2020
WILDLIFE DIVERSITY PROGRAM ANNUAL REPORT

North Carolina Wildlife Resources Commission
Wildlife Diversity Program
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ncwildlife.org/WDP

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The North Carolina Wildlife Resources Commission's (NCWRC) Wildlife Diversity (WD) Program is housed within the agency's Wildlife Management and Inland Fisheries 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. This report represents an overview of many of the recurring program activities and ongoing research within the WD Program for 2020. Information included herein does not represent the full report on these individual activities. Learn more about the program, ncwildlife.org/wdp.

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- Association of Fish & Wildlife Agencies Feral-Free-Ranging Cat Working Group-Chair
- Association of Fish & Wildlife Agencies Partners in Flight/Shorebird/Waterbird Working Group-Chair
- Partners in Flight Steering Committee-Chair
- University of North Carolina-Wilmington-Adjunct Professor and Graduate Faculty

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- Southeastern Association of Fish and Wildlife Agencies, Wildlife Diversity Committee, Past Chair
- Wildlife Diversity Program Managers, Member

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- North American Bird Conservation Initiative, Communications Committee, Chair

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- Endangered Species Research-Editorial Board
- Marine Turtle Newsletter-Editorial Board
- Florida Atlantic University-Affiliate Scientist
- NC State University College of Veterinary Medicine-Adjunct Professor
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- Western Carolina University-Adjunct Faculty

BIRDS

Posted Nesting Signs Kick off Colonial Waterbird Nesting Season

by Carmen Johnson, Waterbird Biologist

The Wildlife Diversity Program's Waterbirds staff, along with a team of outstanding volunteers, kicked off the 2020 colonial waterbird nesting season by posting area closure signs on several islands along the coast. These islands vary in size and composition, but they all share one unique function: to serve as nesting sites for some of North Carolina's most exceptional species.

As development of the state's coast has increased over the decades, waterbirds have fewer undisturbed areas to raise their young. Protecting these areas is an important part of the work that staff do each year as part of habitat management for these species. Many of these species nest directly on the ground, and eggs and chicks are at risk of being stepped on or predated if people, dogs or other potential predators enter a nesting area. Eggs and chicks can also overheat if the adult is forced to leave the nest for prolonged periods to defend against predators or intruders. The signs alert beachgoers and boaters that the area is protected habitat for nesting waterbirds and should not be entered.

If you spot these signs on your next trip to your favorite beach, or while out on the water, give the birds the space they need and do not trespass into the area.

Piping Plover with chicks (RGL Photography)

Colonial Waterbird Survey Conducted Amid COVID-19 Restrictions

by Carmen Johnson, Waterbird Biologist

Every three years, the NCWRC Waterbird Team sets off to complete the Colonial Waterbird Survey, which occurs during May and June, for colonial waterbirds, such as terns, skimmers, pelicans and egrets. This survey counts all colonial nesting waterbirds in the coastal region and is one of the longest running surveys of its kind, dating back to 1977. Its purpose is to gather data on the population and distribution of these birds, as well as habitat conditions, to aid management decisions by NCWRC and other agencies.

Ten agencies and non-profit organizations surveyed more than 200 sites. Habitats included marsh islands, barrier islands, dredged material islands, shoals and gravel rooftops. Staff typically rely on help from volunteers to complete these surveys, but the safety precautions needed to prevent the spread of COVID-19 required drawing on resources from within NCWRC. Many staff throughout the agency contributed their time and boats to help safely complete this year's count. Data are now being entered in the Colonial Waterbird Database maintained by NCWRC and a report will be completed later this year.

Juvenile Great Egrets (Annika Anderssen)

Juvenile Brown Pelicans (Sue Cameron/ USFWS)

Least Tern eggs (Annika Anderssen)

Social distancing was no trouble as surveyors spaced themselves out to walk through colonies while counting nests. (Carmen Johnson)

Waterbird Team Conducts Semi-Annual Surveys on Stopover Habitat

by Carmen Johnson, Waterbird Biologist

Once a month, during spring and autumn, the Waterbird Team contributes to Manomet's International Shorebird Survey (ISS). Implemented in 1974, the ISS gathers information on shorebirds and the wetlands they depend on from biologists and volunteers all over the world. Conducted March through May and late July through October, these surveys help conservationists understand more about species populations and trends.

The Waterbird Team surveys two sites each month: New Dump Island and the New Drum Inlet Shoals. These sites are located in Carteret County and were chosen because of their importance as stopover habitat for shorebirds during migration. Shorebirds travel thousands of miles on biannual migrations, and stopover sites like these are critical, as they provide safe places for birds to rest, refuel, and seek shelter during the most perilous part of their life cycle. Together, New Dump Island and the New Drum Inlet Shoals provide high concentrations of intertidal habitat full of invertebrates and roosting areas that remain above water during high tide and that are necessary to meet these needs. Species richness (number of species) is highest during spring. During the 2020 surveys the most frequently observed species were Black-bellied Plovers and Sanderlings, followed by American Oystercatchers and Semi-palmated Plovers. Federally Threatened Red Knots and Piping Plovers are also occasionally detected during these surveys. Two Piping Plovers were seen this year, including a bird banded in 2018 at nearby Cape Lookout National Seashore by the Virginia Tech Shorebird Program.

Staff detected 321 Red Knots during their May survey, the second highest count of the species at the site, and an exciting observation since the species, which is listed as federally threatened, has declined by 75% since the 1980s.

Top photo: Sanderling foraging; Red Knots and a Willet foraging (Photos: Annika Andersson)

Waterbird Team Begins Preparations for Spring Nesting Season

Carmen Johnson, Waterbird Biologist

In preparation for nesting season, the Waterbird Team built several chick shelters to be used in a colony of Least Terns at Emerald Isle. A species of special concern in North Carolina, Least Terns nest on bare sandy beaches, dredged-material islands, or gravel rooftops by making a small scrape in the sand where they lay one to three eggs, each slightly smaller than a thumb. Once chicks are mobile, the shelters provide a place for them to get out of the sun and avoid potential avian predators, including gulls. Before nesting begins, signs and symbolic fencing (string and flagging) will be set up around the site, and the chick shelters will be placed at that time and secured from high winds by a stake. Volunteers with the Emerald Isle Beach Bird Stewards help the NCWRC monitor the colony and will document use of the shelters throughout the spring and summer.

Least Tern in flight (John Lynch); inset photo - Least Tern egg and chick (Annika Andersson)

Genetic Research Underway to Determine Status of "Wayne's" Warbler

John Carpenter, Eastern Landbird Biologist

Black-throated Green Warblers migrate to North America every year to breed in coniferous forests throughout the southern Appalachian Mountains north to the boreal regions of Canada. In 1918, a very similar looking but smaller version of this species was discovered near Mt. Pleasant, S.C., which was later found to occupy a narrow and isolated range along the South Atlantic Coastal Plain from southeastern Virginia to central South Carolina. These denizens of the Coastal Plain, now colloquially referred to as "Wayne's" warbler, inhabit swamp and bay forests and have for decades been assumed a subspecies due to their differing habitat preference and apparently smaller bill and duller plumage. To complicate matters further, another isolated population occurs in the south-central part of the state at the Uwharrie National Forest.

New advancements in the world of genetic research, notably Whole Genome Resequencing (WGS), is considered a rapid and effective way to study the underlying mechanisms of species development. The NCWRC, in collaboration with Catawba College and Penn State University, is in the early stages of collecting genetic samples to provide definitive proof if these populations differ and confirm "Wayne's" subspecies status.

NCWRC biologist John Carpenter with banded Black-throated Green Warbler from Bladen County (Alex Worm/NCWRC)

Black-throated Green Warbler (Andy Reago/Chrissy McClarren-Wikimedia)

Staff Conduct Wayne's Black-throated Green Warbler Surveys

by John Carpenter, Eastern Landbird Biologist

In late April, NCWRC temporary biologist Alex Worm hunkered down in Tatum Millpond in Bladen Lakes State Forest to search for male Wayne's Black-throated Green Warblers that weeks earlier had been captured and released wearing color bands. The primary goals were to collect blood samples for genetic analysis and to confirm that these individuals remained in the area to attempt breeding. This section of Bladen Lakes State Forest hosts an incredibly diverse avian community during the breeding season and includes approximately

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eight to 10 territorial Black-throated Green males, which surprisingly and unfortunately, represents some of the highest densities of this species in southeast NC. After successfully finding several banded birds, Alex shifted his attention to nest searching, and over the course of three days, four active nests were located. Most nests were found near a canopy gap in otherwise contiguous forest stands surrounded by large-diameter and tall hardwood and pine trees.

Historically, Wayne's were associated mostly with Atlantic White Cedar forests, but the rise of the shingle industry during the late 1800s decimated this unique ecological community in the southeast. Only one nest successfully fledged young, two failed, and the fate of the fourth is unknown. One of the failed nests did occur in a territory that eventually produced young later in the season. Staff will use this sparse but valuable dataset to continue untangling the mysterious ways of the Wayne's Black-throated Green Warbler.

The first breeding evidence of Wayne's Black-throated Green Warbler along the Atlantic Coastal Plain came from Lenoir County in North Carolina, during the summer of 1905. A second nest was described five years later from Lake Ellis, Craven County, in June 1910.

Wayne's Black-throated Green Warbler nest and attending adult, Bladen County (Alex Worm)

Staff Construct New Prototype Nest Boxes for Barn Owls

by Allison Medford, Piedmont Eco-Region Wildlife Diversity Biologist

Despite the setbacks in field work and landowner meetings due to the COVID-19 related restrictions, the Barn Owl Project is moving forward. Outreach by the public has been sincerely appreciated, and new Barn Owl sites have been identified. Three new prototype nest boxes are ready to be installed on properties of willing landowners. These nest boxes are made from used water totes and provide more floor space for the owl nests. Staff hope to see these boxes get used at a higher rate than the previous plywood style, which is much smaller.

These water tote nest boxes will be installed on 8-10 foot platforms. (Allison Medford)

Staff Begin Installation of New Prototype Nest Boxes for Barn Owls

by Allison Medford, Piedmont Eco-Region Wildlife Diversity Biologist

Barn Owl (Anan Kaewkhammul)

The Barn Owl is a N.C. Wildlife Action Plan Species of Greatest Conservation Need (SGCN) that has had little investigation in the past several decades, and biologists know little about its distribution and abundance across the state. In 2018, Wildlife Diversity Program biologist Allison Medford undertook a monitoring scheme for Barn Owls statewide. With the help of John Isenhour, District Conservation Biologist in District 6, Chris Kelly, Wildlife Diversity Program biologist in the mountains, and technician, Clifton Avery, staff are preparing to install nest boxes on properties with Barn Owls across the state.

Barn Owls are difficult to survey and monitor using typical sampling techniques like point counts and driving transects. They are secretive and nocturnal, so the best way to monitor them is by finding nests or monitoring occupied nest boxes as well as asking the public for sightings. In 2019, NCWRC sent out a news release seeking information on Barn Owls from the public. A few reports of owls and a ton of requests for nest boxes flooded in! Unfortunately, Barn Owls are not enticed to colonize an area just because a nest box is installed on a property — it is not an "if you build it, they will come" situation. Because of that, staff efforts are focused on properties that have verified Barn Owl presence. Staff will install fewer nests boxes with this stipulation but expect to have more occupied boxes.

The current Barn Owl Project is an offshoot of a project started by the New Hope chapter of the Audubon Society (NHA) in 2012. Chapter members installed 27 boxes in the northeast Piedmont but none of them have ever been occupied. The NHA used plastic, commercially available boxes that are relatively light and easy to install. NCWRC biologists have used a larger plywood design that has seen some successful occupancy in the mountains, though not for a few years. The design is suitable for installation inside a building, however. The roofing materials necessary to make the box weatherproof make the plywood box very heavy and cumbersome. Isenhour and Medford noted that the occupancy of commercially available Barn Owl boxes is quite low in North Carolina likely because of a combination of poor placement and unsuitability of the size and type of box. They have

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One of several "tote box" prototype nest boxes staff have begun installing on properties with known barn owls. (Allison Medford)

attempted to combat both factors by only installing boxes on occupied habitat and by designing a new type of nest box. The new box uses plastic water totes and is much larger than standard boxes — it is more similar in size to a deer blind, which is a favorite nest site of the Barn Owls. They have one prototype installed and are refining the design this season. Although a truck and winch are necessary to install these water tote nest boxes, they are relatively easy to install and are designed to withstand weather better than plywood versions. Water totes are relatively inexpensive and easy to come by and modifications take little time. Project biologists are preparing to conduct site visits this spring and will install nest boxes on appropriate properties. Please contact Allison Medford (allison.medford@ncwildlife; 910-975-9393) if you have any questions or wish to discuss this project.

