaly Mountain at The Mountain Retreat and Learning Center, logged [16 detections](#), including three in spring migration and 13 in autumn migration. The Pond Mountain Game Land Motus station was operational by mid-April 2023 and logged [11 detections](#) during autumn migration. Anyone can explore the Motus website. NCWRC created simple animations of the tagged birds that passed our two mountain Motus stations. To enjoy these animations, click on: Pond Mountain or The Mountain Retreat and Learning Center in the figure

below. Motus.org notes that “these public animations have been created using broad filters based on theoretical flight speeds, logical geographic/time sequences, and at least 3 consecutive tag bursts at a single station. Individual tracks have not been inspected for accuracy.” For example, the detection of a Kirtland’s Warbler in Washington state is a false detection. Finally, the “Drones and Motus” tags listed in the table of Receiver Deployment Detections at The Mountain Retreat and Learning Center are not birds. They represent test nanotags hung from a drone being flown by researchers at Highlands Biological Station who are examining detection range of the antennas.

Animated Migration Track Maps of Tagged Birds

Click the graphics below to animate the migration tracks. Once the page opens, click the green right arrow. Then watch the directional arrows on the map and the advancing dates to the right of the map.

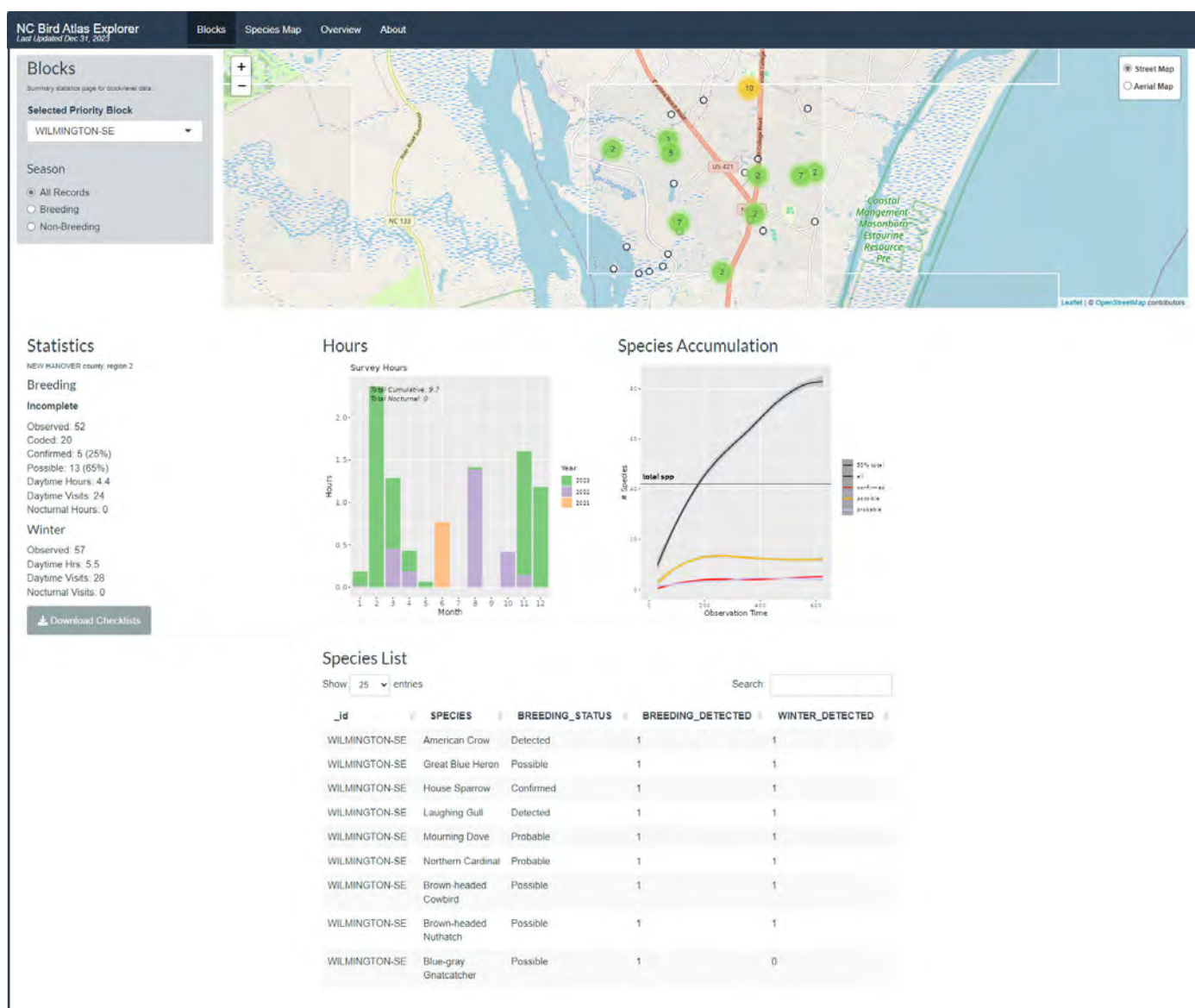


Anyone can look up the latest detections from our Motus stations by visiting <https://motus.org/>.

NC Bird Atlas Wraps Up Third Year with New Tool

by John Carpenter, Eastern Landbird Biologist and Scott Anderson, Science Support Coordinator

The NC Bird Atlas (www.ncbirdatlas.org) wrapped up its third year during the fourth quarter of 2023. During that time, the new Block Explorer, which can be accessed at: www.blockexplorer.ncbirdatlas.org, was rolled out. This tool allows volunteer Atlasers and WRC staff the ability to track block completion progress, view species' breeding maps, and download data. Many of the tool's features were developed through a contract with the NC Cooperative Fish and Wildlife Research Unit of NC State University. More features are planned to be included in future versions. WRC staff leading the NCBA effort have also been assessing the status of the data collection effort and making preparations for the upcoming breeding season.



The new Block Explorer tool in NC Bird Atlas

REPTILES

Reptile and Amphibian Winter Surveys Yield Mixed Results

by Dr. Jeff Humphries; Mike Martin, Conservation Technician

Most winters, reptile and amphibian work focuses on monitoring breeding activity of Species of Greatest Conservation Need (SGCN), such as the Gopher Frog, Eastern Tiger Salamander, Mabee's Salamander, Southern Chorus Frog, and Ornate Chorus Frog. Because we still have a lot to learn about the environmental conditions that trigger migration of these species to wetlands, we closely monitor their activity using automated audio recorders (often called frog loggers) which detect frog vocalizations and help determine activity among various properties.

Sadly, conditions seemed too dry this winter for many of our SGCN frog species to be active, but we have yet to re-view audio recordings to make determinations about presence and absence among survey sites. On the other hand, visual encounter surveys that attempt to detect migrating amphibians on rainy nights proved fruitful, as Eastern Tiger Salamanders (box) and Mabee's Salamanders (below) were

continue on next page



observed at multiple sites. Follow-up surveys for amphibian egg masses proved salamanders actively bred this season, despite low water levels. Low water levels threaten to dry some of these wetlands before larvae can metamorphose and migrate from the wetlands to the surrounding uplands, but variable conditions among the many sites we monitor leave us hopeful that hydroperiod of some wetlands will persist long enough for some larval amphibians to survive this critical period and recruit into future breeding seasons.

Despite the lack of Gopher Frog breeding activity in the sandhills region, our partners at the NC Zoo successfully repeated their efforts of using assisted reproduction techniques to produce eggs from captive Gopher Frogs maintained by the zoo. This is a relatively novel approach to our head starting efforts with Gopher Frogs, which aims to raise young frogs from eggs to augment populations of this rare and often isolated species.

Warming weather in late winter to early spring brings many reptiles out to bask on the surface. We survey among recent prescribed burn

units and tin transects regularly for snakes. This quarter we have detected Pine Snakes, Coachwhips, Corn Snakes, and Pigmy Rattlesnakes. Both Eastern Hognose Snakes and Southern Hognose Snakes are rarely encountered this time of year, although they're anticipated soon, as warming temperatures increase encounters on roadways.

A priority for conserving many of the Sandhills and Coastal Plain SGCN winter-breeding amphibians involves management of various isolated wetlands on game lands as well as other managed lands. Sarah Hecocks, the ORISE fellow with The Nature Conservancy and the U.S. Fish and Wildlife Service, reached out to update management recommendations for several current and former TNC-owned Carolina Bays in and near the sandhills region alongside staff members from the Natural Heritage Program, Scott Pohlman and Nathan Shepard. Sites visited included Antioch Bay, Hamby's Bay, Goose Pond Bay, State Line Prairie Bay, Tunstall Bay, and Cypress Meadow Bay. We collectively agreed that fire was a top management priority among all sites, though

sites like State Line Prairie Bay have considerable needs regarding removal of canopy trees.

Highlights included observations of Eastern Tiger Salamander egg masses at one site that coincided with reports of Mabee's salamander eggs from the same site a few weeks before our visit. Management recommendations will be provided to land managers responsible for each site, aiming to maintain biodiversity including, but not limited to rare reptiles and amphibians.

We attended the Southeast Partners in Amphibian and Reptile Conservation conference in late February, which provided the opportunity to share information with various herpetologists from the southeastern US. The Gopher Frog and Crawfish Frog Task Team met, and stakeholders in the region who gather data on these closely aligned species and implement various conservation efforts, shared ideas and information. Additionally, NCWRC and NC Zoo staff held a workshop to discuss various marking techniques and the constantly evolving tools at our disposal for wildlife monitoring and conservation.



SEE A PINE SNAKE? LET US KNOW!

If you see a pine snake in the wild, send an email to pinesnake@ncwildlife.org with the following information:

- A photo (required)
- Date and time the snake was observed
- The location (GPS coordinates are best, but a detailed location description is acceptable)

Another Successful Box Turtle Connection Training

by Gabrielle Graeter, Conservation Biologist/Herpetologist

In 2008, NCWRC staff, along with other partners, including UNC Greensboro and the NC Division of Parks and Recreation, set up a long-term population study of box turtles in North Carolina called The Box Turtle Connection (BTC). The goal of the BTC is to gather data on population trends and status of box turtles in NC for the next 100 years by engaging community scientists. Each volunteer, or “Project Leader,” makes a long-term commitment to study and collect data on the box turtles at their own site, such as a nature center, state park, or their private property. Turtles are permanently marked and measured by the Project Leaders and data are entered into an online database managed by the WRC. We now have more than 40 established study sites across the state. We are the only state that has such a large-scale box turtle study! In 2021, we published our findings from the first 10 years in *Ecosphere* and you can check out [the article for more information](#).

Every other year we hold a Box Turtle Connection training workshop to train the Project Leaders and occasionally bring new study sites on board. In March 2023, we held a BTC training at Haw River State Park, which was the first in-person training since the Covid-19 pandemic. Project Leaders must attend a BTC workshop to undergo the training necessary to lead their site.

This year we had an exceptional turnout, with many returning project leaders and new volunteers interested in the BTC. The training workshop consists of various presentations and hands-on skill stations where everyone learns about the biology of box turtles, current conservation issues, and how to properly collect and record data. Visit the [Box Turtle Connection](#) for more information.



Keynote speaker and retired NCWRC Wildlife Law Enforcement Sergeant Mark Cagle gives a presentation to BTC participants about the illegal turtle trade in North Carolina.