First Documented Active Red Crossbill Nest in North Carolina in 30 Years

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

Fall Red Crossbill surveys, planned for the high elevation Red Spruce forest, were relocated to lower elevation pine stands when it became apparent that the 2020 spruce cone crop was meager. The Red Crossbill is a medium-sized songbird with a short, notched tail and an unusual, twisted bill that crosses when closed. It is state listed as Special Concern.

Tipped off by birders' reports in eBird, NCWRC staff found small flocks of Red Crossbills in cone-bearing White, Pitch and Table Mountain Pines in Jackson, Henderson and Macon counties. On Oct. 13, technician Clifton Avery found an active Red Crossbill nest at DuPont State Recreation Forest approximately 50 feet up in a Pitch Pine on the edge of a granitic dome. Bill size and call notes were consistent with Type 1 Appalachian Red Crossbill. Calling nestlings were tended by a pair of adults that delivered food and carried away fecal sacs. On Oct. 14, the adults were accompanied by a subadult. Young apparently fledged between Oct. 18 and 20. This marks the latest crossbill nest on record in North Carolina as well as the first active nest documented in North Carolina in 30 years. Unfortunately, the nest was gone following a high wind event when staff returned with a climber in November to retrieve it.

Red Crossbill (top photo); Red Crossbill nest in Pitch Pine (Photos: Christine Kelly)

Staff Conduct Night Surveys on Nightjars

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

A map recently shared by the Nightjar Survey Network shows North Carolina as a leader in nightjar surveys and monitoring. In the western foothills and mountain region, data collected along driving routes by volunteers for 10 years were analyzed by Dr. Scott Pearson of Mars Hill University to develop a model predicting where Eastern Whip-poor-wills are likely to occur. The analysis found that whip-poor-wills were associated with lower elevations and rural landscapes (less developed) with conifer forest. NCWRC biologists began to ground-truth the model. Five survey routes were established using the same protocols as the monitoring program, but with routes selected from among predicted "hot spots" and "cool spots." The model performed well for predicted hot spots along two routes in Burke County, one in Rutherford County, and one in Cherokee County, but not for a route in Madison County. Field staff were pleased to be met with a cacophony of not just whip-poor-will calls but also calls of Chuck-will's Widows along the survey routes in Burke and Rutherford counties.

Female whip-poor-will and one 3-day-old nestling

Granitic dome at DuPont. Arrow marks location of nest on edge of dome and woods

While biologists were completing the night surveys, long-time volunteer Alan Cameron captured footage of whip-poor-wills calling, courting and nesting on and around granitic domes at DuPont State Recreational Forest. North Carolina citizens have shared their stories with NCWRC biologists of "whips" calling from natural amphitheaters such as gentle, bowl-shaped terrain and from the stage of artificial amphitheaters, such as a barn built into a hillside. Biologists suspect the granitic dome topography at DuPont amplifies the whip-poor-will's call in a similar manner. In addition, the domes create a break in the tree canopy, providing an opening for this visual hunter to spot and forage on moths and beetles. Whip-poor-wills synchronize their nest cycle with the lunar cycle. Young hatch approximately 10 days before a full moon, such that ample moonlight aids hunting when the adults have additional mouths to feed. Indeed, the first nestling hatched on June 30 and its sibling hatched the next day, while the moon was waxing gibbous, ~80% full.

Photos: Christine Kelly

Tracking of Two Imperiled Sparrow Species to Begin in 2021

John Carpenter, Eastern Landbird Biologist

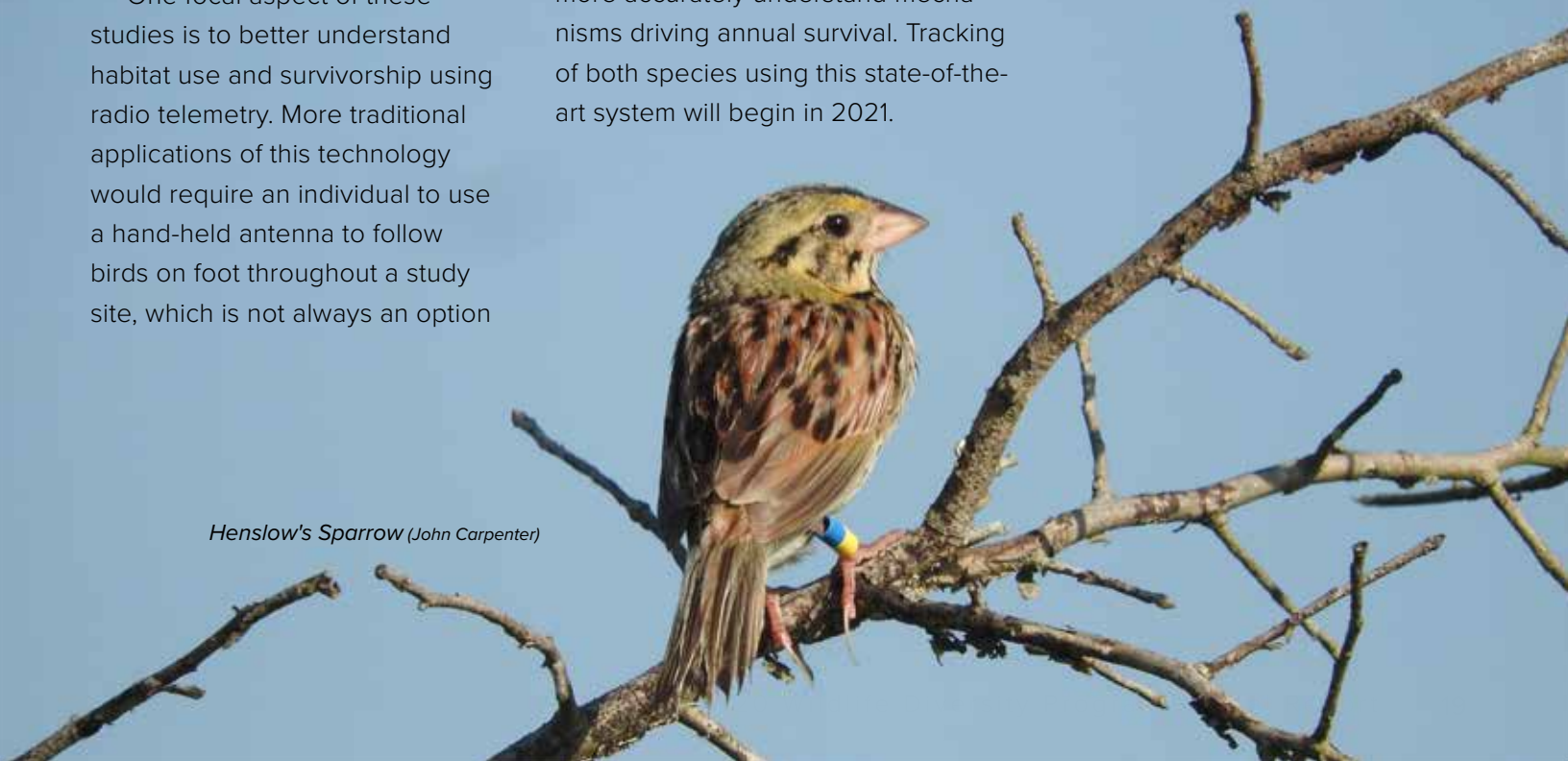
Sparrows can often be dismissed by many as just little brown birds, but these species and the habitats they require to survive are undeniably unique parts of the natural world. The Saltmarsh Sparrow, as the name suggests, inhabits salt marshes throughout its life, and is predicted to become extinct by mid-century. The Henslow's Sparrow breeds in the increasingly rare grassland habitat and is on track to lose half its entire global population in ~ 50 years. Both species are of Greatest Conservation Need in North Carolina, and the NCWRC has undertaken research projects to help increase their numbers in the state and contribute what biologists learn to the wider conservation community.

One focal aspect of these studies is to better understand habitat use and survivorship using radio telemetry. More traditional applications of this technology would require an individual to use a hand-held antenna to follow birds on foot throughout a study site, which is not always an option in the dense, submerged, or simply inaccessible habitats where staff need to work.

Through collaborations with N.C. State University and UNC-Wilmington, NCWRC staff will deploy several mobile, cellular tracking arrays to continuously monitor movements of birds wearing solar-powered transmitters. These tracking stations will cover approximately 1 km^2 each and can collect a bird's location every two seconds. The transmitters also are compatible with other networks, such as Motus, which are deployed across the continent, thereby providing the opportunity for birds to be tracked even after they leave North Carolina. This will allow biologists to delineate space and habitat use at an extremely fine scale, know when birds are migrating to and from study sites, and more accurately understand mechanisms driving annual survival. Tracking of both species using this state-of-the-art system will begin in 2021.

Saltmarsh Sparrow (John Carpenter)

Migratory bird wearing a solar-powered cellular tracking device. (celltracktech.com)



Henslow's Sparrow (John Carpenter)

North Carolina Bird Atlas Launches in March 2021

by John Carpenter, Land Bird Biologist

A group of government agencies, universities, and nonprofit organizations is kicking off the New Year by launching the North Carolina Bird Atlas. The statewide community science survey will harness the power of thousands of birdwatchers to map the distribution and abundance of birds from the Blue Ridge Mountains to the Outer Banks.

The Bird Atlas begins this spring and will take place through 2026. Organizers are encouraging bird enthusiasts of all experience levels to get involved by visiting ncbirdatlas.org and registering for updates.

Bird atlases are large-scale, standardized surveys and have taken place in states across the country since the 1970s. North Carolina Bird Atlas organizers include the NCWRC, N.C. State University, N.C. Natural Heritage Program, North Carolina Audubon, the U.S. Fish and Wildlife Service, the University of North Carolina at Wilmington and Catawba College.

The Bird Atlas will divide the state into 937 "blocks," each roughly 10 square miles. Working with regional coordinators, volunteer observers will fan out across each block recording the birds and bird behaviors they see. All data are submitted through eBird, an easy-to-use, online database of crowd-sourced bird observations.

The project comes at an important time for bird conservation. A recent study published in the journal *Science* found a steady decline of nearly three billion North American birds since 1970, primarily as a result of human activities.

Gathering observations through the North Carolina Bird Atlas helps by giving researchers a more comprehensive picture of bird populations across North Carolina. Ultimately, the data help state wildlife officials, land managers and conservation organizations make important conservation decisions.

A birder observes a Northern Harrier in flight (Allen Boynton)

Biologists Estimate 25-28 Cerulean Warblers in Buncombe County Population

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

In western North Carolina, the largest known population of Cerulean Warblers is found in the Elk Mountains and Bull Mountain of Buncombe County, northeast of Asheville. The prospect of glimpsing a male cerulean glowing like a light tone sapphire in the sunlight draws birders to this area from all over in late April and early May before the trees leaf out. Close monitoring of the Buncombe population has largely been carried out by volunteer birders. The most robust monitoring effort was led by Audubon North Carolina volunteer Charlotte Goedsche from 1998 until 2018. Goedsche is renowned among local birders for her daily visits to record the songs of individual males. Monitoring stopped when Goedsche moved away in 2018, leaving a rich legacy dataset.

In consultation with Goedsche, NCWRC took steps to ensure long-term monitoring of this population. Biologists strove to adapt past monitoring efforts to a user-friendly protocol that could enlist trained volunteers. In 2020, staff conducted a pilot survey consisting of 40 points over a 6-mile stretch of the Blue Ridge Parkway. At each point, observers watched and listened passively for 5 minutes. Surveys were repeated four times at approximately weekly intervals between April 30 and May 18.

With the Parkway closed spring 2020 due to COVID-19 restrictions, Wildlife Diversity Program staff walked and jogged to survey points. Their miles on foot provided rare opportunities to spot female ceruleans during courtship.

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The Cerulean Warbler is long-winged, long-billed, short-tailed and a bit pot-bellied.

Male Cerulean Warbler (Alan Lenk)

The female Cerulean Warbler has been described as a delicate watercolor. (Alan Lenk)

To flesh out a population estimate, staff also surveyed the nearby Mountains-To-Sea Trail. Data were analyzed in program Presence using a single-season occupancy model that reports on the proportion of points occupied. Because ceruleans are not always detectable even when they are present (e.g., they might be too busy gobbling caterpillars to sing), data from all four visits were used to calculate a derived estimate of occupancy of 67.4%. The detection probability, which is the chance of seeing or hearing a cerulean if it was indeed present, was estimated at 57%.

Biologists will continue to analyze the pilot dataset and develop a multi-season occupancy monitoring plan for this population. In addition to the occupancy analysis staff estimated the population size by examining all mapped locations of singing males. An estimate of 30-35 males in 2020 is only slightly higher than Goedsche's estimates of abundance based on in-depth visits between 2014 and 2018.

How YOU Can Support Wildlife Conservation in North Carolina

Whether you hunt, fish, watch, or just appreciate wildlife, you can help conserve North Carolina's wildlife and their habitats and keep North Carolina wild for future generations to enjoy.

How? It's as easy as 1, 2, 3.

1 Donate to the Nongame and Endangered Wildlife Fund by checking Line No. 30 on your N.C. State Tax Form.

2 Purchase a Wildlife Conservation Plate, which features an illustration of a Pine Barrens Treefrog, for $30, with $20 going to the agency's Nongame and Endangered Wildlife Fund.

3 Donate to the Wildlife Diversity Endowment Fund, a special fund where the accrued interest — not the principal — is spent on programs that benefit species not hunted or fished. ncwildlife.org/donate

REPTILES

Nearly 300 Sea Turtles Rehabilitated and Released Since November 2019

Dr. Matthew Godfrey, Sea Turtle Biologist

One component of the North Carolina Sea Turtle Stranding and Salvage Network, coordinated by NCWRC biologists, is to expedite the release of successfully rehabilitated sea turtles from various facilities in the state. This can be a challenge in winter months, when coastal water temperatures are normally too cold for beach releases, even though there are often many turtles that have finished their treatment for hypothermia (cold-stunning).

One option for release is to engage various partners to transport turtles to warmer waters near the Gulf Stream off North Carolina, including the U.S. Coast Guard, research vessels from local universities and charter fishing boats. A second option is to drive the turtles to or near Florida where they can be released from beaches that have warmer water. This latter action often requires the cooperation of partners from various states who help with some or all the transport and/or release. Between Nov. 1, 2019 and March 24, 2020, 478 live sea turtles were recovered along the coast and taken for rehabilitation. Of these, 299 have been released back to the ocean, including 146 released offshore by boats and 124 released from beaches in Florida or southern Georgia. More recently, a shift in the Gulf Stream resulted in warm waters reaching the eastern beaches of South Core Banks, in Cape Lookout National Seashore. Taking advantage of this situation, NCWRC staff and volunteers released 29 more turtles from this beach in mid-March. All released turtles were tagged with internal PIT tags, in case they are seen again.

A juvenile Loggerhead successfully treated for cold stunning at the NC Aquarium at Roanoke Island is released to the ocean on the eastern side of South Core Banks.
(Dr. Matthew Godfrey)

Tagged Green Sea Turtle from Florida Found on North Carolina Beach

Dr. Matthew Godfrey, Sea Turtle Biologist

On June 18, not long after daybreak on Onslow Beach, on Camp Lejeune Marine Corps Base, an adult female Green Sea Turtle was observed crawling back to the ocean. Just before she entered the water, the base biotechs observed that the turtle had a single metal flipper tag in its right front flipper, with a unique ID: QQR472. This ID was not found in the NCWRC's sea turtle tag database, so the information was sent to the central sea turtle tag database maintained by the University of Florida. Records indicated that the tag came from the Marathon Sea Turtle Hospital in the Florida Keys. Subsequent correspondence revealed that this turtle had been captured as a hatchling in 1993 from a nest that was laid on Hutchinson Island, Fla., and raised in captivity for two years at the Marathon Sea Turtle Hospital as part of various health studies. It was released into the ocean in Florida in May 1995 with a metal flipper tag in each front flipper. This tag recapture is surprising not only because it is rare for a metal flipper tag to remain in place over nearly three decades and on a turtle that has grown from roughly 10 lbs at release to >200 lbs at adulthood, but also because she came from a nest laid in Florida.

Recent analyses suggest that although nesting Green Sea Turtles in North Carolina are genetically distinct from those nesting in Florida, it is likely that the North Carolina population originally came from Florida. This turtle's history demonstrates that green turtles can and do move between nesting areas in Florida and North Carolina.

Tagged Green Sea Turtle observed nesting on Onslow Beach in Onslow County, NC
(Les Pearson, Threatened & Endangered Species Program, Marine Corps Base Camp Lejeune)

Over 200 Sea Turtle Nests Lost Due to Hurricane Isaias in August

Dr. Matthew Godfrey, Sea Turtle Biologist

Hurricane Isaias made landfall near Ocean Isle Beach on Aug. 4, causing heavy overwash and sand loss along many islands in Brunswick County and elsewhere along the North Carolina coast. Most of the signs and poles used to mark the location of incubating nests were washed away, and initial estimates were that nearly 300 sea turtle nests in Brunswick County had been lost to the hurricane. However, subsequent careful inspection by various sea turtle volunteer groups in the county resulted in the rediscovery of many remaining eggs, whose locations were marked and observed until the end of expected incubation. Nevertheless, dozens of sea turtle nests were completely washed out by the hurricane, particularly in locations where the hurricane removed several feet of sand from the beach. The volunteer groups also worked closely with their respective towns during efforts to remove debris and reinforce dunes, specifically to ensure that all work with heavy equipment avoided marked areas with known sea turtle eggs. While the sea turtle hatching season is not yet finished, to date, the volunteer groups have determined 203 sea turtle nests had 0% success, either because they were washed away by heavy waves or the eggs stopped development due to excessive inundation from storm surge. Several dozen sea turtle nests that survived the storm produced hatchlings in late August and September, and nests laid after the hurricane's landfall continued to incubate.

Before (left) and after (right) photographs of the location of a Loggerhead Sea Turtle nest in Ocean Isle Beach, relative to Hurricane Isaias. Wave action and storm surge from the hurricane removed several feet of sand (and incubating eggs) from this part of the beach
(Photos: Ocean Isle Beach Sea Turtle Protection Organization)

First Case of Fibropapillomatosis Found in Kemp's Ridley Sea Turtle in NC

Dr. Matthew Godfrey, Sea Turtle Biologist

Fibropapillomatosis is an infectious disease in sea turtles and is characterized by tumors that grow both internally and externally on the soft skin around flippers, tail and head of the animals. Although primarily found in Green Sea Turtles, it has been documented in all species, and outbreaks of this disease are thought to be linked to altered or degraded environments.

Fibropapillomatosis is regularly observed in sea turtles that inhabit the waters of Florida but rarely has been seen in turtles in Georgia and the Carolinas. At the end of June 2020, a live but severely debilitated Kemp's Ridley Sea Turtle was found in the swash zone of the beach on Oak Island in Brunswick County.

Volunteers with the Oak Island Sea Turtle Protection Program recovered the turtle and transported it to the Karen Beasley Sea Turtle Rescue and Rehabilitation Center in Surf City, Pender County. The turtle died overnight, and a necropsy was performed by NCSU College of Veterinary Medicine.

One striking feature of this turtle was the presence of a large tumor on its right front flipper. Samples of tissue were collected for analyses of the tumor. Histopathology of the tumor tissue confirmed that the tumor was from fibropapillomatosis, and a blood sample tested positive for chelonid herpesvirus 5 (ChHV-5), which is associated with this disease. This is the first confirmed case of fibropapillomatosis found in a stranded Kemp's Ridley Sea Turtle in North Carolina. The NC Sea Turtle Stranding and Salvage Network continues to work closely with the NCSU College of Veterinary Medicine to track this disease in North Carolina sea turtles.

Stranded Kemp's Ridley Sea Turtle from Oak Island, NC with fibropapillomatosis tumor on its front flipper. (Suzan Bell)

First Record of Northern Pine Snake Documented in Mountains in 10+ years

by Gabrielle Graeter, Conservation Biologist/Herpetologist & Sam McCoy, Wildlife Diversity Technician, Mountain Reptiles

One of North Carolina's many Species of Greatest Conservation Need as described in the Wildlife Action Plan is the Northern Pine Snake. This large, nonvenomous snake is also state listed as Threatened. While it is most commonly encountered in the Sandhills and southern Coastal Plain of North Carolina, there are a handful of records, mostly historic, from the southwestern Mountains. Pine snakes have been reported in Cherokee and Swain counties, and a few range maps show their distribution extending from Cherokee to Rutherford counties.

Northern Pine Snake (Lori Williams)

The NCWRC began work last year to better understand pine snake populations in the mountains, and it is beginning to pay off. The first step toward learning more about these populations was to locate some of these elusive animals. Pine snakes spend most of their time burrowing underground, so it can be difficult to encounter them. Staff partnered with three private landowners in Cherokee County and installed a drift fence with specialized camera traps on each of their properties. These properties were selected because they all contain potential pine snake habitat; open areas near pine-oak forest.

A drift fence is a common method of capturing reptiles and amphibians. The drift fence acts as a barrier on the landscape to direct the movement of animals and usually has some type of trap attached to it to capture the animal as it tries to go around the fence. In this case the trap is a camera. This camera trap consists of a modified trail camera suspended in a bucket placed at each end of the fence to photograph animals moving along the fence. The drift fence cameras are deployed during the pine snake's active season, April through Oct. While they captured images of many species in 2019, including copperhead, five lined skink and six lined racerunner, they did not photograph a pine snake. But on May 25, they finally photographed one. This is the first confirmed record of a pine snake in Cherokee County, or anywhere in the mountain region of North Carolina, since 2009. Now that biologists have this new record, they hope to expand their camera trapping effort and attempt live trapping in the future.

In addition to the camera trapping, staff have led a public outreach campaign in hopes the public could tell them more about pine snakes in their area. The agency published a news release statewide on April 9 requesting the public report any pine snake observations to pinesnake@ncwildlife.org. This news release was picked up by at least four local newspapers in the southwestern mountains (ncwildlife.org/News/wildlife-commission-seeks-pine-snake-sightings-in-southwestern-north-carolina).

To date, biologists have received 45 submissions from the public, which include two con-

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First Record of Northern Pine Snake Documented in Mountains in 10+ years

firmed records of pine snakes in Hoke County. Although they have not received any pine snake records from the public yet in western North Carolina, they have received responses from Buncombe, Haywood and Henderson counties, which shows that residents of the southern mountains heard their request. Biologists are hopeful that they may yet have a pine snake reported from the western part of the state.

Photos of the Northern pine snake that was documented by a camera trap in Cherokee County in May 2020.

The drift fence in Cherokee County where a Northern Pine Snake was detected on May 25, 2020. Modified trail cameras are suspended in the buckets at the ends of the fence. (NCWRC)

Success and Limitations with Using Predator Excluder Cages to Protect Bog Turtle Nests

by Gabrielle Graeter, Conservation Biologist/Herpetologist

With the Bog Turtle in decline in North Carolina, NCWRC biologists and their conservation partners have been busy trying to help the species in every way possible. Conservation of this species, which is state listed as Threatened and federally listed as Threatened (S/A), requires a multi-faceted approach, including addressing numerous threats (e.g., vegetation succession, road mortality, human subsidized predators, poaching, etc.), by implementing habitat and species management and restoration projects. One method recently employed in conjunction with other efforts has been nest protection from predators.

Bog Turtles lay their eggs in vegetation on the ground within the wetland in early summer, typically mid-to-late June, followed by hatching in August or September. When Bog Turtle nests are located, NCWRC biologists and their partners install predator excluder cages over the nests soon after the eggs are laid. This is very similar to the way biologists protect sea turtle nests on beaches, though on a much smaller scale, as bog turtle nests are very difficult to find. In a recent study in several bog turtle sites in North Carolina, only 28 percent of eggs hatched when nests were located but left unprotected (Knoerr 2018). Similarly, the percent of eggs that hatched at Bog Turtle sites in the northeast United States was low, ranging from 13 to 33 percent (Macey 2015, Whitlock 2002, Zappalorti et al. 2017).

Bog Turtle nest in North Carolina after a biologist has exposed the eggs for examination.