Participants in the 2023 Box Turtle Connection Training at Haw River State Park

Volunteers and Cooperators Responded to More Than 400 Cold-Stunned Sea Turtles This Winter

by Dr. Matthew Godfrey, Sea Turtle Biologist and Sarah Finn, Coastal Wildlife Diversity Biologist

Volunteers and cooperators with the North Carolina Sea Turtle Stranding and Salvage Network (STSSN), coordinated by NCWRC biologists, responded to more than 400 cold stunned sea turtles during the 2022-2023 winter season. Live turtles were taken to rehabilitation facilities including the Sea Turtle Assistance and Rehabilitation (STAR) Center at NC Aquarium Roanoke Island, NC Aquarium at Pine Knoll Shores, the Karen Beasley Center for Sea Turtle Rescue and Rehabilitation in Surf City, and even the SEALIFE Aquarium in Charlotte. Although not all turtles survived, to date 260 were nursed back to health and cleared for release by vet teams from the NC Aquariums and the College of Veterinary Medicine at NCSU. Most of the turtles were released in warmer waters several miles off the coast of North Carolina by the US Coast Guard near Fort Macon and smaller research vessels operating out of Wilmington, Beaufort, and Hatteras Village. Because of the generosity of these groups, the STSSN minimized the amount of time sea turtles spent in rehabilitation. With the return of warmer waters adjacent to our beaches, any remaining turtles will be released from NC beaches as soon as they are deemed healthy. In addition, facilities outside of North Carolina, including the New England Aquarium, National Aquarium, and Virginia Aquarium, have arranged to release their rehabilitated cold stunned turtles from North Carolina beaches into our warmer coastal waters.



The Coast Guard Cutter "Richard Snyder" based in Fort Macon, NC, transported >100 sea turtles for release into warmer waters off the NC coast at the end of January (NCWRC).



Coast Guard personnel placing rehabilitated Kemp's ridley sea turtle into warmer waters off North Carolina (US Coast Guard).

NCWRC and Partners Receive New Funding to Address Critical Bog Turtle Conservation Needs

by Gabrielle Graeter, Conservation Biologist/Herpetologist

In spring 2023, the NCWRC and many partners began work on a southern bog turtle (Federally listed Threatened due to similarity of appearance; status review initiated, 2022) conservation project that was funded by a Competitive State Wildlife Grant (C-SWG). This project aims to fill knowledge gaps about the status and viability of bog turtles in the southern population of the species. Partners on this project include the Virginia Department of Wildlife Resources, Amphibian and Reptile Conservancy (ARC), Mainspring Conservation Trust, Tangled Bank Conservation (TBC), Eastern Band of Cherokee Indians Natural Resources, South Carolina Department of Natural Resources, Defenders of Wildlife, North Carolina Chapter of The Nature Conservancy,

Bog Learning Network and Catawba Land Conservancy.

During second quarter 2023, NCWRC staff coordinated and set bucket camera traps at 10 sites in North Carolina, and partners set these traps at seven sites in Virginia. The bucket camera trap is the primary method they are using to evaluate the status and viability of historical and understudied bog turtle populations in this project. With this method, they mount a wildlife camera inside an upside-down 5-gallon bucket that has openings cut out on opposite sides and place it on the ground in the wetland in places they would expect bog turtles to travel (Figure 1). The bucket-camera traps were set for 21 or more days and photos will be evaluated in the coming months.

In the last few months, NCWRC

staff have also been involved in collecting genetic tissue swab samples from bog turtles in North Carolina, taking action to manage habitat with non-native invasive species, and surveying for and protecting bog turtle nests to improve nest hatching success (Figure 2).



Figure 1. View of a bucket-camera trap set in a rivulet within a mountain bog (Gabrielle Graeter)



Figure 2. Biologists searching for bog turtle nests in a wetland in summer 2023 (Gabrielle Graeter)

Biologists Work to Reduce Incidental Capture of Sea Turtles

by Dr. Matthew Godfrey, Sea Turtle Biologist and Sarah Finn, Coastal Wildlife Diversity Biologist

Sea turtles and fishing gear regularly interact in North Carolina waters, particularly between April and November, when coastal water temperatures are most suitable for sea turtles. Fishing gear in North Carolina, such as otter trawls and estuarine gill nets, have received much attention in the past few decades because of the relatively high frequency of incidental captures of sea turtles. In response to this issue,

The number of reported hook and line interactions has increased in the past five years, with 52 reported hook-and-line interactions as of May 2023.

changes to gear configuration and time/area restrictions have been established, helping to reduce the likelihood of incidental capture of sea turtles. These changes have also allowed attention to be directed at other types of fishing gear that cause incidental captures, particularly recreational hook-and-line gear.

In partnership with the NOAA-Na-

tional Marine Fisheries Service, NC Division of Marine Fisheries, NCSU College of Veterinary Medicine and NC Aquariums, N.C. Wildlife Resources Commission (NCWRC) biologists have worked to increase awareness about interactions with sea turtles with recreational fishing gear. This outreach includes talking to fishing pier owners and employees, distributing informational brochures, and putting up signs about what to do if you catch a sea turtle.

Often when a turtle is incidentally captured, the turtle is lightly hooked and the angler can easily remove the hook and release the turtle back to the ocean. In cases where the hook has been swallowed, the turtle is brought to an aquarium or rehabilitation facility so the hook can be removed under more controlled circumstances. In rare cases, the turtle might have other injuries and need further rehabilitation before it can be released.

Overall, the number of reported hook and line interactions has been increasing in the past five years, with 52 reported hook-and-line interactions so far in 2023. Although it is likely that the actual number of sea turtle interactions with recreational anglers is underreported, increasing the overall rate of reporting will help increase our understanding of these interactions and illuminate possible management actions to minimize risk to sea turtles.



A Kemp's ridley sea turtle that was incidentally captured by a hook-and-line recreational angler on a fishing pier. The turtle was raised to the deck of the pier with a hook net to facilitate hook removal, after which the turtle was released. (NC Aquariums)



A radiograph of a Kemp's ridley sea turtle that swallowed a recreational fishing hook at a fishing pier. The turtle was taken to the NC Aquarium on Roanoke Island for hook removal (NC Aquariums).

Alligator Marking and Data Collection

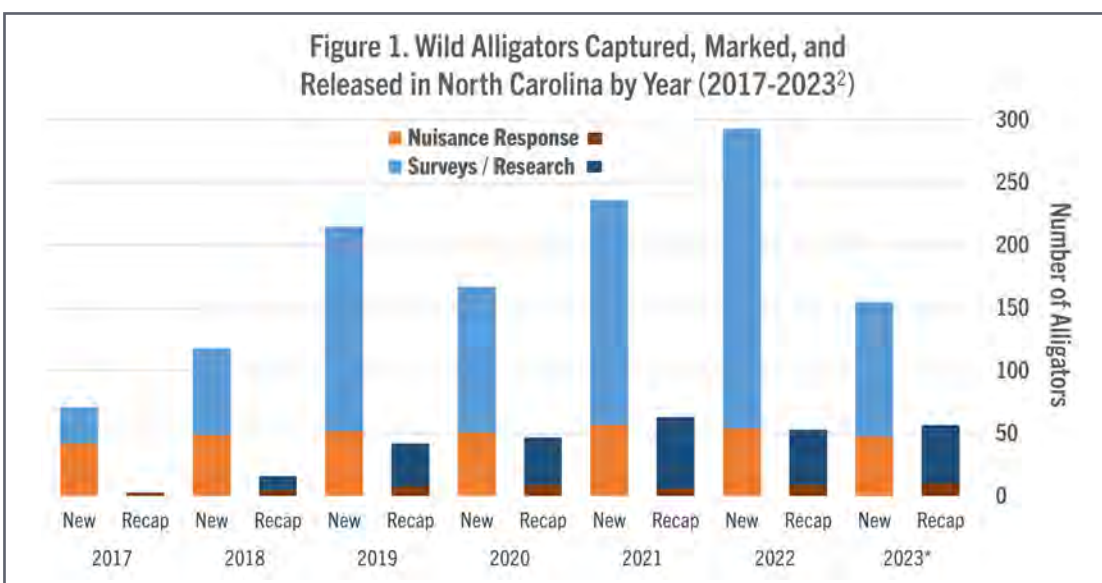
by Alicia Wassmer, Wildlife Diversity Biologist

In Spring 2017, the NCWRC initiated a new marking and data collection protocol for all alligators handled by agency staff and permitted external handlers, including Alligator Control Agents, Jurisdictional Alligator Handlers, and scientific researchers. Permitted scientific researchers include Dr. Stephen Dinkelacker of Framingham State University and Dr. Scott Belcher from NC State University.

Handlers mark all new captures with an internal Passive Integrated Transponder (PIT) tag, collect two tissue samples from tail scutes, determine sex, take body size measurements, and record GPS coordinates of locations of capture and release. These data are of great benefit to the agency's alligator conservation efforts. Equipped with this information, biologists are able to learn more about growth rates and movements of individuals at different life stages, evaluate the effectiveness of various management practices, and identify communities that could benefit most from outreach programs with guidance on coexisting with alligators.



Juvenile alligators



These numbers are inclusive of research subjects of all sizes, such as nest site surveys over the years in which dozens of individuals may be tagged at once. Approximately 46% of the individuals marked since 2017 were still in vulnerable juvenile stages with high mortality rates. In fact, only about 16% of the alligators marked in NC since 2017 were large enough to be reproductively mature adults. Only partial data are available for 2023.

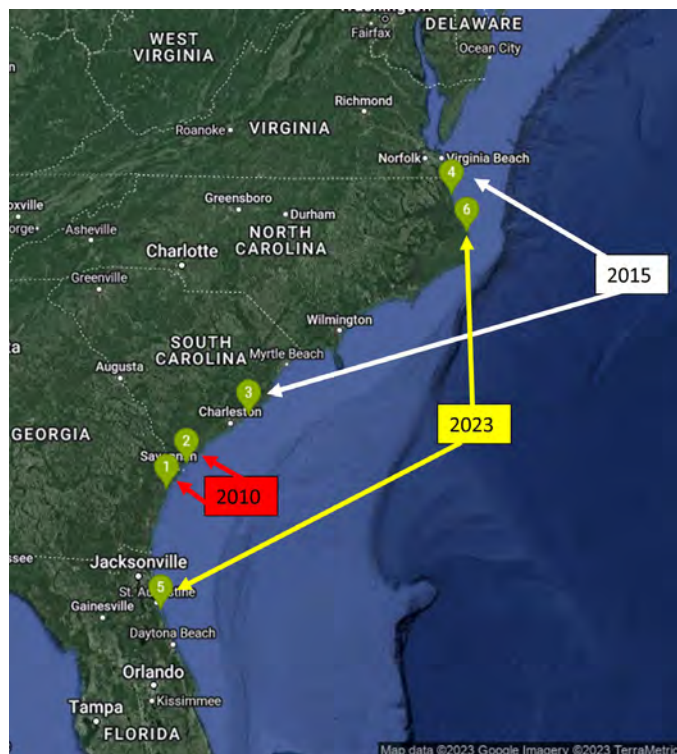
DNA Fingerprints of Female Sea Turtles Reveal New Nesting Behavior

by Dr. Matthew Godfrey, Sea Turtle Biologist and Sarah Finn, Coastal Wildlife Diversity Biologist

Historically, adult female sea turtles were thought to return to their natal beaches to lay their eggs. With the advent of molecular tools and phylogeographic analyses, it became clear that “natal homing” of sea turtles occurred at a broader regional scale. Nevertheless, observations of sea turtles bearing physical flipper tags suggested that nesting sea turtles remained relatively faithful to a bounded stretch of coastline, even if they hadn’t been produced there as hatchlings. Since 2010, North Carolina has partnered with other states along the east coast of the U.S. to collect eggshell samples from all nests laid by loggerhead sea turtles from Virginia to northern Florida. The samples provide unique DNA fingerprints for each adult female loggerhead that laid eggs in the area, providing previously undiscovered insights into the spatial distribution of nests laid by different individuals over time. While most female loggerheads tend to place their nests within a 35 to 45-mile range of one another, there are some individual turtles that select nesting beaches hundreds of miles apart, even within the same nesting season. Other turtles show a mixed approach, as seen in the map to the right. In this case, the turtle nested twice in 2010 within a 35-mile range near the SC/GA border. She nested twice again in 2015, once near Charleston, SC and once near Nags Head, NC, which are separated by more than 300 miles. In 2023, she nested twice again, laying the first nest in northern Florida and the second on Hatteras Island, NC, traveling over 500 miles between nesting events. Not only is this plasticity remarkable, but it also suggests that some sea turtles will be able to colonize new nesting sites to the north of their current range, which may be one way sea turtles compensate for the negative impacts predicted to occur with climate change and sea level rise.