A hatchling Bog Turtle being held during the data collection process.

In summer 2020, NCWRC biologists, in collaboration with conservation partners, protected nests at five known Bog Turtle populations. Most females lay two to four eggs. Through extensive searching efforts, staff found and protected 24 nests across these sites, for a total of 85 eggs. From those eggs, 64 (80%) hatched and were subsequently released adjacent to their nest in the wetland after a brief data collection period. Although there are examples of natural nest success this high (e.g., Whitlock 2002, Zappalorti et al. 2017), it appears to be uncommon; an 80% hatch success with the predator excluders is certainly much higher than was documented by Knoerr (2018) when nests were left unprotected. When biologists find a Bog Turtle nest and protect it, this technique has resulted in an increased proportion of eggs successfully hatching, an obvious conservation win.

Although the use of predator excluders has proven to be of great value, this method has limitations and is not effective in every circumstance or at every site. For instance, at sites with a small Bog Turtle population, it can be very difficult to visually find nests since Bog Turtles do a thorough job of

Photos: Ben Dalton

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hiding their eggs within the vegetation. Despite extensive surveys for nests this year, staff were able to find only two or three nests at most sites, and unable to find any nests at two sites. Therefore, the number of nests protected was quite small, and at the two sites where they were unable to find any nests, biologists were not able to improve egg survivorship at all. In this situation, other methods may be more effective. For example, biologists have found that radio-telemetry on gravid female turtles yields a greater number of located nests at the sites with few turtles and allows for immediate nest protection or collection of the eggs for captive incubation and head-starting, by releasing the hatched turtles back into the bog.

Another limitation of the predator excluder is that it does not address other issues that decrease nest success. For example, nests can flood due to storm events, which may result in egg failure. With an increase in extreme storm and flood events due to climate change, this will likely continue to be a threat to Bog Turtle nests in the future. Similarly, if weather conditions are less than ideal for egg incubation (e.g., cool, wet weather in spring and/or summer), incubation rates can be slowed to the point that the turtles are unable to hatch before cold weather in the fall. This, in fact, has occurred at a couple of bog turtle populations in fall 2020, with hatching occurring into early-mid October and some eggs failing to hatch. NCWRC biologists are considering alternate conservation strategies, such as head-starting, to address these types of additional risks and improve nest and nestling survivorship in the future.

A predator excluder cage can be installed in a bog to cover and protect a bog turtle nest from predators. (Gabrielle Graeter)

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Partners For Fish and Wildlife Program Expands On-the-Ground Conservation for Bog Turtles

by Gabrielle Graeter, Conservation Biologist/Herpetologist

Bog Turtles and their habitat – mountain bogs – are a high conservation priority in North Carolina. The Bog Turtle is federally threatened (S/A) and state threatened. As part of its conservation efforts with this species, the NCWRC manages wetlands with known Bog Turtle populations. Unfortunately, many of these wetlands have more woody vegetation and canopy closure than they likely had historically. Various factors have played a role in this change, including increased nutrient input, changes in land-use, development in the surrounding landscape, and differences from historical levels of grazers, fire and beaver activity. The plant communities and wildlife that rely on these open canopy, predominantly herbaceous vegetation areas can begin to decline if biologists do not act.

Funding from the Partners for Fish and Wildlife Program allowed NCWRC biologists to contract out Bog Turtle habitat management work to complete large-scale vegetation management at five sites in western North Carolina in 2020.

Bog Turtles lay their eggs in a nest on the ground within the wetland. Nests require full sun so the eggs can properly develop. The turtles also need areas for basking. The bog habitat management goal is to create a mosaic of various habitat types, with some areas as shrub-scrub and others predominantly herbaceous vegetation without canopy.

Much of the bog habitat management that the NCWRC has done in the past has been funded using State Wildlife Grants but those funds have become limited in recent years. Moreover, past management has relied heavily on assistance from volunteers for workdays, but that has its limitations as well. Volunteers may not have experience or the skills for the work; they can be unreliable; and they may not be as motivated to work hard and complete the job as a paid worker. Plus, the work requires hard physical la-

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Juvenile Bog Turtle (Gabrielle Graeter)

Bog Turtle (Jeff Hall)

bor while working in deep mud and it is not for everyone! Volunteers are more appropriate for filling in when a few extra hands are needed, as opposed to being the primary workers.

This is where the Partners for Fish and Wildlife Program (PFW) has been such a big help. The PFW funding has allowed the NCWRC to contract out the work, and accomplish much more than would have been done otherwise. The PFW program provides technical and financial assistance to landowners interested in restoring and enhancing wildlife habitat on their land.

Many of the Bog Turtle populations NCWRC is working to conserve are on privately owned land. NCWRC applied for and was awarded PFW funding on behalf of interested private landowners. In 2020, despite the challenges due to COVID-19 restrictions, agency staff completed large-scale vegetation management at five sites in western North Carolina with this PFW funding (Figure 1). This work was completed over 10 workdays in October. Habitat management in these wetlands consisted of cutting most trees within the wetland, treating invasive plant species, and thinning out woody vegetation. Some sites were grown over with shrubs and trees, and the difference after the work was completed was dramatic (Figure 2). The Bog Turtles at these sites will benefit from having a mosaic of habitat types and more directly sunlit areas for nesting and basking.

Figure 1. Recently cleared area in wetland in fall 2020 at one of the PFW-funded sites. All cut woody stems are treated with wetland-approved herbicide to reduce re-growth. (Gabrielle Graeter)

Figure 2. This small area was opened up to allow more sunlight to reach the ground and improve bog turtle nesting habitat. (Gabrielle Graeter)

Alligator Monitoring Continues in 2020

by Alicia Davis, Alligator Biologist

In spring 2017, 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.*

Every handled alligator is first scanned to determine if it has already been tagged. 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. Measurements and locations are recorded for all recaptured individuals. To date, 568 wild alligators have been captured, marked and released in North Carolina (Figure 1) using this method. Data were collected from 207 alligators in 2020, 41 of which were recaptured individuals that had been marked previously.

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.

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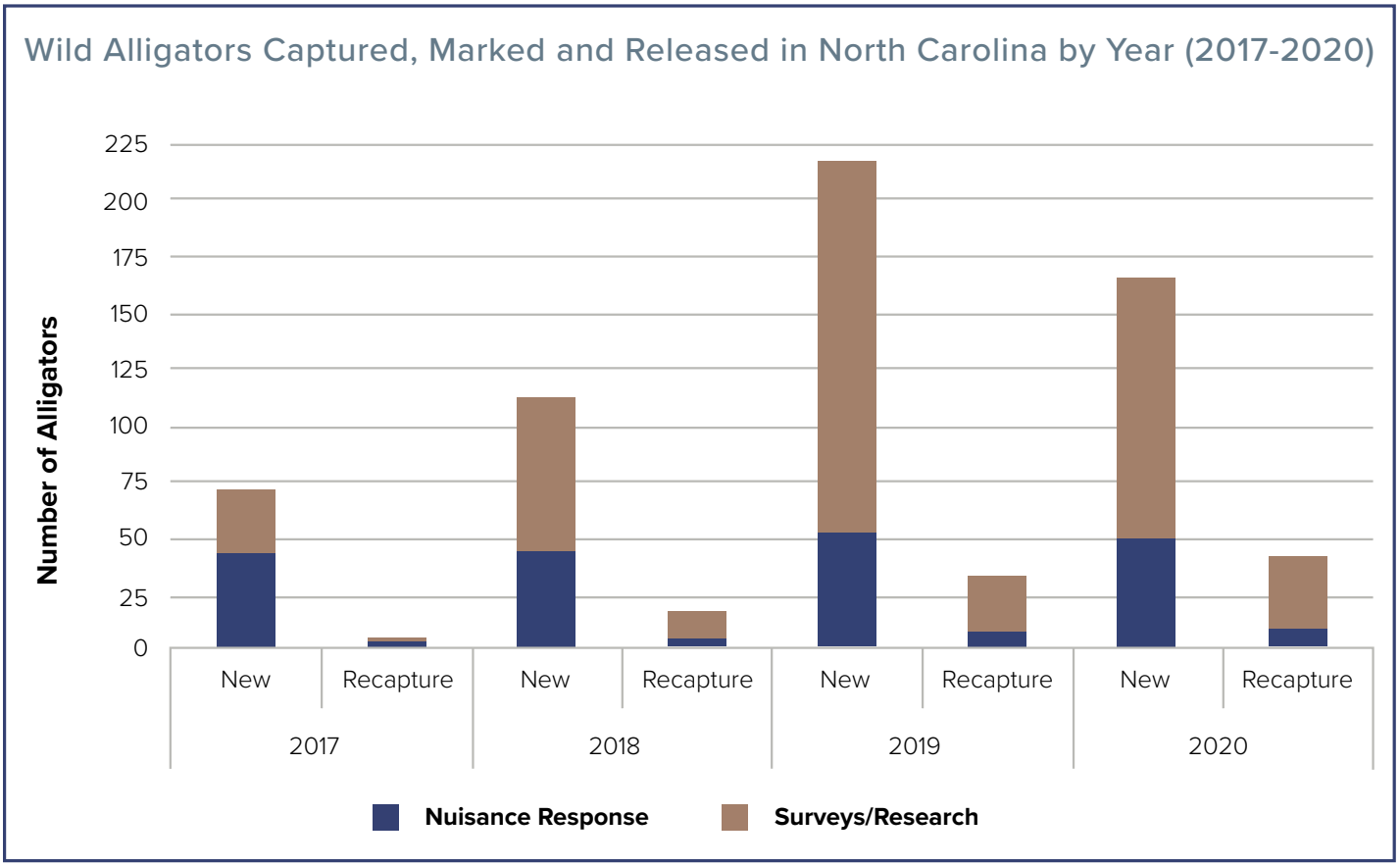
Figure 1. Wild Alligators Captured, Marked and Released in North Carolina by Year (2017-2020)



*Scientific researchers include Dr. Stephen Dinkelacker, Framingham State University and Dr. Scott Belcher, NC State University

In addition to data collection from live alligators, NCWRC began collecting data from all dead alligators in 2017. To date, data have been collected from 44 dead alligators, including 25 in 2020 (Table 2). While alligators are rarely euthanized in North Carolina, three required euthanization in 2020; two were severely injured by motor vehicle strikes, and one was suffering from extreme emaciation and deterioration of overall body condition. Of the 22 alligators that were found dead, nine were hit by motor vehicles, 11 appeared to have been killed illegally, one was inadvertently captured and drowned in a commercial pump filter, and one appeared to have either been cannibalized by a larger alligator or died from some other non-anthropogenic cause. Data and tissue samples, including femurs, are also collected from each dead alligator. In 2021, stored alligator femurs will be sent to a laboratory where growth rings in bone cross-sections will be analyzed in an attempt to age each individual.