A nesting female loggerhead seen on the beach after sunrise.



All known nesting locations along the SE USA of a single adult female loggerhead since 2010.

NCWRC and Partners Monitor Bog Turtle Populations for Poaching in Real Time

by Gabrielle Graeter, Conservation Biologist/Herpetologist

When the bog turtle was originally federally listed in 1997, one of the primary concerns was poaching of turtles from the wild. Unfortunately, there is international pressure from the illegal turtle trade on most wild North American turtle species, including the bog turtle. More information about the severity of this threat can be found on the Partners in Reptile and Amphibian Conservation's website at <https://parcplace.org/species/collaborative-to-combat-the-illegal-trade-in-turtles/>. Given the threat of illegal collection and that the bog turtle is declining in North Carolina, we wanted to add another level of protection and information gathering to our current efforts to deter poaching. To monitor bog turtle populations in North Carolina, NCWRC and the USFWS have set cellular cameras at numerous sites across western

North Carolina, on both public and private lands, with permission of the landowner. These cameras submit real-time images to staff so enforcement officers can respond immediately if needed (Fig. 1). This operation has been planned and initiated in collaboration with state and federal law enforcement officials.

A side benefit of having these cameras deployed is that over time, they will produce a thorough inventory of the meso-predator species present at each location (Fig. 2). Through this data set, we are learning about both the predator diversity and relative abundance of mid-sized predator species at each wetland complex. This provides valuable information about the degree of threat posed to a particular population by increased predator abundance from human-based subsidies.

With bog turtle populations spread out across the western part of the state, these cellular cameras have proven incredibly helpful at providing a method for biologists and law enforcement to remotely monitor multiple sites simultaneously. In conjunction with these cellular cameras, NCWRC Law Enforcement are stationed in every county of the state, and that allows for close monitoring of each of these important bog turtle populations. Given the utility of these cameras, we plan to deploy cameras at more populations in 2024.



Figure 2. An example of images captured of mid-sized predators that could prey on bog turtles and bog turtle eggs.



Figure 1. These photos demonstrate some of the types of real-time images we are getting of people and vehicles on these cellular cameras.



Rare Hawksbill Sea Turtle Stranded on Hatteras

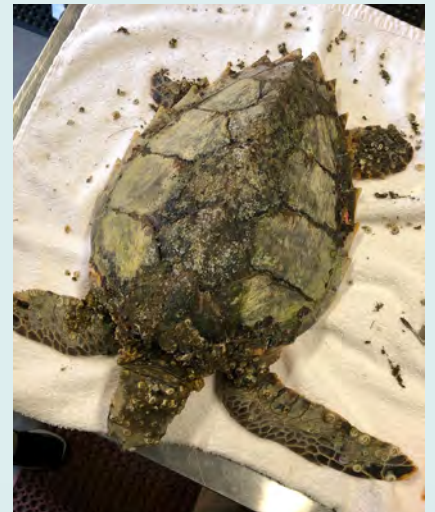
by Dr. Matthew Godfrey, Sea Turtle Biologist and Sarah Finn, Coastal Wildlife Diversity Biologist

Hawksbill sea turtles occur almost exclusively in tropical and semi-tropical waters, where they commonly forage on sponges and other invertebrates in coral reef habitats, and nest on nearby sandy beaches. And yet, there have been a few observations of hawksbill sea turtles in North Carolina waters, including a small post-hatchling turtle that was found washed up on Atlantic Beach in Carteret County in 2017; it was successfully released back to the wild after a short period in rehabilitation.

In late November 2023, another hawksbill sea turtle was found stranded on an inshore section of beach on Hatteras Island during a regular patrol for cold-stunned sea turtles. This hawksbill turtle was not only cold but also skinny and cov-

ered in so many small barnacles that the patrollers did not realize it was a hawksbill sea turtle. Only when the turtle was transferred to the Sea Turtle Assistance and Rehabilitation (STAR) Center at the NC Aquarium on Roanoke Island and the barnacles were removed as part of its initial assessment, did the staff of the STAR Center realize that it was a species rare to North Carolina. One unanswered question is where this turtle could have come from. The closest major nesting sites are in the northern Caribbean, including Mexico, Cuba and the Turks and Caicos Islands. A tissue sample was collected for eventual molecular analysis, to compare its genetic markers with various nesting populations in the Atlantic. The turtle's condition

continues to improve under the care of NC Aquarium staff and, once it is well enough, it should be released back to the wild during 2024.



Above: A stranded juvenile hawksbill sea turtle found in late November 2023 on Hatteras Island. Below: The hawksbill sea turtle in its rehabilitation tank at the STAR Center in Manteo, NC (NC Aquariums)



Conservation Partners Gather for Southern Bog Turtle Meeting

by Gabrielle Graeter, Conservation Biologist/Herpetologist

In November 2023, the U.S. Fish & Wildlife Service hosted multiple partners for a two-day meeting in Asheville, NC, with support and attendance by NCWRC biologists, to discuss an upcoming USFWS Species Status Assessment (SSA) for the southern lineage of the threatened bog turtle (*Glyptemys muhlenbergii*). The southern lineage of the bog turtle is under consideration for federal listing, and the meeting was an opportunity to share knowledge from the latest research, identify data gaps, and better inform the SSA and listing process. Each state presented information about current population status and trends, protection efforts, threats, and management needs and efforts. Attendees included South Carolina Department of Natural Resources, Georgia Wildlife Resources Division, Virginia Department of Wildlife Resources, Tennessee Wildlife Resources Agency, Eastern Band of Cherokee Indians (EBCI) Fish & Wildlife Department, Virginia Tech, Zoo Knoxville, U.S. Forest Service, and non-governmental conservation organizations including The Nature Conservancy, Tangled Bank Conservation, Amphibian and Reptile Conservancy, and Catawba Lands Conservancy.



Meeting attendees listening to a presentation by NCWRC Biologist Gabrielle Graeter during the November 2023 Southern Bog Turtle meeting in Asheville, NC (Gary Peeples/USFWS).

We also heard progress updates regarding the bog turtle Competitive State Wildlife Grant (C-SWG) project in North Carolina, Virginia, and South Carolina. One of the main accomplishments in 2023 was a bucket camera trap survey in NC and VA. Seventeen bogs (9 in NC) were surveyed between the two states, with 11 of those sites confirming bog turtle presence (only 4 of 9 in NC had bog turtles detected). Other C-SWG activities accomplished this year included protection of bog turtle nests, collection of genetic samples, and habitat management workdays.

On the 2nd day of the meeting, we had two small group meetings. The state and tribal wildlife agency representatives met to discuss the SSA process in more detail and everyone involved in the C-SWG project met to coordinate logistics for the coming year. Meetings may not be the most glamorous part of a wildlife biologist's job, but it is an important part of keeping the momentum going with complex projects, facilitating collaboration, and keeping everyone well-informed. It was a very productive meeting that advanced conservation of southern bog turtles and prepared partners for the USFWS Species Status Assessment!



Mike Knoerr with the Amphibian and Reptile Conservancy and Byron Hamstead from the USFWS discuss placement of a bucket-camera trap as part of the C-SWG bog turtle project (Sue Cameron/USFWS).

AMPHIBIANS

Hellbender Surveys in the Watauga River Sub-basin

by Lori Williams, Western Amphibian Biologist

In the second quarter of 2023, Wildlife Diversity staff teamed up with Appalachian State University (ASU), MountainTrue and other volunteers to conduct snorkel surveys for all age classes of the Eastern Hellbender (State-listed Special Concern) in the Watauga River

sub-basin. Despite cold temperatures in May and early June, and challenging river habitat, crews completed surveys and collected habitat data from four 150-meter sites or river transects. We found nearly two dozen hellbenders at three of the four sites, including 14 adults. One

goal of this project is to “mark” adult hellbenders with inserted Passive Integrated Transponder tags (PIT-tags), each with a unique ID number similar to a microchip for a pet, to help monitor hellbender survival and habitat use in subsequent visits. Teams from ASU and others have

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A team of snorkelers searching for Eastern Hellbenders in the Watauga River drainage (Lori Williams)

AMPHIBIANS

consistently monitored hellbenders in the drainage for nearly a decade and recently alerted NCWRC staff to noticeable declines in capture numbers and habitat quality at long-term study sites. Declines could be related to land use changes and/or

potential impacts from recreational use, including private fish stocking and feeding operations. Traditionally, the Watauga drainage was thought to have some of the best remaining hellbender populations in North Carolina, so the documented de-

clines are concerning. However, the fact that we found all age classes of hellbenders at some sites is an encouraging sign. NCWRC staff will continue working with partners in the coming years to assess population trends.



NCWRC Wildlife Diversity technician, Ben Dalton, cradles an adult Eastern Hellbender that was processed for data collection and PIT-tagging (Appalachian State University).



An adult Eastern Hellbender in a measuring board for data collection (Doug Hall)



One of many Eastern Hellbender gilled larvae (1 year-old) found in the upper Watauga River drainage (Doug Hall).

Staff Conduct Research to Detect Effectiveness of eDNA Methodology

by Lori Williams, Western Amphibian Biologist

In March 2023, Wildlife Diversity staff completed another iteration of a field research project testing the distance Eastern Hellbender environmental DNA (eDNA) can be detected downstream from a source. We conducted several previous pilot studies in the last six years with attempts based at Marion Fish Hatchery with our captive hellbenders in outdoor runs and with attempts in

Pisgah National Forest in a stream outside the hellbender's range in the Catawba River drainage (McDowell County). The most successful of our attempts came in 2021 when we met our goal of detecting hellbender eDNA the full 1,000 meters of our study reach. Our methods included dripping water from captive hellbender habitats overnight into the stream to introduce DNA. We also

submerged specimens of dead adult hellbenders in minnow traps so they would shed DNA into the stream overnight as well. The next day, we collected water samples at transects every 100 meters from the farthest downstream point, working our way back upstream to the source. We also collected water quality, stream flow, and substrate composition data to see if there are any correlations

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Wildlife Diversity technician, Ben Dalton, and Inland Fisheries biologist, Peter Lamb, setting up the drip station and the hellbender specimens before deployment in the stream, 2021 (Lori Williams)



Overview of the field set up at the start of the study reach with water drip stations and submerged traps with hellbender specimens, 2021 (Lori Williams)

AMPHIBIANS

with eDNA at each sampling location. This spring, we replicated what we had done in 2021 but this time increased the study area to 2,500 meters downstream. Water samples are currently being analyzed. If we are successful, we will detect hellbender eDNA at least to 1,000 meters again but hopefully beyond that and with a defined ending so we can get a clearer understanding of the effective distance for hellbender eDNA sampling. These results will help us, and other hellbender researchers, better interpret eDNA results from similar mountain streams in terms of potential locations of source animals.



Two of the submerged minnow traps with hellbender specimens, 2021 (Lori Williams)



Wildlife Diversity technician, Reed Rossell, using an electric pump and vacuum flask to filter water samples in the lab, 2021 (Lori Williams)



Wildlife Diversity technicians (Ben Dalton, Reed Rossell) and Inland Fisheries technician and volunteer (Garrett Wood, Hugh Lamb) conducting pebble counts and measuring stream flow, 2022 (Lori Williams)

Biologists See Highest Nest Failure for Green Salamanders in 14 Years

by Lori Williams, Western Amphibian Biologist

Over a year ago, in fall 2022, staff reported 13 years of nest success results for state threatened Green Salamanders. That year, we observed the second-lowest nest success rate on record (50%; $n = 20$ nests). The number of nests monitored since 2010 have ranged from 12 to 42, and success rate has ranged from 38%

to 92% but has declined over time. In fall 2023, during an extreme and prolonged drought, we recorded the lowest nest success rate ever, at 15% ($n = 20$ nests; Fig. 1). Reasons for such a high nest failure remain unknown but could include predation of brooding females and eggs or nest abandonment because of drought

intolerance. From previous years of data analysis, we know the negative impact extreme drought can have on Green Salamander populations. Staff and volunteers will continue to closely monitor nests sites in 2024 to gauge the long-term impact of drought on local populations.

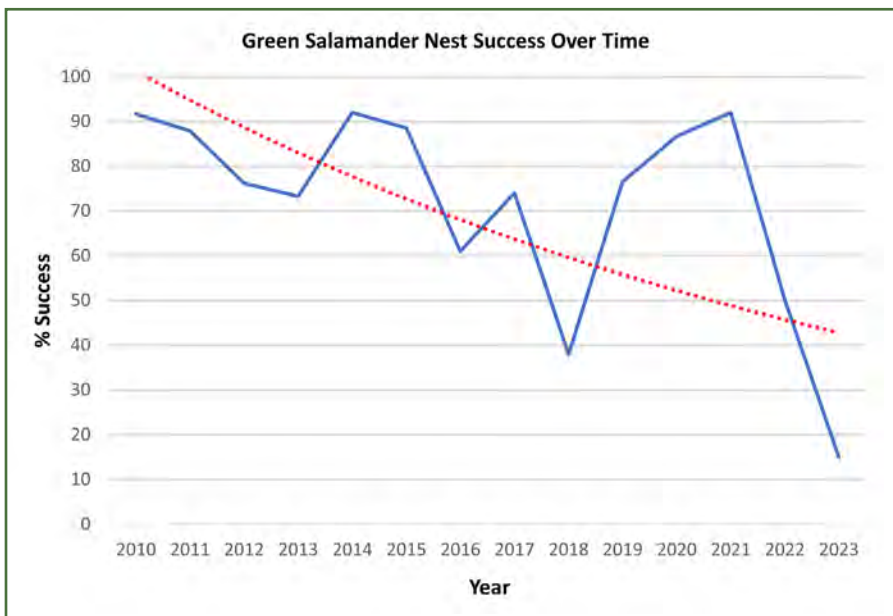


Figure 1. Green Salamander (*A. aeneus*) nest success rate (2010-2023) showing a negative trend over the last 14 years. Sample sizes ranged from 12 to 42 nests.



Left: A female Green Salamander (head visible to left of egg clutch) brooding her nest in a rock crevice. Without the female, eggs are easily predated or succumb to fungus (Alan Cameron). Top: Wildlife Diversity technician, Ben Dalton, climbs a rock outcrop complex in search of salamanders (Lori Williams).

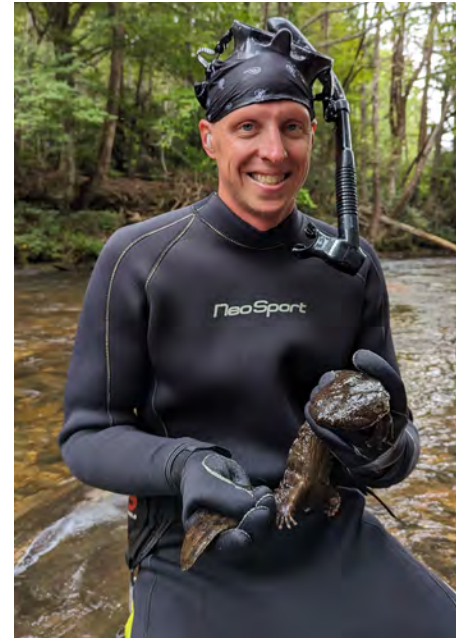
Hellbender Surveys Conducted in the Upper French Broad River

by Lori Williams, Western Amphibian Biologist

Partnerships and collaborations continue to be vital for state Special Concern Eastern Hellbender (*Cryptobranchus a. alleganiensis*) conservation efforts in western North Carolina. A main objective for the summer included collaborating with Clemson University to model hellbender population status and investigate population structure in the upper French Broad River drainage, where surveyors made repeat visits at sites to look for all age classes of hellbenders

and mark adults with a permanent tag. This work will continue in the coming years. Another objective of the collaboration involved hellbender breeding season surveys during this quarter. Each year, our breeding season work spans an intensive 3-week period of daily field surveys. We try to locate sites, count individuals, document where hellbender breeding activity occurs, and record the presence of “den master” males, the individuals responsible for defending

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Top right photo: Wildlife Diversity technician Clifton Avery holds an adult Eastern Hellbender after data collection, before release back to its capture location. (Ben Dalton) Wildlife Diversity technician and Clemson University PhD student, Ben Dalton, snorkels over a male Eastern Hellbender den master in a nest rock. Red arrow points to the den master (Kabryn Mattison).

AMPHIBIANS

nest rocks and egg clutches within. Starting this year, working with Clemson University, we tried to identify what makes used nest rocks different from other, available rocks. We made repeat visits to monitor the outcome at potential nest rocks and record field data on available rock shelters. Seven sites in four streams in the upper French Broad drainage were targeted. In those sites, we identified 44 potential nest rocks based on the presence of a den master male hellbender exhibiting defensive behavior. However, only 12 (27%) of potential nest rocks actually had confirmed nests, across all sites.

This result was rather surprising, as we did not expect it to be so low. As we continue this research going forward, we will gain a better understanding of whether nest presence is inherently low, even for our “best” populations, or if lack of nesting may be a sign of more serious population threats.



Top right photo: Wildlife Diversity biologist Lori Williams inserts a permanent marker, a PIT-tag (Passive Integrated Transponder), in an adult Eastern Hellbender. The tag is like a microchip to detect and identify individual animals on subsequent visits. Above photo: Under a nest rock, a male Eastern Hellbender den master guards his nest of eggs. Red arrows point to the hellbender on the left and eggs on the right.



*Underwater camera (borescope) images inside nest rocks: a male Eastern Hellbender den master (on left) and a clutch of eggs (on right).
(All photos: Ben Dalton)*

NCPARC



N.C. Partners in Amphibian and Reptile Conservation Updates

by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

GOPHER FROGS

Due to continuing winter drought, most winter amphibians had a poor breeding year. Gopher Frogs (below) were among the amphibians affected by drought, with only 1 of the 7 known populations showing any reproduction. However, the bright spot is that the population with breeding was the Holly Shelter Game Land population, and staff detected the most egg masses (right) ever found there (28 total egg masses). In addition, in conjunction with Land and Water Access staff, Wildlife Diversity staff have been working on restoration efforts in several ponds on the game land. Gopher Frogs

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NC PARTNERS IN AMPHIBIAN & REPTILE CONSERVATION (NCPARC)

bred in three of those ponds. One of the ponds they bred in had never yielded reproduction before, and it had 4 egg masses this year. Another pond yielded greater production than in any previous year with 7 egg masses this year. Gopher frogs also bred in the same primary pond they have been using in recent years and appear to be making use of the restored vegetation staff have added into that pond as well (17 egg masses). Because of the successful breeding at Holly Shelter, staff have been able to partner with three different locations to continue head-starting efforts: the NC Aquarium at Fort Fisher, NCSU's Center for Marine Science and Technology, and the USFWS National Hatchery at Edenton. Each partner is working on raising tadpoles to frogs that will be released back to Holly Shelter around June or July.



Staff collected egg masses to conduct head-starting efforts, raising tadpoles in containers so that they can be released back to Holly Shelter this summer (Jeff Hall).



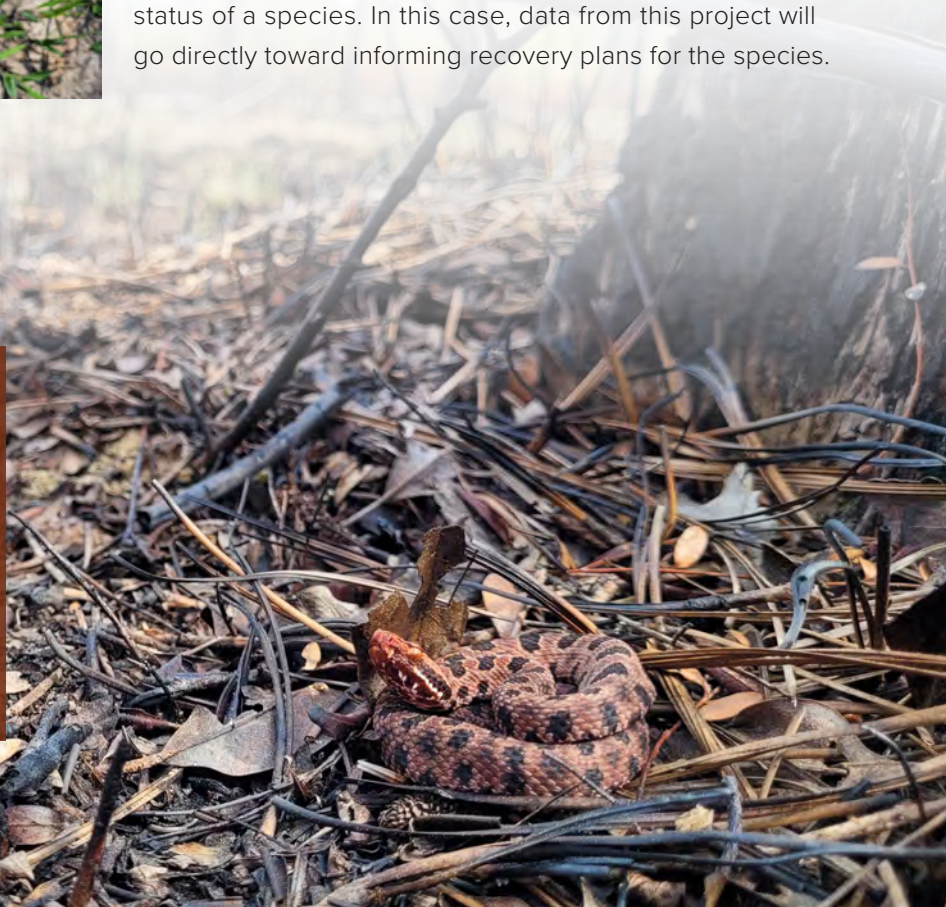
Neuse River Waterdog (Jeff Hall)

NEUSE RIVER WATERDOGS

Staff again assisted NCSU graduate student Eric Teitsworth and his field technicians with survey efforts for the federally threatened Neuse River Waterdog. This is the final survey year for this student's project. Multi-year wide-ranging surveys like these can be helpful for determining the status of a species. In this case, data from this project will go directly toward informing recovery plans for the species.