Table 2. Alligator Mortality Events in North Carolina (2017-2020)

Mortality Type	2017		2018		2019		2020		Total Records
	New	Recap	New	Recap	New	Recap	New	Recap	
Euthanization	0	0	0	0	1	1	2	1	5
Found Dead	5	0	9	0	3	0	17	5	39
Total	**5**	**0**	**9**	**0**	**4**	**1**	**19**	**6**	**44**

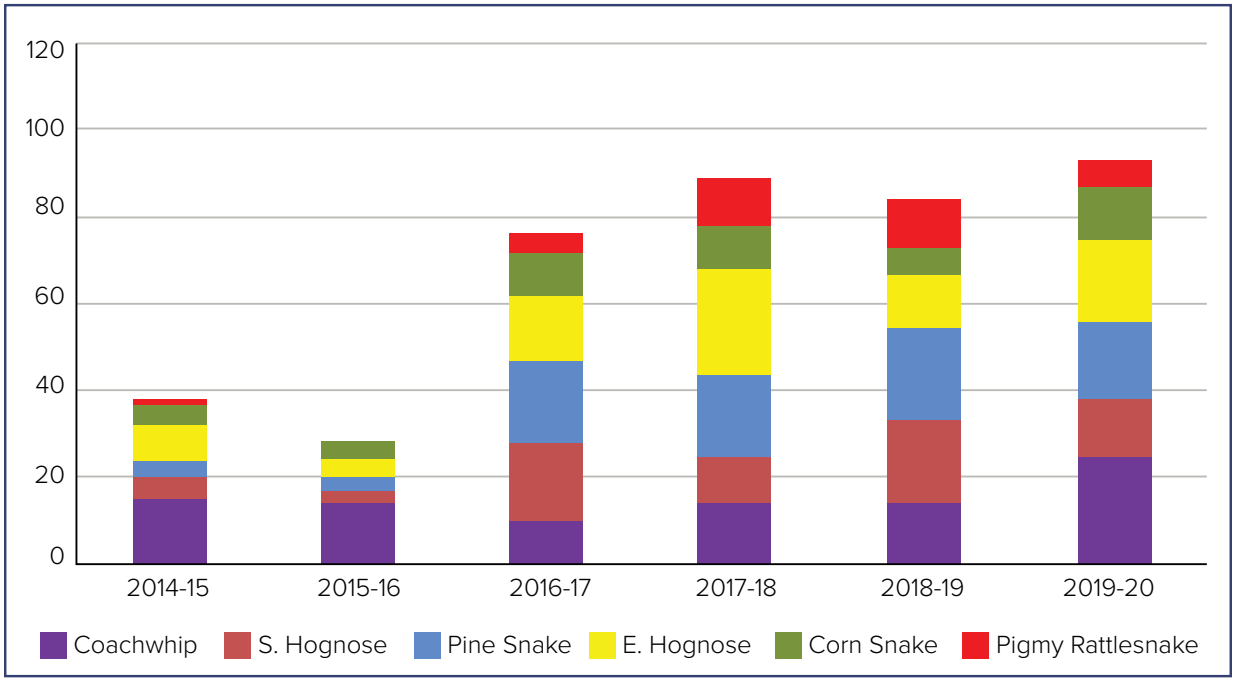
Newly hatched alligator from a 2020 season nest in North Carolina (top left); David Turner, Northern Coastal Management Biologist, captured a subadult in Hyde County. (right) *(Photos: Alicia Davis)*

Snake Surveys Continue on Sandhills Game Land & Nearby Areas

Dr. Jeff Humphries, Eastern Amphibian and Reptile Biologist

During last quarter 2020, NCWRC biologists finished the seventh year (2014-2020) of targeted snake species surveys and mark-recapture on the Sandhills Game Land. They chose a group of snake species on which to focus, including perceived "common" and perceived "rare" species to monitor over the long-term. These species include: Eastern Hognose Snake, Southern Hognose Snake, Eastern Coachwhip, Northern Pine Snake, Corn Snake and Pigmy Rattlesnake. Surveys are mainly done by the same, small group of biologists to maintain consistency across years. By the end of 2020, the group documented 460 individuals (including road mortalities) of the target snake species on Sandhills Game Land and nearby property. When possible, biologists mark individuals with injectable PIT tags to attempt to build population estimates and gather information about movements of each species. They have marked 375 individual snakes over the survey period, but have only recaptured 27 individuals, sometimes several years apart. This project is ongoing, and data continue to be analyzed, but some interesting trends are already evident. For example, though number of snakes observed per year varies due to numerous factors, the proportion of each species compared to total number of snakes captured (community composition) remains relatively stable. Long-term projects like this are key to monitoring populations and can inform management decisions.

Southern Hognose Snake (Dr. Jeff Humphries)



Composition of six snake species encountered on the Sandhills Game Land from 2014-2020. Though snake encounters over time vary, the relative proportion of each species encountered remains relatively stable.

AMPHIBIANS

Gopher Frog Surveys Continue on the Sandhills Game Land

During the first quarter of 2020, NCWRC biologists continued to survey for Gopher Frogs on Sandhills Game Land. This winter, they detected 22 Gopher Frog egg masses at the main breeding pond for the population on the game land. Considering the fairly good weather conditions during February and March (multiple warm, rainy nights), biologists expected a higher breeding output than what occurred. Staff collected small portions of each egg mass and transferred them to The North Carolina Zoo for captive rearing to continue the head-starting program of juvenile Gopher Frogs. In collaboration with the Zoo, staff are raising 400 tadpoles to be released as juvenile frogs during the summer of 2020.

The single population of Gopher Frogs on Sandhills Game Land appears to remain stable, but with only one population existing, the chance of extirpation of this species in the area remains a concern. Despite extensive surveys throughout the Sandhills, Gopher Frog breeding was not detected at any additional wetlands.

Collecting Gopher Frog eggs for captive rearing and head-starting *(Dr. Jeff Humphries)*

Gopher Frog *(Jeff Hall)*

Biologists Captive Rear Gopher Frogs to Release on the Sandhills Game Land

Dr. Jeff Humphries, Eastern Amphibian and Reptile Biologist

Isolated wetland undergoing restoration on Sandhills Game Land, NC. This site was completely forested until 2011 when vegetation communities and hydroperiod were restored with the intention of providing more breeding and upland habitat for the Gopher Frog and other amphibian species. *(Brady Beck/NCWRC)*

During the second quarter, NCWRC biologists, in collaboration with the North Carolina Zoo, captive reared (headstarted) juvenile Gopher Frogs in an effort to create a new population of the species where they once existed. Frogs have been captive reared and released on Sandhills Game Land for over five years in order to augment the remaining single population. This is the first year staff are attempting to translocate juvenile frogs to a new population — an effort that is important for the long-term viability of Gopher Frogs on this landscape. In 2011, NCWRC staff began restoration on a large isolated wetland that had been neglected for decades (e.g., lack of fire, heavy growth of pine and hardwood trees). This involved removal of large trees and subsequent restoration of the natural hydroperiod and herbaceous plant cover. After nine years, this wetland now appears to be suitable for supporting Gopher Frogs.

More than 300 juvenile headstarted Gopher Frogs are being released at the restored site, with the hopes of establishing a self-sustaining population. This is in the experimental phase as of now, but if successful, staff hope to translocate additional Gopher Frogs to this and other restored wetlands in the area in order to create a more robust metapoplation, ensuring that the Sandhills population does not become locally extirpated. Automated frog call loggers and dipnet surveys will be conducted at this particular restoration site over subsequent years to determine success in translocating Gopher Frogs to wetlands likely to have once supported this extremely rare and specialized amphibian.

Mountain Chorus Frog's Known Distribution Expands Again

by Lori Williams, Western Amphibian Biologist

In late winter 2020, WD staff monitored Mountain Chorus Frogs, a Special Concern species and a Species of Greatest Conservation Need, by conducting frog call surveys and road cruising on rainy nights. Staff documented a new site, which represents a significant distribution extension out of Murphy, northwest 3.5 airline miles toward Andrews, after many years of unsuccessful survey attempts in this area. This new site is the first for the community of Marble, the first on the east side of the Valley River and Hwy. 19/129 corridor.

Also, staff and a project partner from Young Harris College in Georgia identified five additional new sites in Clay and Cherokee counties at or near the North Carolina/Georgia border. For North Carolina, there are now 179 documented sites for Mountain Chorus Frog; only seven were known prior to the mid-2000s when WD staff began surveys. Of the 43 known sites monitored this year, staff detected the species at just nine sites (20.9% success). This survey success is lower than in 2019 (35%) and in 2018 (29%). The next step for this project is to use detection probability and occupancy metrics in repeated surveys of the same sites to establish a framework for more standardized, long-term monitoring.

Mountain Chorus Frog (Sam McCoy)

Typical wetland breeding habitat for Mountain Chorus Frog (Lori Williams)

Salamander Surveys Conducted on Pisgah and Nantahala National Forests

by Lori Williams, Western Amphibian Biologist

In spring 2020, WD staff reviewed the U.S. Forest Service's draft National Forest Management Plan revision, in consideration of amphibian communities and Species of Greatest Conservation Need (SGCN), sensitive habitats, and amphibians with management concerns, particularly for salamanders that thrive in closed-canopy forest conditions. Overall, data on salamander community composition, relative abundance and habitat use are lacking on national forest areas slated for timber harvest, but it is important to understand baseline information for salamander communities and populations pre-harvest, so biologists can monitor species presence and examine recolonization in the years that follow forest management actions.

Thus, staff boosted survey effort in timber management units on both Pisgah and Nantahala national forests this quarter in daytime and nighttime searches. Target areas included forest units in northern Haywood, southern Haywood, and western Macon counties, with plans to begin inventory surveys on upcoming forest management projects in Clay and Graham counties as well.

Staff have conducted 10 surveys so far, and besides a wide variety of common species, they have documented SGCN such as Southern Appalachian Salamander, Southern Pygmy Salamander and Red-legged Salamander in management areas.

The Southern Appalachian Salamander is a Species of Greatest Conservation Need and is found in mostly closed canopy conditions of mesic forests along a wide elevational gradient.

The Southern Pygmy Salamander is a Significantly Rare, Species of Greatest Conservation Need primarily found in high-elevation, mature forest.

The Red-legged Salamander is a Watch List species and Species of Greatest Conservation Need that often uses mature, mesic forest habitat at mid-to-high elevations.

Photos: Ben Dalton

Staff Conduct Successful Passive Snorkeling Surveys for Hellbenders, Despite COVID-19

by Lori Williams, Western Amphibian Biologist

Due to COVID-19 restrictions, Wildlife Diversity staff were unable to conduct summer surveys for Eastern Hellbender, which is a state-listed species of Special Concern, as well as a Species of Greatest Conservation Need. These surveys have been conducted each year since 2007. However, in late August and early September, staff and partners were able to complete three weeks of socially distant, passive snorkeling surveys to monitor hellbender populations active during their breeding season. Surveys consisted of using a dive light and underwater cameras to document animals without disturbing them or their habitat. Despite missing some days due to poor conditions from heavy rain, staff completed a record number of surveys, and noted more hellbenders than in any year prior. Staff conducted 47 surveys, at 41 individual sites within 20 different streams, across 12 western North Carolina counties. Staff observed 186 hellbenders during this breeding season, making it the most successful hellbender monitoring season to date.

Clockwise from top left: Wildlife Diversity technician Clifton Avery conducting a passive snorkel survey for hellbender breeding season; Hellbender eggs found dislodged from of a nearby nest rock; A "denmaster" adult male hellbender; Adult hellbender on the move during breeding season

(Photos: Lori Williams)

Record Number of Surveys Completed for Green Salamanders

by Lori Williams, Western Amphibian Biologist

In fall 2020, Wildlife Diversity Program staff, volunteers and partners focused rock outcrop surveys on the state threatened Green Salamander (*Aneides aeneus*) and the newly described, and proposed state endangered, Hickory Nut Gorge Green Salamander (*Aneides caryaensis*). Collectively, they completed the most surveys ever in a single season for these species with 194 in the Hickory Nut Gorge in Henderson, Buncombe and Rutherford counties and 736 in the Blue Ridge Escarpment population of Henderson, Transylvania, Jackson and Macon counties for a total of 930 surveys.

In the Hickory Nut Gorge, 44 surveys (22.7%) produced at least one Hickory Nut Gorge Green Salamander with six new sites discovered. In the Blue Ridge Escarpment population, staff found at least one Green Salamander in 238 surveys (32.3%) with 29 new sites discovered.

Objectives for the Hickory Nut Gorge Green Salamander surveys included an attempt to re-visit, at least once, every known historical location and conduct multiple surveys at as many of those sites as possible. Questions remain about this species' current distribution within the Hickory Nut Gorge as well as the dire need for a better understanding of population status of this exceedingly rare, endemic species.

An adult female Green Salamander with one of her hatchlings; when found, the hatchling was missing part of its tail, which will regenerate in time (Ben Dalton)

Their focus for monitoring and inventory surveys of Green Salamanders (Blue Ridge Escarpment population) included updating records at historical sites in Macon, Jackson, Transylvania and Henderson counties, on private properties as well as on state and federal lands. Some sites in Nantahala National Forest were targeted for their proximity to upcoming timber harvest projects and/or concern over long-term population decline. Specifically, for the DuPont State Recreational Forest population, they reprised a previous study examining effects of prescribed burning on Green Salamander populations and microhabitat conditions after seeing possible declines in recent years after repeated burning in some forest units. This objective entailed surveying three times each a randomly chosen subset of known sites that received multiple burns in recent years, as well as, a set of control sites that has not received management treatments.

Both the Blue Ridge Escarpment projects and the Hickory Nut Gorge project will continue in 2021.