SGCN SNAKES

Staff have participated in many surveys for upland snakes in areas with recent prescribed fire and have detected numerous Species of Greatest Conservation Need (SGCN) snakes including: Carolina Pigmy Rattlesnake (right, Jeff Hall), Mole Kingsnake, and Eastern Coachwhip.





Spotted Turtle (Jeff Hall)

SPOTTED TURTLES

During this quarter, NCWRC staff continued monitoring efforts as part of a long-term mark/recapture project for Spotted Turtles. This is now year four of the project and more than 300 turtles have been marked in the project area. The results from this project should help USFWS staff more accurately understand abundance of this species in NC as they draft a Species Status Assessment and consider whether this species will receive federal protection.

MANAGEMENT ACTIONS TO BENEFIT GOPHER FROGS

Several management actions took place on Holly Shelter game land during this quarter by NCWRC staff and partners directed at Gopher Frog conservation. These activities included releases of head-started juvenile frogs, as well as preparation and restoration of ponds. Partner head-starting agencies, including the NC Aquarium at Fort Fisher, NCSU CMAST, Carteret Community College, and the USFWS Edenton National Fish Hatchery were able to release all remaining juvenile frogs during July. Then later in August and September, pond restoration efforts kicked into full gear. Building on previous work with several ponds on the game land, staff used water pumps to fully dry down a man-made pond to enable the addition of higher quality soils and appropriate herbaceous vegetation (right photo). These additions to the pond will bolster the local population of Gopher Frogs by giving them additional places to lay eggs and better habitat for tadpoles to develop, both hopefully leading to more recruitment of adults.



(Jeff Hall)

TIMBER RATTLESNAKE GENETICS PROJECT

During the third quarter, staff conducted surveys for a long-term genetics project focused on conservation of the Timber Rattlesnake. Staff visited sites in Pisgah National Forest, along the Blue Ridge Parkway, and at several state parks. During surveys, tissue samples in the form of shed skins were acquired for future analysis, along with clipped scales and/or muscle tissues taken from road-killed specimens. Staff continued to receive reports from the public as part of our community rattlesnake project with over 200 sightings documented in 2023.



*Clockwise from top left:
gravid female Timber Rattlesnakes;
a shed skin from a
Timber Rattlesnake; and a
Timber Rattlesnake neonate
(All photos: Jeff Hall)*



SPECIES OF GREATEST CONSERVATION NEED SURVEYS

Field work during the fourth quarter included surveys and monitoring on both public and private lands to detect SGCN snakes such as Carolina Pigmy Rattlesnake, Timber Rattlesnake, Southern Hognose Snake, Northern Pine Snake, and Eastern Coachwhip, just to name a few. Visits to private lands often result in opportunities to discuss management actions directly benefiting reptile and amphibian species, as well as other wildlife. Additionally, sometimes these landowners are good candidates for the Wildlife Conservation Lands Program leading to further conservation actions. Additionally, staff deployed over a dozen automated audio recording devices (AKA “frogloggers”) to detect SGCN frogs and toads. Several of these were deployed on private lands, with permission from landowners.

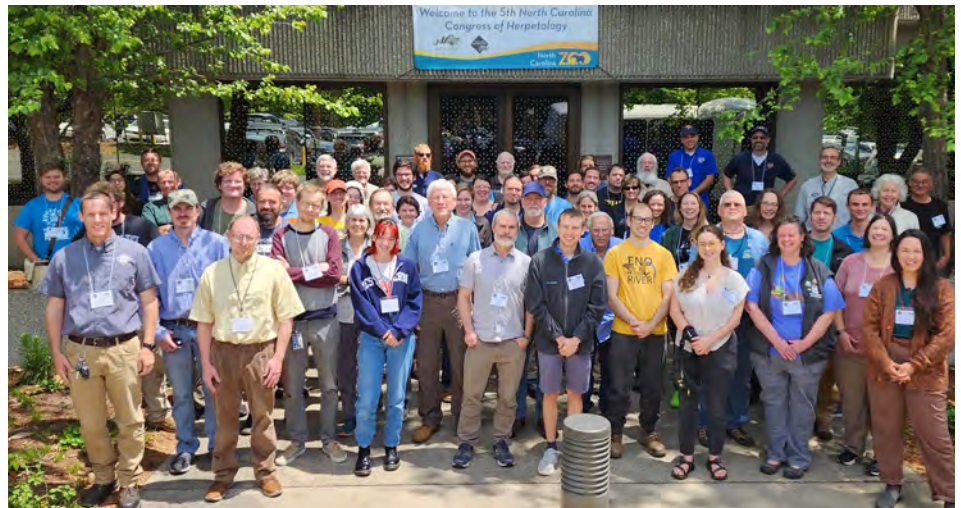


Clockwise from top left: Froglogger; Carolina Pigmy Rattlesnake found on private land in Hyde County; Carolina Pigmy Rattlesnake found on Sandhills Game Land.

NCPARC MEETINGS

In February, Southeast Partners in Amphibian and Reptile Conservation (SEPARC) held its annual meeting at the Blue Ridge Assembly in Black Mountain. This was the third time the regional meeting has been held in NC and the second time at this location. As the group has grown, finding a location to hold all the participants has been a challenge, but this western NC location has been up to the task! This year was no different as the meeting attracted 282 in-person attendees and 25 virtual registrants. NCWRC staff were heavily involved in the meeting as moderators for sessions and keynote panels, leaders of task teams, presenters of both talks and posters, and facilitators of workshops. To learn more about the meeting including a full agenda, as well as abstracts for the presentations and posters, visit the [SEPARC website](#).

The North Carolina Chapter of Partners in Amphibian and Reptile Conservation (NCPARC) held its annual meeting jointly with the North Carolina Herpetological Society (NCHS) from Friday-Sunday, May 5-7, at the North Carolina Zoo in Asheboro. This joint meeting between NCPARC and NCHS was represented as the 5th NC Congress of Herpetology. The meeting had



Attendees gather for a photo during the NCPARC and NCHS joint meeting in May in Asheboro (Jeff Hall).

about 95 in-person attendees with an additional dozen online viewers through Zoom. Fifteen presentations over the first two days covered species from American Alligators to Neuse River Waterdogs to Timber Rattlesnakes and many more. The final day of the meeting was devoted to field trips including sites in the Uwharries and Sandhills. A more detailed account of the meeting can be found in the July issue of the NCHS newsletter (NC HERPS, Volume 46, No. 3).

During the third quarter, NCPARC members were involved in several important webinars, presentations, and meetings. This included a joint presentation with staff from the N.C. Museum of Natural Sciences on Snakes of the Piedmont to the Chatham Conservation Partnership, a virtual meeting with North Carolina and South Carolina partners to facilitate discussion about Gopher Frog conservation, a virtual meeting with North Carolina and Virginia partners to discuss future Tiger Salamander collaboration, and a presentation given about the NCWRC community rattlesnake project to a regional meeting about Timber Rattlesnakes.

Additionally, staff visited with a landowner in Columbus County to conduct surveys for rattlesnakes, as well as assess the property for potential rattlesnake habitat. Through these visits, NCWRC staff can determine whether a landowner might be eligible to enroll in the Wildlife Conservation Lands Program. These sorts of site visits are wonderful opportunities for NCWRC staff to collaborate with private landowners and learn more about rare species in our state.

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NCPARC highlights from the fourth quarter of 2023 included presentations to many groups including the Carteret Wildlife Club, the Croatan chapter of the Society of American Foresters, the NCSU Herpetology Club, the UNCW Wildlife Club, the University of Mount Olive, the NC Herpetological Society, and the NC Longleaf Summit. Presentations ranged from regionwide overviews of WRC herpetological projects to specific details of individual species projects such as Gopher Frog and Southern Hognose Snake. Presentations such as these continue to be very popular and are an excellent way to keep the



Jeff Hall

community aware and knowledgeable of WRC projects. WRC staff also hosted a congressional staffer on Sandhills game land in October (right photo). This gave staff an opportunity to share information about ongoing management efforts for numerous species including several SGCN reptiles and amphibians.



Collaborator John Sealy and NCWRC geneticist Kara Carlson process rattlesnake samples (Jeff Hall).

Timber Rattlesnakes

To continue efforts towards understanding the genetic diversity of Timber Rattlesnake populations in NC, staff met in Raleigh during the fourth quarter to process samples of tissues, such as shed skins, scale clips, and rattles. Staff geneticists have been invaluable in this process. An assessment of allelic diversity and heterozygosity within and between populations is needed to determine the long-term viability and conservation needs of these populations and will allow for more concerted management efforts in areas with at-risk populations.

MAMMALS

Project Status Update: Interspecific Competition, Population Genetics, Hybridization Zones, and Management of Appalachian Cottontails

by Andrea Shipley, Mammalogist

This project is a partnership among the N.C. Wildlife Resources Commission, Tangled Bank Conservation, and Virginia Tech, and it will help us better understand the distribution of Appalachian Cottontails (below; NC State Parks), understand where Appalachian Cottontails co-occur and hybridize with Eastern Cottontails, and provide clear management objectives to both monitor Appalachian Cottontails and promote the habitat that Appalachian Cottontails depend on.

The team has begun planning the sampling design and protocol, which will target 60 sites across western

North Carolina, at which scat surveys will be conducted. Twenty-six sites have been selected as priority sampling locations, and 62 transect locations have been selected within them. Additional sites are being selected and access permission is being acquired for sites on private land. The team has scheduled meetings with partners to discuss project planning and details.

The protocol for sampling rabbit scat along transects has been updated by species experts and adjustments were made to the protocol to ensure project objectives will be met. This new scat sampling

protocol was field tested during winter 2023, and 22 samples were collected across one site. These winter surveys continued through March 2023 and will resume again in December 2023.

To supplement field-collected scat samples from this project, the team is sorting through a database of scat samples from previous collection efforts. Selected samples will be used to bolster the sample size of scat analyzed for genetic properties, principally, species identification and rate of hybridization.



First Record of a Southern Flying Squirrel after 20 years of Squirrel Box Surveys: Are They Creeping Upslope?