Wildlife Diversity technician, Ben Dalton, surveying rock outcrop crevices for Green Salamanders (Lori Williams)

MAMMALS

Bat Counts Increase after Nearly a Decade of White-Nose Syndrome Declines

by Katherine Etchison, Mammalogist

Biologists noted an encouraging change during this 2020 winter bat hibernacula surveys: counts of tricolored bats increased at six hibernacula in the Mountains. Some increases were minimal (2-6 bats), while others were more substantial (23-51 bats). Before white-nose syndrome (WNS) arrived in North Carolina in 2011, tricolored bats were the most numerous hibernating species in the state with over 3,500 in a single hibernaculum; however, counts dropped to just nine tricolored bats at this site by 2015. This hibernaculum is among those that showed increases in 2020 and is now up to 45 tricolored bats. While these counts are a fraction of their pre-WNS counterparts, this is still a hopeful sign.

Increased counts were also noted in a Virginia Big-eared Bat hibernaculum. This species is not

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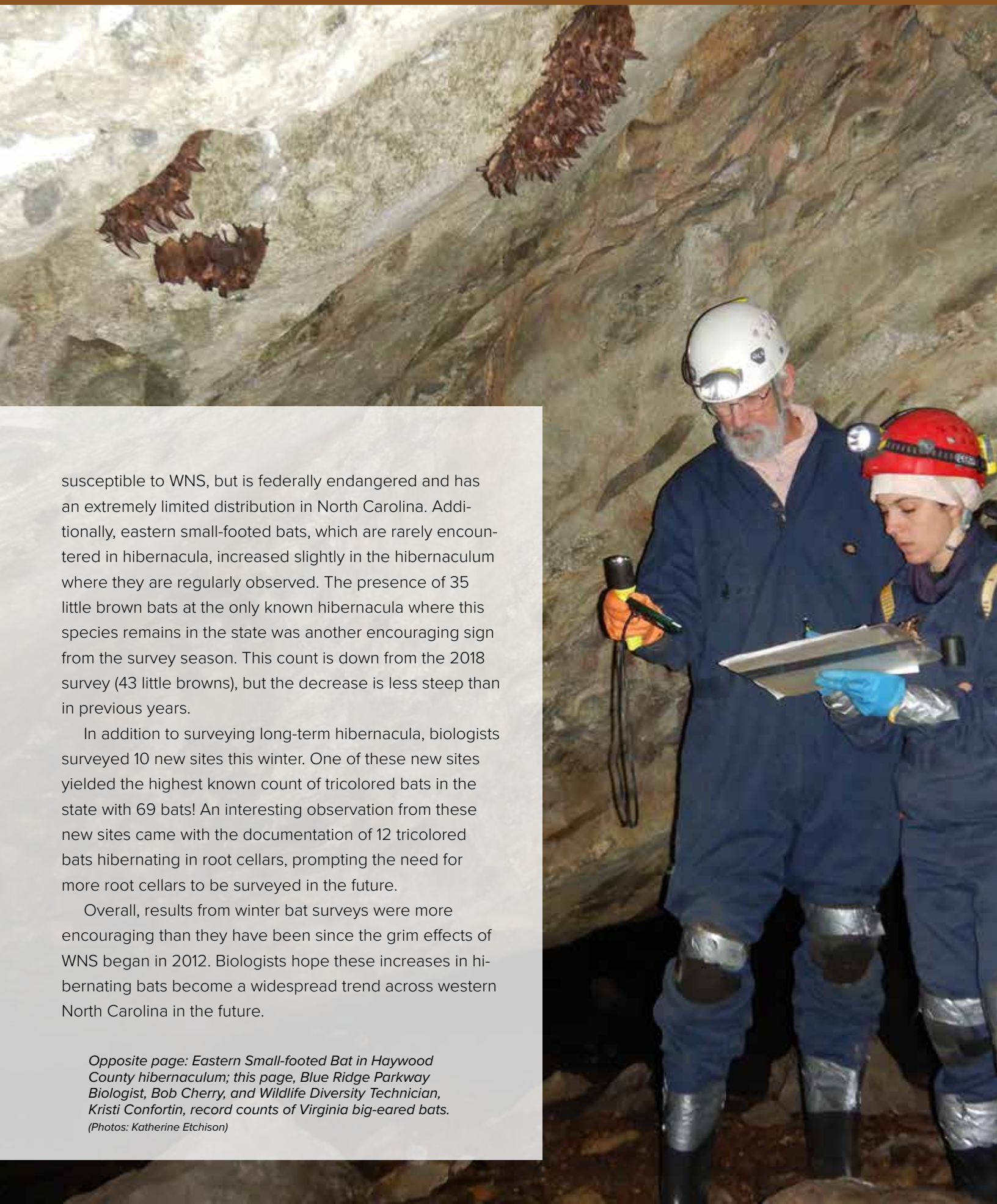


susceptible to WNS, but is federally endangered and has an extremely limited distribution in North Carolina. Additionally, eastern small-footed bats, which are rarely encountered in hibernacula, increased slightly in the hibernaculum where they are regularly observed. The presence of 35 little brown bats at the only known hibernacula where this species remains in the state was another encouraging sign from the survey season. This count is down from the 2018 survey (43 little browns), but the decrease is less steep than in previous years.

In addition to surveying long-term hibernacula, biologists surveyed 10 new sites this winter. One of these new sites yielded the highest known count of tricolored bats in the state with 69 bats! An interesting observation from these new sites came with the documentation of 12 tricolored bats hibernating in root cellars, prompting the need for more root cellars to be surveyed in the future.

Overall, results from winter bat surveys were more encouraging than they have been since the grim effects of WNS began in 2012. Biologists hope these increases in hibernating bats become a widespread trend across western North Carolina in the future.

Opposite page: Eastern Small-footed Bat in Haywood County hibernaculum; this page, Blue Ridge Parkway Biologist, Bob Cherry, and Wildlife Diversity Technician, Kristi Confortin, record counts of Virginia big-eared bats.
(Photos: Katherine Etchison)

Bat Surveys Shift Focus During Pandemic

by Katherine Etchison, Mammalogist

Biologists stepped up non-contact bat surveys during May and June amid concerns about the unknown potential for humans to transmit the SARS-CoV-2 virus to North American bats. Until results become available from research trials, bat surveys requiring direct contact were postponed. Typically, mistnetting surveys are the priority from May through August, but biologists shifted the focus to roost surveys to avoid contact with bats. Some bat species roost in man-made structures, like bat houses and bridges, and can be easily documented by observation. In May and June, 34 bridges and 32 bat boxes were surveyed in 16 counties and resulted in detection of five species. These surveys are conducted each spring and summer on a small scale, but this year's circumstances allowed biologists to check more roosts than ever before. A highlight of these surveys was the sighting of two little brown bats in a bridge previously occupied by a maternity colony before White-Nose Syndrome caused severe population declines in this species.

Biologists also conducted sunset counts of bats emerging from roosts, termed emergence counts. Emergence counts are useful for counting bats that are sensitive to human disturbance or in situations where bats cannot be accurately counted during daytime surveys. A record high number of endangered Virginia big-eared bats was tallied during an emergence count in early June. An emergence count at a bridge roost in Buncombe County totaled 745 bats, with many endangered gray bat calls recorded during the count.

(continued on next page)

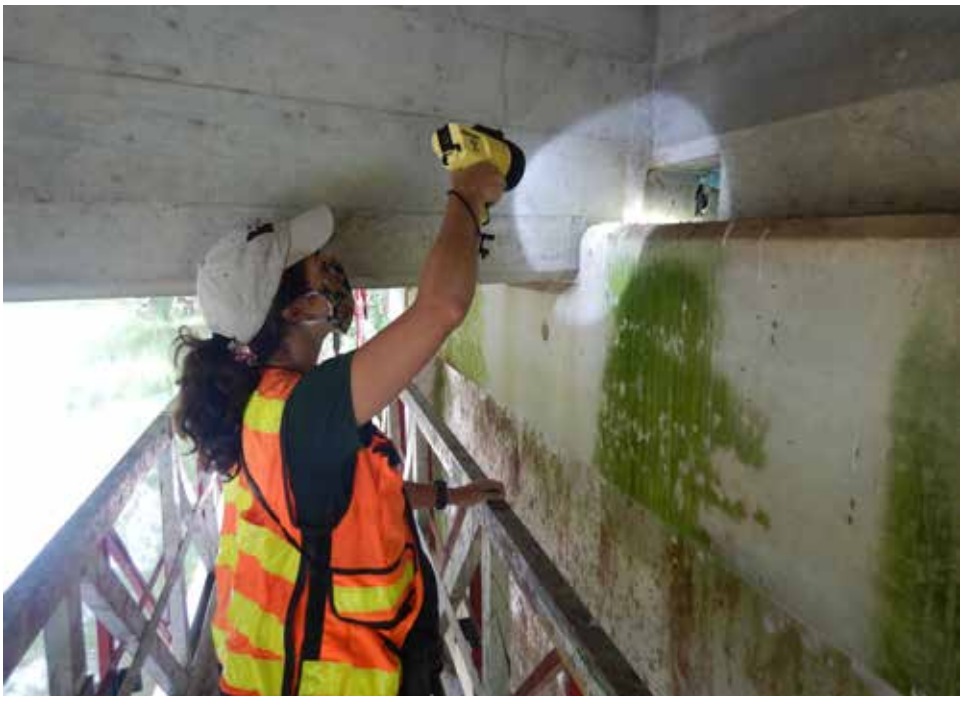
A big brown bat roosting in a bat house in Henderson County.

A big brown bat roosting on the side of a building in Buncombe County.

Finally, the NABat acoustic program afforded another non-contact survey method, in which bats were acoustically recorded during driving transects. This program is statewide and involves NCWRC staff from five divisions, over 30 volunteers, and researchers from UNC-Greensboro. This survey method was fitting during socially distant times because participants were required to conduct the survey independently or with household members only. Though this quarter was unusual, bat monitoring continued and in some cases was even improved.

Wildlife Diversity Biologist, Katherine Etchison, surveys a bridge in Polk County for bats. *(Kristin Confortin)*

Wildlife Diversity Technician, Kristi Confortin, surveys a bat house in McDowell County.



Wildlife Diversity Technician, Kristi Confortin, examines a bridge in Cherokee County for signs for roosting bats.

Unless otherwise indicated, all photos by Katherine Etchison

Staff Excavate Cave Gate After Landslide; Cave Yields Disappointing Results

by Katherine Etchison, Mammalogist

A landslide buried the entrance to a cave that offers important winter refuge to bats in the Nantahala Gorge last February. Mud and debris were removed from a small section of the entrance to allow bats to exit during spring emergence, but efforts to fully unearth the entrance were postponed due to COVID-19 restrictions. In July, a crew of NCWRC staff, U.S. Forest Service personnel, and local cave grotto members was assembled to excavate the entrance to the cave. Over three days, approximately 3-4 cubic yards of mud, rocks, and woody debris were removed from the cave gate and adjacent area by hand tools. Surveys for the endangered Noonday Globe Snail were conducted prior to digging efforts each day and one snail was found and moved out of the work area.

This cave, like other bat hibernacula in the Mountains, has experienced sharp population declines resulting from white-nose syndrome. Over 1,000 hibernating bats were documented in this cave in 2010, but only 21 bats were observed in the most recent hibernaculum survey in 2018. Historically, five bat species hibernated in this cave including the now federally threatened Northern Long-eared Bat and rare Little Brown Bat and Tricolored Bat. Though no Little Brown Bats or Northern Long-eared Bats have been seen in the cave since 2013, a few surviving Tricolored Bats remain. Tricolored Bats are the first species to return to their hibernation sites in the fall, so fully uncovering the cave entrance during the summer was critical.

Noonday Globe Snail

The top right corner of the cave gate is barely visible behind landslide debris.

Western Wildlife Diversity Technician, Kristi Confortin, removes mud from the cave gate.

Western Wildlife Diversity Supervisor, Kendrick Weeks, and U.S. Forest Service Wildlife Biologist, Johnny Wills, remove the remaining mud from the cave gate.

Photos: Katherine Etchison

Mine Gate Repairs Ahead of Bat Hibernation Season

by Katherine Etchison, Mammalogist

Protections for an important bat hibernation site were restored by NCWRC staff from the Wildlife Management, Law Enforcement, and Land and Water Access divisions ahead of winter. Gates and fencing for this site were breached during the past year, resulting in unauthorized entry. This site houses up to seven species of hibernating bats, including the tricolored bat and little brown bat, which have become rare because of the fungal disease white-nose syndrome. In 2008, winter counts in this site were as high as 1,800, but by 2016 the count dropped to 11 bats. The most recent count was 23 bats, showing a small increase in survivors consistent with trends seen in other hibernacula in the mountains. Continued protection at this important site will prevent disturbance of bats when they are most vulnerable, hopefully aiding the survival of these rare bats.