by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

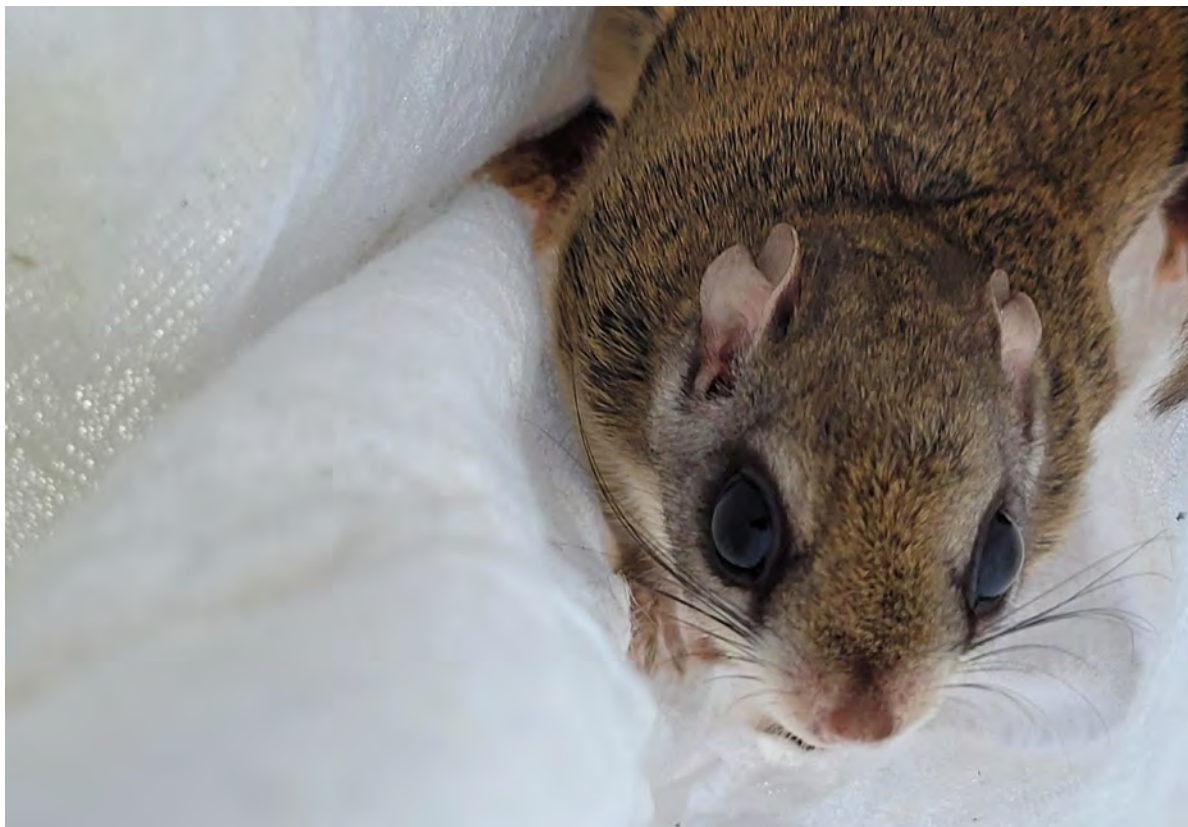
Wintertime in the mountains is time for NCWRC's annual nest box monitoring for the endangered Carolina Northern Flying Squirrel. Biologists bundle up, strap on ice cleats, and head up to the high peaks to check hundreds of snow-encrusted wood boxes for this rare rodent. But winter 2023 wasn't typical, nor was one of the flying squirrels captured in the Black Mountains in Yancey County. On Jan. 30, the NCWRC's flying squirrel team captured a Southern

Flying Squirrel in a squirrel box off State Route 128 — the entrance road to Mount Mitchell State Park. This is the first record of a Southern Flying Squirrel in 20 years of monitoring this transect of nest boxes in the Black Mountains massif.

Southern Flying Squirrels are common across North Carolina, but scarce in the high peak forests of western North Carolina. They are occasionally captured incidentally in squirrel boxes or traps during sur-

veys for the rarer Carolina Northern Flying Squirrel in a few areas where their ranges overlap. Those areas of overlap, or sympatry, have remained fairly steady over two plus decades of squirrel box monitoring in the mountains. Records of overlap are found in other high elevation massifs in western North Carolina, including at higher elevations in the more southerly Great Balsams massif. This particular individual was captured at an elevation of 5,482 feet in a stand of

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A Southern Flying Squirrel captured in January (Christine Kelly)

Red Spruce, Fraser Fir, Yellow Birch, and other northern hardwoods with a component of Norway Spruce that was introduced during early efforts in the mid-20th century to restore the logged forest. All previous records of Southern Flying Squirrel captures in the Black Mountains massif have been below 5,000-foot elevation, particularly in areas with a component of oak, beech, and cherry.

Biologists point to a few reasons Southern Flying Squirrels are not typically found at high elevations year-round. The tiny Southern Flying Squirrel loses body heat easily because of its large surface area to volume ratio. To stay warm enough to survive and remain active in the cold at high elevations in winter, it needs a cacheable food source. Most Red Spruce, Fraser Fir, and northern hardwood forests lack a reliable source of hard mast for caching. In contrast, the larger Northern Flying Squirrel does not rely on a cacheable food source to survive the cold winters up high and it loses body heat less rapidly. But winter 2023 featured periods of mild temperatures and very little snow or ice. Mount Mitchell averages 89.1 inches of snow annually, but received only 24.9 inches between December and March. Under those circumstances, a Southern Flying Squirrel could conceivably survive at higher elevations. The individual captured was an adult male in breeding condition, which is often associated with long distance dispersal movements in late winter.

Although this is a single incident,

biologists' concern is that the smaller Southern Flying Squirrel could, if more incidents occur, potentially displace the Carolina Northern Flying Squirrel through range expansion, competition for cavities, hybridization, and parasite transmission. Regarding the latter, Southern Flying Squirrels can transmit a parasitic nematode (*Strongyloides robustus*) to Carolina Northern Flying

Squirrels through shared den sites. While the Southern Flying Squirrel suffers little in the way of deleterious effects from the parasite, infected Northern Flying Squirrels tend to show poor body condition, which can negatively impact reproduction. Thus, NCWRC biologists are keeping a close eye on changes to these areas of sympatry, particularly with warming climate trends.



Top photo: A Southern Flying Squirrel captured in January (Christine Kelly);



Left photo: Biologists captured a male Southern Flying Squirrel near Mount Mitchell (Clifton Avery).

NCWRC staff conducted bat hibernacula counts in January and February and noted increasing tricolored bat counts at six of eight long-term sites surveyed. The combined tricolored bat count from all eight sites was up 52% from the previous survey. This species was recently proposed

to be listed as endangered by the US Fish and Wildlife Service because of population declines caused by white-nose syndrome (WNS). Winter counts of tricolored bats have declined 95% in western NC since WNS arrived, so this year's increase, though small, is encouraging (Figure 1). A slight

bat, which was also observed in the 2020 decline of 97% in same positive rate. The winter emergence over the three spring years. The emergence of this with the highest survey of first February bats in the state showed 5 little brown bats first 2020 the 43 first white (February 20, 102st was the first travel to school one little brown bat

Year	# Tricolored Bats
2010	4900
2011	4850
2012	3200
2013	1000
2014	400
2015	100
2016	100
2017	100
2018	150
2019	200
2020	250
2021	200
2022	100
2023	300

A photograph of a worker in a dark tunnel. The worker is wearing a white helmet with a headlamp, a white face mask, and orange gloves. They are holding a flashlight in their right hand. The tunnel walls are rough and rocky. Another worker is visible in the background.

Wildlife Diversity Technician, Joey Weber, observes a hibernating tricolored bat. (Katherine Etchison)



Tri-colored bats (Katherine Etchison)

of decreasing since arrival of WNS in the colony site. Counts of Virginia big-eared bats, a federally endangered species not susceptible to WNS, also increased this winter. The 2023 count of 462 Virginia big-eared bats surpassed the highest count on record, which was 431 in 2007 (Figure 3).

NCWRC staff also conducted bridge surveys for bats on the Coastal Plain after receiving a 20-year-old dataset from NC State University and University of North Carolina Wilmington students. Twenty-one bridges with previous summer evidence of bats were surveyed in January and tricolored bats were found roosting under 9 of these bridges (Figure 4). Roosting data for this species are scarce and the use of bridges is not well understood, so these records are significant. NCWRC staff will continue surveying bridges identified in the historic dataset to better understand tricolored bat occurrence in bridges on the Coastal Plain in winter and summer.

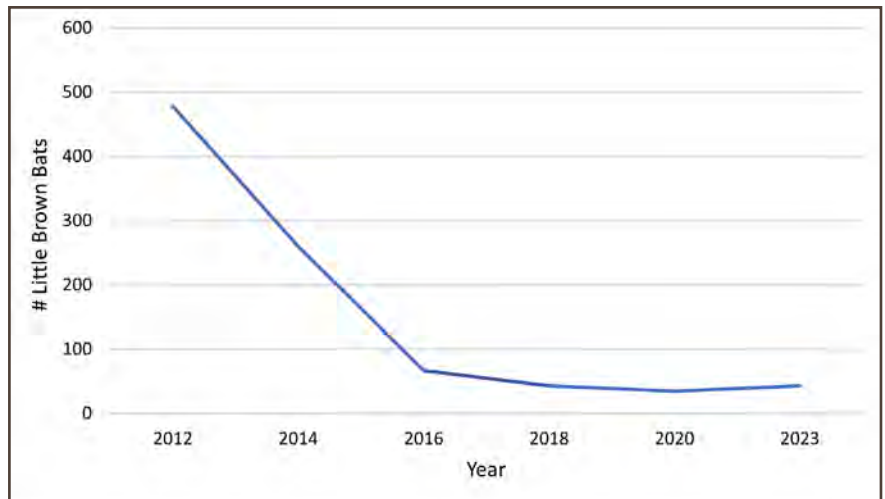


Figure 2. Little brown bat counts at the last known hibernaculum in western NC from 2012 to 2023.

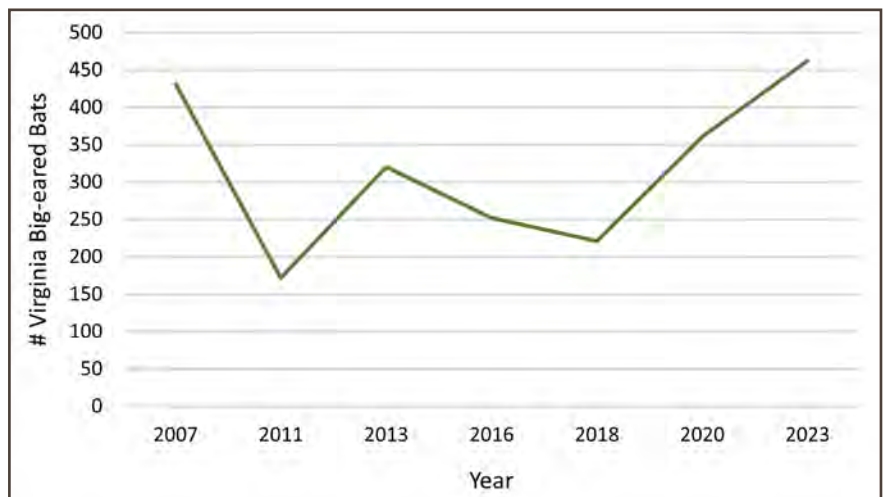


Figure 3. Virginia big-eared bat counts in the primary hibernacula from 2007 to 2023

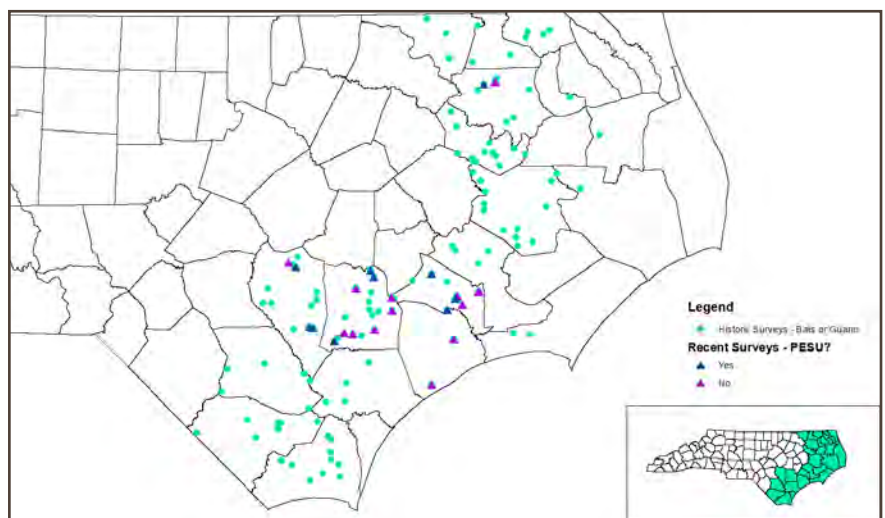


Figure 4. Map of historic bridges with bats or guano and NCWRC 2022-2023 tricolored bat findings (PESU).