Conservation Technician, Joe Tomcho, prepares to fix an interior gate while Wildlife Diversity Technician, Kristi Confortin, provides a light source.

Western Wildlife Diversity Supervisor, Kendrick Weeks, and Senior Officer, Jared Thompson, install hinges to a recently breached gate.

Western Wildlife Diversity Supervisor, Kendrick Weeks, and Wildlife Diversity Technicians, Kristi Confortin and Clifton Avery, reinstall barbed wire to the security fence surrounding a bat hibernaculum.

Photos: Katherine Etchison

Woodrat Surveys Conducted in Western North Carolina

by Andrea Shipley, Mammalogist

The Appalachian Mountains of North Carolina are home to both the Allegheny and the Southern Appalachian woodrat. Both woodrat populations are distributed throughout western North Carolina (WNC), where they have a potential range overlap in Buncombe and McDowell counties, referred to as the "zone of contact." Neither species has been studied or monitored for over two decades; thus, little is known about their current status.

A pilot study of the species was initiated in summer 2020, and its objectives are to determine the (1) best camera trap techniques for long-term monitoring of Allegheny woodrat colonies; (2) genetics of Allegheny woodrat (*Neotoma magister*) hybridization with Southern Appalachian woodrat (*Neotoma floridana haematoreia*); and (3) presence and potential exposure of woodrat colonies to raccoon roundworm (*Baylisascaris procyonis*). Staff will also look for signs of reproduction at each colony site, such as capturing either an adult female plus an adult male, or an adult female and a subadult of either sex.

During summer 2020, seven of 18 historical colony sites were surveyed, and 14 individual woodrats were captured in the Linville Gorge "zone of contact" area, as well as nearby Alleghany woodrat sites. Signs of reproduction (subadults) were documented at four of the seven sites. Numbers of males and females captured were nearly equal, but more adults than subadults were captured.

Tissue and flea samples were taken from each woodrat for analyses of genetic species identification and potential flea borne diseases, respectively. Staff deployed unbaited camera traps at six occupied trap sites to document woodrat activity and persistence, as well as mesocarnivore presence. To date, staff have collected 29,816 photos from 13 of 21 cameras.

During spring and summer 2021, staff will visit 11 other historical colony sites to trap rats and deploy cameras, and plan to explore new potential colony sites, pushing westward in the region. They will continue to take tissue and flea samples from trapped individuals, and cameras will remain active for long-term monitoring of woodrats.

The Allegheny woodrat is a medium-size rodent, brownish-grey in color, with white undersides and feet. Its most distinctive characteristic is its tail, which is completely covered with hairs approximately one-third of an inch long and is prominently bicolored; nearly black above and white below.

Woodrat in a trap

Biologists with a woodrat caught in a trap

Photos: Colleen Olfenbuttel

Staff Continue Carolina Northern Flying Squirrel Monitoring

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

After a drop in Carolina northern flying squirrel captures in winter 2019, particularly in the Black Mountains, WD staff were pleased to see improved numbers in 2020. Captures rose 136% in the Black and Craggy mountains. However, the capture of seven individuals in the Craggy Mountains masks a continued dip in captures from formerly high-capture sites around Mt. Mitchell and Deer Mountain. The Great Balsams, Unicoi Mountains and Grandfather Mountain have smaller box networks by comparison, but still produced captures of adults and subadults.

Among the captures in the Great Balsams was a female that was first tagged as an adult in January 2014. This means she was born no later than summer 2012, making her at least 8 years old. In fact, biologists have captured her four times over the years. She uses several different boxes on the squirrel box transect in that area. Previous research by NCWRC and Virginia Tech in this area documented female home range sizes of 6.5 hectares, with squirrels concentrating their nightly foraging in sheltered areas with taller conifer trees (Ford et al. 2014).

Although the flying squirrel crew enjoyed a dusting of snow at Grandfather Mountain in January, winter snowfall was quite low in winter 2020. (NCWRC)

Staff haul spare boxes and a ladder into remote flying squirrel box lines via ATV. (NCWRC)

Carolina northern flying squirrel (Mike Carraway)

FISHES

Blotchside Logperch Reintroduction and Population Assessment Surveys

Reintroduction

The state endangered Blotchside Logperch is one of the rarest freshwater fish species in western North Carolina. Blotchside Logperch populations have been declining across their range for over a century due to their sensitivity to pollution and habitat alteration. In August, Aquatic Wildlife Diversity biologists began reintroduction efforts in the Cheoah River near Robbinsville, NC by stocking 76 hatchery-bred Blotchside Logperch. These animals were propagated by Conservation Fisheries Inc., a non-profit partner located in Knoxville, Tenn., which specializes in rare fish propagation across the Southeast. This is the first time in over a century that Blotchside Logperch have been in the Cheoah River. Biologists are planning to continue annual stockings and will eventually conduct snorkel surveys to determine how successful these efforts have been in creating a viable population.

(continued on next page)

A healthy adult Blotchside Logperch found during snorkel surveys in the South Toe River (Dr. Luke Etchison)

Surveys

Blotchside Logperch's small size, relatively low abundance and solitary lifestyle make it a difficult fish to study: even in its known range, biologists might survey an entire reach and not encounter a single individual. Aquatic Wildlife Diversity biologists recently conducted snorkel surveys to update their understanding of Blotchside Logperch distribution and abundance throughout its range in North Carolina (which, aside from the recent Cheoah River introduction, is thought to be entirely limited to the South Toe River). They were able to complete 16 surveys, where they saw 38 Blotchside Logperch (approximately 2.4 fish per site). Findings this year are fairly consistent with previous efforts, indicating that a stable, yet still rare, population remains viable in the South Toe River. Biologists were also able to home in on the Blotchside Logperch's highest density sites and are hopeful to use these areas to capture fish during future propagation efforts that will lead to additional stockings in the Cheoah River and throughout much of western North Carolina.

Blotchside Logperch finding its new home in the Cheoah River (Luke Etchison)

Lake Waccamaw Fish Monitoring Surveys Continued During Third Quarter

by Brena Jones, Central Region Aquatic Wildlife Diversity Coordinator

NCWRC staff, in partnership with N.C. State Parks, has conducted annual standardized surveys since 2009 for three fish Species of Greatest Conservation Need at multiple sites in Lake Waccamaw, including the endemic, federally Threatened Waccamaw Silverside.

The mean number of Waccamaw Silversides collected per minute of seining (catch rate) at all sites combined has been highly variable over nine sampling years and was 10 fish/minute (fpm) of seining in 2020. This value has ranged from 1.82 fpm in 2017 to 23.5 fpm in 2009. Variability is expected due to the fish's schooling behavior, preference for open waters of the lake, and varied sampling conditions. Waccamaw Killifish and Waccamaw Darters were also collected, suggesting that populations persist within Lake Waccamaw. Lake water levels were very high this year.

Lumber River Surveys Yield No Broadtail Madtoms

by Brena Jones, Central Region Aquatic Wildlife Diversity Coordinator

Staff conducted site visits in the Lumber River and its tributary, Shoe Heel Creek, for the state listed special concern Broadtail Madtom, a rare, undescribed native catfish. Twenty small, artificial cover structures, informally named "madtom motels," which were previously deployed at three localities were checked for occupancy. Two native catfish species, Flat Bullhead and Margined Madtom, were found occupying three of the motels; however, no Broadtail Madtoms were present. No other fish species were found utilizing the structures. Staff will continue to check motel occupancy for this ongoing project and additional future deployments are planned.

Field gear at a Madtom Motel site in the Lumber River; Inset photo: Broadtail Madtoms found during a previous survey
(Photos: Katherine DeVilbiss)

Roanoke Logperch and Dan River Restoration at Lindsey Bridge Dam

by TR Russ, Foothills Region Aquatic Wildlife Diversity Coordinator

Five years of focused surveys, science and partnerships are paying off for the Roanoke Logperch population in North Carolina. Since 2015, NCWRC has conducted ongoing distributional surveys and found a wide range of Roanoke Logperch existing in the Dan, Mayo and Smith rivers, including smaller tributaries Big Beaver Island, Cascade and Wolf Island creeks. What started out as two known Roanoke Logperch locations in 2008 is, in 2020, the knowledge that Roanoke Logperch occupy ~50 river miles in North Carolina. Although, NCWRC did not find Roanoke Logperch in the Dan River in Stokes County during these surveys, staff believed that the Lindsey Bridge Dam in Madison, NC had cut off historic upstream migration. In 2017, a partnership with Georgia Southern University and Dr. Jamie Roberts provided key insights into the Roanoke Logperch population genetic structure and discovered a large, genetically distinct metapopulation in the state stretching from the dam in Madison, downstream past Eden to the Virginia state line. The entire size of the population in North Carolina was likely over 11,000 individuals. Following these insights, biologists began management plans in earnest to restore the Roanoke Logperch to its native waters in Stokes County.

Over the past three years an extraordinary partnership among governmental, private and nonprofit organizations has pulled together to help the Roanoke Logperch. These partners include: the Town of Madison, Kris Bass Engineering, LKC Engineering, The Conservation Fund, U.S. Fish and Wildlife Service, NCWRC, Rockingham County Education Foundation, Conservation Fisheries Inc. and the Dan River Basin Association.

In September 2020, Conservation Fisheries Inc. and the NCWRC released 114 propagated Roanoke Logperch into Big Beaver Island Creek.

Lindsey Bridge Dam before retrofitting

Work on Lindsey Bridge Dam begins to allow for Roanoke Logperch passage;

Photos: TR Russ

Roanoke Logperch

These fish will augment the low population in this creek and supplement the Dan River population. The biggest news in 2020, despite uncertain state budgets and COVID-19, came in late September when the USFWS stream restoration crew began retrofitting the Lindsey Bridge Dam to allow Roanoke Logperch passage over the dam and the ability to migrate upstream into at least ~50 river miles of historical habitats.

Over the next five years the partnership has secured enough funding to propagate more Roanoke Logperch in order to restore the population in the upper Mayo River, upstream of two barriers in Mayodan. Additionally, more juveniles will be stocked in the upper Dan River to supplement the newly established population. By 2025, the ultimate goal for the Roanoke Logperch in North Carolina is to occupy over 100 river miles throughout Stokes and Rockingham counties.

MOLLUSKS

Staff Begin Propagation of Federally Endangered Dwarf Wedgemussel

by Michael Fisk and Andrew Glen

In March, Aquatic Wildlife Diversity staff began conducting mussel surveys in the Neuse Basin to collect the federally endangered Dwarf Wedgemussel. These broodstock will be used in the agency's propagation program to augment and bolster dwindling populations. The population in the Neuse Basin has been impacted by impaired water quality, degraded habitat and introduced species, and is at risk of extirpation. To date, staff have collected two male Dwarf Wedgemussels in Swift Creek in Johnston County making them the first Dwarf Wedgemussels collected in the Neuse Basin since 2018. Efforts will continue this spring to collect more to facilitate propagation this year.

One of two male Dwarf Wedgemussel collected from Swift Creek for propagation purposes (NCWRC)

Shuler Creek Rainbow Mussels Relocated Ahead of Barrier Removal

by Dylan Owensby, Western Region Aquatic Wildlife Diversity Biologist

In the not so distant past, western North Carolina fisheries biologists would conduct "renovation" projects in cool water streams to reduce competition with stocked trout. During these projects, fish barriers were constructed at the downstream end of streams and rotenone, a commonly used piscicide, was applied upstream of the barrier to kill off any resident fish. Trout would then be stocked above the barrier.

In 1985, biologists conducted this type of project on Shuler Creek, a tributary to the Hiwassee River, with the hopes of creating a successful wild Brown Trout fishery. Although an initial survey estimated that the rotenone treatment was effective at killing approximately 95% of the fish, a 6-year monitoring project revealed that the nongame fish biomass quickly rebounded close to pre-treatment conditions.

Needless to say, fisheries management has come a long way in the last 35 years. In spring 2020, plans have moved forward to remove the barrier on Shuler Creek. Benefits of barrier removal include stream restoration and habitat connectivity, allowing aquatic species to expand their ranges and facilitate gene flow.