20-Year-Old Dataset Guides Efforts to Find Bats in Coastal Plain Bridges

by Katherine Etchison, Mammalogist

During spring 2023, NCWRC staff conducted bat roost surveys of 23 bridges to investigate bat presence in bridges with historic bat roosting records from 1998-2002. Bridges were surveyed in five Coastal Plain counties in May, and bats were found using nine bridges with two additional bridges showing signs of bat use. Tricolored bats were found

roosting under six bridges, Rafinesque's big-eared bats were found roosting under two bridges, and a big brown bat was found roosting under one bridge. Tricoloreds were in clusters of three to five individuals or roosting singly, and immature bats and adults were observed in the clusters. This species roosted in four bridges that had not been

replaced since the original survey, and two bridges that were replaced since the original survey. Based on the historic and 2023 records, this species appears to rely on bridges as roosts to some degree on the Coastal Plain.

The highest bat count occurred at a bridge that was used as a maternity site during the original survey in 1998, which has not been replaced. Seventy-three (73) adult Rafinesque's big-eared bats were counted, and a telltale bump could be seen under most adults' wings, signifying the presence of a bat pup tucked closely to the adults' bodies.

Because the historic dataset is proving useful in finding current bat roosts, additional follow-up bridge roost surveys are planned for the coming years.



A cluster of tricolored bats roosting under a Coastal Plain bridge (Katherine Etchison)



A cluster of Rafinesque's big-eared bats roosting under a Coastal Plain bridge (Katherine Etchison); Right: Wildlife Diversity Technician, Joey Weber, records data during a bat roost survey at a Coastal Plain bridge (Katherine Etchison).



Little Brown Bat Radiotelemetry Pays Off for Second Year in a Row

by Katherine Etchison, Mammalogist

Captures of little brown bats have become a rarity in NCWRC's long-term mistnetting surveys in the wake of White-nose Syndrome (WNS) except at one site in Avery County. Little brown bats are still reliably caught at this net site each summer and a total of 54 little brown bats have been caught since WNS was detected in 2011. Efforts to understand this survivor population began in 2022 with a radiotelemetry survey that led to the discovery of a large roost 2.5 miles from the net site. NCWRC staff are working closely with the landowner to monitor the roost and to learn more about this survivor population.

Because the 2022 efforts were so successful, a second round of radiotelemetry was conducted in 2023. In August 2023, NCWRC biologists radio-tagged two (2) little brown bats from a bridge roost in Watauga County. The radio-tagged bats were tracked 11.2 miles away to a cellar beneath a home in Avery County. This was surprising because the bats radio-tagged in 2022 roosted less than three (3) miles from their capture site and because the cellar is underground and somewhat cave-like. NCWRC biologists are working closely with the landowner to understand the number of bats roosting in the cellar and how often bats are present. Additionally, the cellar will be monitored this



A radio-tagged little brown bat in Watauga County
Katherine Etchison

winter to determine if bats use it as a winter roost. WNS is established in caves and mines in the area, but this cellar could offer a WNS-free refuge if bats are using it as a hibernaculum.

Joey Weber



Left: Wildlife Diversity Biologist, Katherine Etchison, tracking radio-tagged little brown bats. Right: The entrance to a cellar where little brown bats were found roosting

Katherine Etchison



Appalachian Cottontail Research Update

by Andrea Shipley, Mammalogist

A research project aiming to better understand the distribution, sizes, and connectivity of Appalachian Cottontail populations in North Carolina, as well as the species' interspecific competition, population genetics, hybridization zones, is being funded by the Commission. The following is an excerpt from Tangled Bank's most recent interim report.

As of Jan. 9, 2024, we have completed scat surveys and collected habitat quantification data along 150 transects across 52 sites (Fig. 1). Fourteen of these sites are privately owned, and 38 are on public lands. An additional four privately owned sites will be surveyed in late winter to early spring 2024. We will conduct occupancy analyses on a subset of these sites; 18 total sites will receive duplicate surveys for occupancy analysis. To date, 12 sites (9 in winter 2022-23, 3 in winter 2023-24) have been surveyed twice, and the remaining 6 sites have been surveyed once. The repeat occupancy surveys at these six sites will be conducted in late winter to early spring 2024 (Fig. 2). Thirty-four new sites were surveyed from fall to winter 2023-24. We will survey an additional eight new sites in late winter to early spring 2024. As of Jan. 9, 2024, we have collected 1,388 rabbit scat samples that will be used for genetic analysis. Samples will be extracted and processed in 2024.

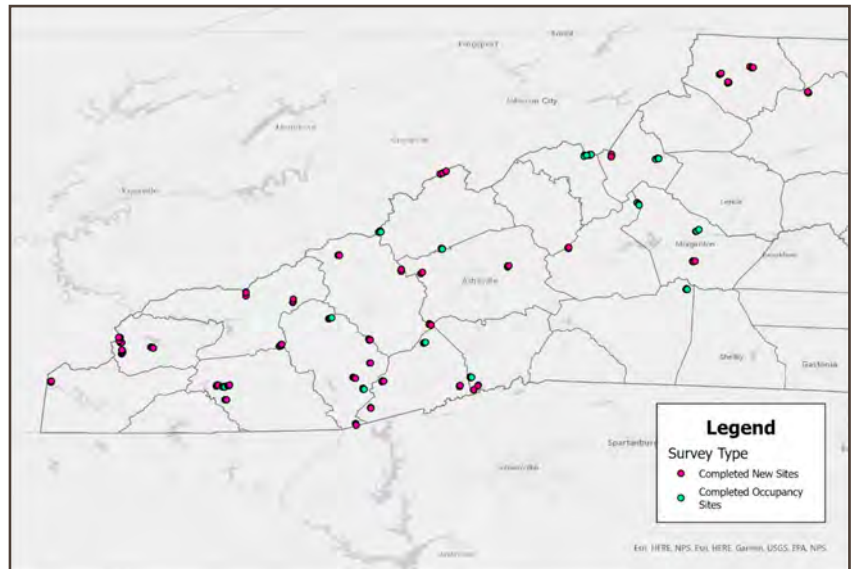


Figure 1. Locations of completed Appalachian Cottontail scat surveys as of January 9, 2024, in western North Carolina. Completed new site surveys are represented by pink circles, and completed occupancy surveys are represented by green circles.

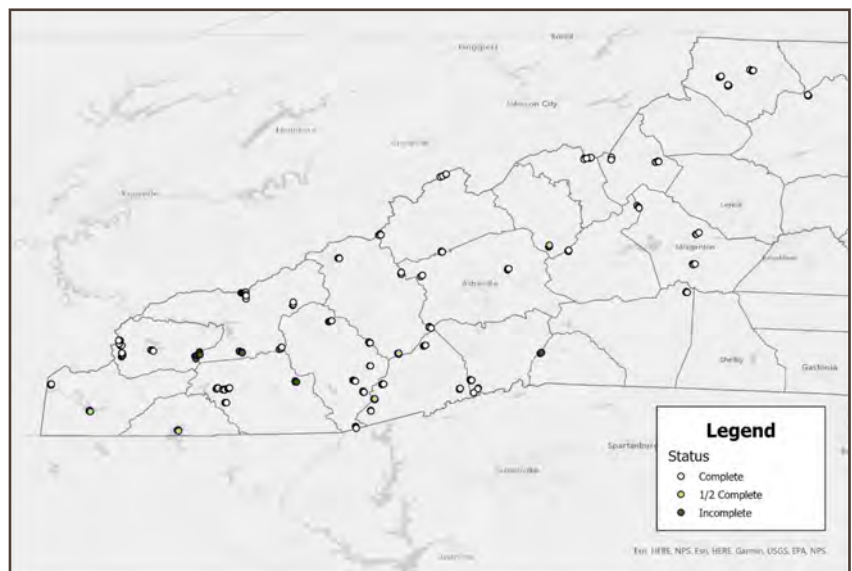


Figure 2. Locations of completed and planned Appalachian Cottontail scat surveys as of January 9, 2024, in western North Carolina. Note that there are 3 sites where transect locations have not been planned yet, so these are not represented on this map. Complete surveys (both occupancy surveys and new site surveys) are represented by white circles, incomplete surveys are represented by dark green circles, and occupancy surveys that have been surveyed once and will be surveyed a second time are represented by light green circles.

A Busy Season for Bat Outreach and Meetings

by Katherine Etchison, Mammalogist

As summer fieldwork came to an end, public outreach events and meetings ramped up. Wildlife Diversity staff delivered bat presentations and programs on ten occasions to groups ranging from k-12 students, college students, state and federal agency colleagues, conservation groups, and more. Highlights includ-

ed a homeschool educational event at Reed Gold Mine in Midland with over 1,000 attendees, a Bat Week educational event at Sierra Nevada Brewing Co. in Mills River with over 100 attendees, and hosting the annual NC Bat Working Group meeting at the NC Zoo in Asheboro. Much of the year is spent gathering

data in the field, and updates on this work through outreach and meetings with peers are crucial for continued conservation of bats in NC. Presentations and programs were well received, and many groups have requested annual bat programs in future years.



Wildlife Diversity Technician, Ellen Pierce (left), and Community Science Specialist, Karen Clark (right), deliver a presentation at the NC Bat Working Group Meeting. (Katherine Etchison)



Wildlife Diversity Biologist, Katherine Etchison (left), Community Science Specialist, Karen Clark (middle), and Wildlife Diversity Technician, Joey Weber (right), speak with attendees about the importance of bat conservation at the Sierra Nevada Brewing Co. Bats and Brews event (Sue Cameron).



Wildlife Diversity Biologist, Allison Medford, educates attendees of the Reed Gold Mine Homeschool Day (Katherine Etchison).

FISHES

An Update on Sucker Translocations in the French Broad River

by Dylan Owensby, Western Region Aquatic Wildlife Diversity Biologist

Reintroductions for three sucker (Catostomidae) species to the upper French Broad River continued in 2023. Biologists with the Western Region of the Aquatic Wildlife Diversity Program and the US Fish and Wildlife Service have been capturing Smallmouth Buffalo, Black Buffalo,

and Smallmouth Redhorse, from the French Broad River near Marshall and transporting them approximately 55 river miles upstream to the French Broad River near Etowah. Active reintroductions are the only way for these species to return to portions of the watershed that they

once inhabited; a series of dams on the French Broad River downstream of Asheville currently prevent them from swimming upstream.

During three days in October 2023, biologists used boat electrofishing to capture and translocate 165 suckers (7 Black Buffalo, 26

continue on next page



Smallmouth Buffalo and 132 Smallmouth Redhorse). As with past reintroductions, each fish was weighed, measured, photographed and given a unique PIT tag before being transported in a fish hauling tank to their new home upstream. Since spring 2022, biologists have now moved 390 adult suckers (37 Black Buffalo, 103 Smallmouth Buffalo and 250

Smallmouth Redhorse) to the upper French Broad River.

Initial monitoring efforts have provided biologists with an early indication that at least some of the fish are sticking around. Two Smallmouth Redhorse were captured by boat electrofishing in the vicinity of the stocking site in late October. Specialized PIT tag antennae that have

been deployed at restoration sites in the upper French Broad River have also detected one Black Buffalo and one Smallmouth Buffalo earlier in 2023. Biologists are planning to continue reintroduction efforts and will also be monitoring changes in the fish community of the upper French Broad River in the coming years.



Above: Aquatic Wildlife Diversity Biologists work up suckers downstream of Redmon Dam prior to translocation. (Luke Etchison) Previous page: Aquatic Wildlife Diversity Biologist, Chantelle Rondel, releases a sucker into the upper French Broad River (Dylan Owensby).

Freshwater Drum Reintroductions in the French Broad River

by Dr. Luke Etchison, Western Region Aquatic Wildlife Diversity Coordinator

Biologists with the Western Region of the Aquatic Wildlife Diversity Program started a reintroduction project aimed at restoring Freshwater Drum populations in the upper French Broad River. Freshwater Drum are one of many fish species that are found in the lower French Broad River that are currently unable to occupy their former native range further upstream. A combination of past water quality issues and three dams on the mainstem French Broad, all of which are located downstream of Asheville, has prevented the fish from returning to large portions of the watershed that they once inhabited.

Reintroduction of species like the Freshwater Drum into its historical range will improve mussel populations by establishing an important host fish

for many imperiled mussel species. For example, Freshwater Drum are the only known fish host for the recently discovered Pink Heelsplitter. The Pink



Freshwater Drum from the French Broad River near Marshall, NC (Dr. Luke Etchison)

Heelsplitter is a rare freshwater mussel species and is proposed as Special Concern in North Carolina. The Pink Heelsplitter is only found where Freshwater Drum occur and they have a limited distribution in the Madison County portion of the French Broad River.

In spring of 2023, 109 Freshwater Drum were collected by Tennessee Wildlife Resources Agency in the French Broad River and Nolichucky River sections of Douglas Reservoir in Tennessee and were translocated to the upper French Broad River near Etowah, NC. Each Freshwater Drum translocated to the upper French Broad was implanted with Passive Integrated Transponder (PIT) tags to evaluate survival and growth of recaptured individuals. PIT tags will also help evaluate the use of restored slough habitats near Mud Creek. The sloughs are outfitted with PIT tag antennas and will detect the tagged Freshwater Drum if they enter the habitat. Biologists will begin long-term monitoring this summer to evaluate survival and establishment of this reintroduced species.



Freshwater Drum collected at Douglas Reservoir, TN (left); Pink Heelsplitter collected from the French Broad River near Hot Springs, NC (Dr. Luke Etchison)

MOLLUSKS

Biologists Investigate the Effects of Release Timing and Microbiomes in Two Propagated Mussel Species

by Michael Fisk, Eastern Region Aquatic Wildlife Diversity Coordinator

Aquatic Wildlife Diversity staff are working with NC State University PhD candidate, Madi Polera, investigating the effects of release timing on mucosal microbiomes in propagated Yellow Lance and Dwarf Wedgemussel. A mussel's microbiome is linked to its overall health, but these microbiomes are largely undescribed and its not well understood what factors can impact it. Our objective is to determine how the

microbiome is affected by timing of release (i.e., Spring vs Fall) and how it changes over time compared to resident wild mussels. Staff have released Dwarf Wedgemussel into Swift Creek and Little Shocco Creek in Johnston and Franklin counties as well as Yellow Lance into Fishing and Shocco creeks in Halifax and Franklin counties. Releases took place in November 2022 and Spring 2023. Surveys will be conducted this

year to recapture tagged individuals and re-swab them to describe and compare microbiomes. By describing and establishing a baseline of health and fitness, a suite of biomarkers and mussel health metrics can be used to assess the health and fitness of mussel populations and can be used to inform management actions, hatchery operations, and species restoration efforts.



Big Mussel News on the Little River

by Chantelle Rondel, Aquatic Listed Species Biologist

In May 2023, Western Region Aquatic Wildlife Diversity staff and U.S. Fish and Wildlife Service biologists surveyed the Little River of the French Broad River Basin for a federally threatened species, the Longsolid. The goal of these surveys was to collect individuals to take to the Marion Conservation Aquaculture Center (MCAC) for broodstock. In 2022, when propagation of this species started, only 14 individuals were found with over 25 hours of effort. Although the first few 2023 surveys for Longsolid broodstock only resulted in four individuals found in 11 ½ hours, during the third day of surveys, 17 individuals were found in 8 ½ hours

during one day of sampling with 15 of those coming from one small reach in four person-hours. Seven of these Longsolids were transported to the MCAC for propagation while the others were tagged with PIT and Hall-print tags and returned to the reach where they were found.

In June 2023, staff from Western Region Aquatic Wildlife Diversity, U.S. Fish and Wildlife Service and Madi Polera, a Ph.D. candidate at NC State University conducted additional mussel surveys on the Little River to obtain a sizeable sample of each of the five mussel species that call this river home. Madi swabbed multiple individuals of each species to assess health

based on their microbiome. A survey in the same reach where most of the Longsolid broodstock was collected in May resulted in 15 Longsolids, with only two of those being recaptures from earlier in the year. Additionally, four Tennessee Clubshells were found, breaking previous records for the species in the Little River. The Tennessee Clubshell is under review by the U.S. Fish and Wildlife Service and considered state endangered in North Carolina. There were also over 100 Appalachian Elktoe, which is state and federally endangered, found during these surveys. One of the Appalachian Elktoe found was the largest known individual in the world measuring in at 119.05mm found by biologist Dylan Owensby. Other species found during these surveys include the Creeper and Slippershell.

The Little River remains a stronghold for the Longsolid and Appalachian Elktoe in the French Broad Basin of western North Carolina. However, less than 5 river miles of the Little River is currently suitable enough to support this rich freshwater mussel fauna. Monitoring and propagation efforts will continue for the preservation of this population and establishment of other populations throughout the basin.



Clockwise from top left: Western Region Aquatic Wildlife Diversity Biologist Dylan Owensby with a Appalachian Elktoe; Longsolids; smallest and largest Appalachian Elktoe found in a day

Biologists Conduct Rare Mussel Surveys in Rockingham, Davie Counties

by TR Russ, Foothills Region Aquatic Wildlife Diversity Coordinator

Exceptionally low water levels through the late summer and fall allowed Foothills Aquatic Wildlife Diversity (AWD) biologists to conduct surveys in areas where sampling has often been difficult. Biologists focused on two areas with noteworthy populations of rare mussels — the Dan River in Rockingham County and the Dutchmans Creek watershed in Davie County.

Draper Landing on the Dan River, just southeast of the town of Eden, supports a unique and relatively diverse group of mussels. This reach of river is notoriously difficult to sample because of high flows and depth, and also is complicated by hydrologic releases from the Smith River in Virginia. Foothills biologists, along with Eastern AWD staff and Virginia Department of Wildlife Resources biologists, put in a successful effort to locate the federally threatened Atlantic Pigtoe for an ongoing genetic cataloguing project in collaboration with researchers at Georgia Southern University and NC State University. Biologists recovered two individuals, including a juvenile, which indicates reproduction is still occurring in this reach of the river. Biologists also found the federally endangered James Spiny mussel and the proposed federally threatened Green Floater. Dutchmans Creek in Davie County is a direct tributary of the Yadkin River and had somehow evaded proper surveys for freshwater mussels over the last 30 years. The



Federally protected mussels from the Dan River. Top left and center - Atlantic Pigtoe; top right - James River Spiny mussel; bottom left - Green Floater. (Michael Perkins)



Foothills AWD coordinator TR Russ grubs for mussels in Dutchmans Creek in Davie County (Michael Perkins)

watershed is noteworthy because it was the focus of an intense flood management program in the mid-20th century, culminating in the construction of numerous flood-control dams by Natural Resources Conservation Service. Staff conducted several surveys and discovered a robust assemblage of nine mussel species, including the state-endangered East-

ern Lampmussel and state-threatened Creeper mussel, all of which are new records for the county. Staff believe the abundance of low-head dams stabilizes stream habitat as well as boosts the food supply and quality for the mussels downstream, a trend that has been well-documented in other dammed mussel streams in North Carolina and throughout the Southeast.

Genetic Analyses on Listed Mussels Will Help with Future Propagation and Augmentation Strategies

by Mike Walter, Eastern Region Aquatic Wildlife Diversity Biologist

Eastern Region Aquatic Wildlife Diversity staff have been collecting genetic material from several species of mussels within the Tar, Neuse and Roanoke River basins in cooperation with Georgia Southern University. The focus is on the federally endangered Tar River Spiny mussel and Dwarf Wedgemussel, as well as the federally threatened Yellow Lance and Atlantic Pigtoe. The main objective of the study is to gain a better understanding of the genetic diversity of these species within and among river basins and management units.

Biologists collect genetic material by gently opening the mussel a few millimeters and swabbing the foot and visceral mass. In 2023, staff collected 233 swabs from these species in nine management units across three river basins. These samples have been combined with previous year's collections for a total of 365 samples. Collections will continue until June 2024. Once field collections are complete, single nucleotide polymorphism genotyping will be used to elucidate population structure, define population boundaries, estimate effective population sizes, identify cryptic populations, and analyze genetic diversity within and between populations.

These results will help biologists make more informed decisions about propagation and augmentation strategies and aid in conservation efforts that benefit these species.



Tar River Spiny mussel



Dwarf Wedgemussel (USFWS)



Yellow Lance



Atlantic Pigtoe (USFWS)



Mike Walter, Eastern Region Aquatic Wildlife Diversity Biologist and NC State University students swabbing mussels in Swift Creek in Johnston County.

HABITAT MANAGEMENT

Southern Appalachian Spruce Restoration Initiative Update

by: Christine Kelly, Western Bird and Carolina Northern Flying Squirrel Biologist

In October 2023, Great Smoky Mountains National Park hosted the Southern Appalachian Spruce Restoration Initiative (SASRI) annual meeting in Gatlinburg, TN. Highlights were NEPA, a spruce book, and updates to SASRI leadership. NEPA is the National Environmental Policy Act, which guides an often-lengthy process of environmental review for activities such as forest restoration on federal lands. The U.S. Forest Service is backing the development

of a “subregional NEPA” decision to facilitate high elevation forest restoration on national forests in four states (NC, TN, VA, WV). A Red Spruce Technical Advisory Board has been established to provide collaborative technical recommendations along the way. A spruce book is being written by several SASRI members with technical review from a NCWRC biologist. It will be published by Springer Publishing and made available as an eBook

thanks to a donation by The Nature Conservancy. Projected completion date is summer 2024. SASRI is seeking a coordinator position which will report to the SASRI steering committee. Gary Peeples of the U.S. Fish and Wildlife Service completed his two-year term as co-chair of the steering committee, and Jason Rodrigue of the U.S. Forest Service welcomes Marquette Crockett of Southern Appalachian Highlands Conservancy as his new co-chair.



Great Smoky Mountains National Park staff led SASRI members on a hike through the spruce-fir zone (left). SASRI members embraced the spirit of Gatlinburg with their airbrushed flying squirrel t-shirts (Gary Peeples/USFWS).

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The Wildlife Diversity Program

The Wildlife Diversity Program was established in North Carolina in 1983 to prevent nongame species from becoming endangered by maintaining viable, self-sustaining populations of all native wildlife, with an emphasis on species in decline.

More than 700 nongame animals call North Carolina home. Many nongame species, including mammals, birds, amphibians and reptiles, freshwater mussels and fish, are common and can be seen or heard in your own backyard. Other nongame animals, such as bald eagles and peregrine falcons, were, at one time, considered endangered, but now soar high in the sky, thanks to the work conducted by wildlife diversity biologists.

The staff who work for the Wildlife Diversity Program are dedicated to conserving and promoting nongame wildlife and their habitats through a variety of survey and monitoring programs, species management, and habitat conservation or restoration projects. These programs and projects target nongame animals and their habitats, but game species — such as deer, turkey, mountain trout, and black bass — also benefit because they share many of these same habitats.

You can learn more about the many projects and programs conducted by wildlife diversity personnel on behalf of nongame and endangered wildlife by visiting www.ncwildlife.org/wdp.



Jeff Hall