In February 2020, biologists completed a snorkel survey in a 200-meter reach downstream from the barrier to locate and remove any freshwater mussels that might be at risk from the heavy equipment involved in the restoration work. They relocated 30 Rainbow mussels (10 mussels per person-hour) and moved to suitable habitat approximately 2 km upstream. This was the most successful mussel survey completed to date in Shuler Creek. During past surveys, biologists had only collected a maximum of 6 mussels (2 mussels per person-hour) at any single site. The Rainbow mussel is state listed as threatened and is a Species of Greatest Conservation Need. Biologists plan to monitor this section of the creek to see if mussels are able to recolonize in the restoration site.

Old U.S. Forest Service Barrier on Shuler Creek-Hiwassee River Basin *(Luke Graeter)*

Rainbow Mussels collected in Shuler Creek, Hiwassee River Basin *(Dr. Luke Etchison)*

Priority Mussel Surveys and Management Actions by Foothills Aquatic Diversity Staff

by TR Russ, Foothills Region Aquatic Wildlife Diversity Coordinator

Foothills Aquatic Wildlife Diversity staff participated in a number of projects related to freshwater mussel conservation in the Mountains and Piedmont of North Carolina. Biologists continued to monitor propagated individuals of the state-listed Yellow Lampmussel, Green Floater and Notched Rainbow that were stocked into several reaches of the Dan River in 2019. Biologists conducted a series of dive surveys throughout the Catawba River lake-chain and documented new localities of the state-listed Eastern Pondmussel and Rayed Pink Fatmucket in Lake Wylie. Additional surveys were also conducted in the Old Catawba River channel, where a new population of the state-listed Creeper mussel and propagated individuals of the state-endangered Brook Floater were re-introduced after a century-long absence. Foothills biologists collaborated on surveys with the Central Wildlife Aquatic Diversity staff and U.S. Fish and Wildlife Service for rare mussel species in the Uwharrie River basin. Foothills biologists are currently engaged with several collaborators on numerous conservation genetics projects that will benefit federal and state listed freshwater mussels throughout the state.

Staff Continue Augmentation Efforts of Yellow Lance in the Tar River Basin

by Michael Fisk, Eastern Region Aquatic Wildlife Diversity Coordinator

Yellow Lance being tagged (Sierra Benfield)

This summer, Aquatic Wildlife Diversity Program staff continued their augmentation efforts by releasing Yellow Lance into the Tar Basin in Halifax, Franklin and Nash counties. The augmentations are part of ongoing efforts to bolster existing populations of mussels. The Yellow Lance is a federally threatened mussel found in the Tar, Neuse and Chowan river basins in North Carolina. The Yellow Lance's historical range extends from the Neuse River Basin in North Carolina north to the Patuxent River Basin in Maryland. Yellow Lance distribution and abundance are a fraction of historical populations resulting in fragmented contemporary populations. Population declines are associated with habitat degradation resulting from reduced water quality, quantity and instream habitats. In 2020, staff released over 5,000 age-2 Yellow Lance into eight different sites into Fishing and Shocco creeks as well as the Tar River. Augmentations will be monitored annually to document survivorship, growth and reproduction to evaluate augmentation success.

Pigeon River Mussel Population Growth Update

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

Western Region Aquatic Wildlife Diversity biologists spent much of the summer snorkeling in the Pigeon River in Haywood County, where they were conducting mussel surveys to update antiquated population records. They were thrilled to find that the federally and state endangered Appalachian Elktoe population has been increasing in abundance throughout most of its distribution in the West Fork, East Fork and main-stem Pigeon River upstream of Canton, NC. For the 20 surveys that were conducted in the species' previously known range, an average of 39 Appalachian Elktoe were found at each site. This is a notable increase from surveys conducted between 1999 and 2018, when an average of seven Appalachian Elktoe were found per site. Biologists also found a healthy population of the state special concern Wavy-rayed Lampmussel. More Wavy-rayed Lampmussels were found at a single site in 2020 (129) than at any site previously (50). Biologists hope to take advantage of these findings by augmenting or reintroducing mussel populations in other water bodies in the French Broad River basin. This process will involve collecting broodstock from the Pigeon River and propagating juveniles at the Conservation Aquaculture Center in Marion, NC.

Representatives from a healthy Appalachian Elktoe (and one Wavy-rayed Lampmussel) population found in the West Fork Pigeon River in Haywood County (Dylan Owensby)

Staff Begin Study to Determine Climate Change Impacts on Mussels

by Michael Fisk, Eastern Region Aquatic Wildlife Diversity Coordinator

In fall 2020, Aquatic Wildlife Diversity Program staff assisted NC State University graduate student Joseph McIver collecting Tidewater mucket to be used as part of a study focused on climate change and its impacts on native mussels. Gravid females were collected and transferred to the Harrison Lake National Fish Hatchery in Virginia to be used as broodstock.

Progeny will be used to conduct salinity and water temperature experiments at N.C. State University that will help understand the impacts of climate change, and specifically salinity associated with sea level rise, may have on native mussels in the Coastal Plain of North Carolina.

Tidewater mucket collected during surveys on the Chowan River in Gates County (NCWRC)

& NORTH CAROLINA
the Recovering America's Wildlife Act

Sustaining North Carolina's Diverse Fish & Wildlife Resources

The Recovering America's Wildlife Act (H.R. 3742) is a bipartisan bill that, if passed, would dedicate over $20 million annually to North Carolina to conserve and restore nearly 500 nongame fish and wildlife species of greatest conservation need, as well as their habitats. RAWA would allow North Carolina to invest in proactive, voluntary, incentive-based, non-regulatory conservation on both private and public lands.

LEARN MORE: NCWILDLIFE.ORG/RAWA

CRUSTACEANS

Cape Fear Crayfish Surveys Ongoing

by Brena Jones, Central Region Aquatic Wildlife Diversity Coordinator

Staff biologists visited six sites in September 2020 as part of ongoing efforts to update distributional records of native crayfish species. The sites were in Randolph and Guilford counties, specifically targeting the known geographic area of the state listed special concern Greensboro Burrowing Crayfish. Although the target species was not found, three species were excavated from burrow pits including the Carolina Ladle Crayfish, Sickle Crayfish and individuals of the native *Cambarus* species. Additionally, young Sickle Crayfish were found with their mothers in two separate burrows. No exotic crayfish species were collected.

Additionally, two of the five individuals of an unknown, potentially new-to-science species from the Little River of the Pee Dee drainage that were collected and sent to the N.C. Conservation Aquaculture Center (CAC) in September 2019 became gravid this fall. Staff are studying the structure of the glochidia (mussel larvae), monitoring if a host attraction strategy, such as producing a lure, occurs in the gravid females. Staff are also testing which host fish species, if any, are utilized by the mussel to host glochidia, providing food and oxygen until the glochidia are ready to transform into juveniles and drop off in suitable habitat. Central Aquatic Wildlife Diversity staff collected numerous fish species in September to be used in the host infestation trials at the CAC. These efforts are providing additional details on the unknown mussel species taxonomy and life history.

Young Sickle Crayfish; inset photo, Carolina Cradle Crayfish
(Katherine DeVilbiss)

HABITAT MANAGEMENT

Restored Sandhills Game Land Wetlands Attract Numerous Wildlife Species

Dr. Jeff Humphries, Eastern Amphibian and Reptile Biologist

During the third quarter, NCWRC biologists continued to monitor numerous wetlands being restored on Sandhills Game Land. Efforts focused on surveying amphibians and reptiles as well as monitoring the vegetation response multiple years after restoration work began. In cooperation with foresters and land managers, staff are able to apply the best possible management actions to improve the quality of these wetlands over time. Overall, wetlands are quickly colonized by many species of amphibians and reptiles, even just a few years post-restoration. On the other hand, it is becoming clear that some of these wetlands take more effort and attention to appropriately apply fire and reduce invading hardwood trees than others. Staff have been sharing the outcomes of NCWRC's work with partners in other states and learning from them as well. Overall, wetland restoration efforts on Sandhills Game Land have certainly increased populations of many focal species and provided more connectivity for isolated wetland species across the landscape.

An isolated wetland created "from scratch" by NCWRC staff in 2013 is now becoming a high-quality wetland, supporting over 19 species of amphibians and reptiles that colonized the site. This site has been colonized by Gopher Frogs and Tiger Salamanders, two focal species of agency efforts (inset photos).

(Tiger Salamander, Gopher Frog-Jeff Hall; Wetland on the Sandhills Game Land-Dr. Jeff Humphries)

Collaboration Is Key to Success in a Recent Bog Habitat Management Project

by Gabrielle Graeter, Conservation Biologist/Herpetologist

Bog turtles and their habitat – mountain bogs – are a high conservation priority in North Carolina. The bog turtle is federally threatened (S/A) and state threatened. As part of the Wildlife Diversity Program's conservation efforts with this species, the NCWRC manages wetlands with known bog turtle populations. Unfortunately, many of these wetlands have more woody vegetation and more canopy closure than they likely had historically. Various factors have played a role in this change, including increased nutrient input, changes in land-use, development in the surrounding landscape, and differences from historical levels of grazers, fire and beaver activity. The plant communities and wildlife that rely on these areas that are open canopy and predominantly herbaceous vegetation can begin to decline if actions are not taken.

Habitat management in these wetlands often consists of cutting most trees within the wetland, treating invasive plant species, and reducing the amount of shrubby, woody vegetation. Bog turtles lay their eggs in a nest on the ground within the wetland and thus, require that the nest gets full sun so the eggs can properly develop. They also need some areas for basking. Thus, the goal is for the bog to have a mosaic of various habitat elements, with some areas as shrub-scrub and others predominantly herbaceous vegetation without canopy.

In February 2020, through a collaboration with the Nantahala National Forest, NCWRC, MountainTrue and a crew from the American Conservation Experience (ACE), a team of people worked for two days to conduct habitat restoration work at a bog on U.S. Forest Service property. The aim of the work was to restore full sun exposure to a few small areas in the bog by cutting and removing a majority of shrubs and trees. The remainder of the bog is mostly shrub/scrub habitat. Bog turtles and the plant community will benefit from having a mosaic of habitat types and structures with varying degrees of sunlight.

With a lot of preparation, good teamwork, fair weather and a large group assembled ready to work hard, a lot was accomplished in two days. Collaboration with partners was key to the success of these workdays!

Habitat management work underway in the bog with NCWRC and conservation partners

This sphagnum moss hummock could be excellent bog turtle nesting habitat if it receives enough direct sunlight, something that was addressed in these workdays.

Photos: Gabrielle Graeter

Staff and Partners Plant Spruce Trees to Benefit Birds and Mammals

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

Progress was made on two high elevation forest projects in October and November. First, with help from Haywood Community College forestry students and Pisgah Ranger District employees, NCWRC staff planted Red Spruce seedlings for the Flat Laurel Project. The over-Zoomed, field-starved students were game to plant even in the soaking front bands of Hurricane Zeta. In November, an American Conservation Experience (ACE) crew helped NCWRC and Cheoah Ranger District staff plant more spruce for Carolina northern flying squirrels in the Unicoi Mountains and complete release work around the new and previously planted seedlings. Red Spruce is shade tolerant, but like most trees, it will grow more rapidly with access to sunlight. Rather than underplanting beneath a hardwood canopy — an approach that requires later release work to get sun on the seedlings — this year's batch of seedlings was planted in small pockets of open canopy to take advantage of ample sunlight. At Flat Laurel, these were small tree fall gaps that had filled in with blackberry (bottom right photo). In the Unicois, these were canopy gaps created by dead American Beech, killed by beech bark disease. With some maintenance the first few years, seedlings planted in these small groves reach out over the competing blackberry. Biologists look forward to these conifers maturing to provide cover for the Carolina northern flying squirrels and food for the N.C. Listed Special Concern Red Crossbill.

Wildlife Diversity Technician Clifton Avery uses a brushcutter to knock back blackberry prior to planting Red Spruce seedlings this fall. (top photo); A tree fall gap where blackberry has been knocked back for spruce seedlings *(Inset photos: Christine Kelly)*

Red Crossbill
(Photo: Wang LiQiang)

NCPARC

N.C. Partners in Amphibian and Reptile Conservation Updates

by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

Several NCWRC staff were able to attend the Southeast PARC meeting from Feb. 27-March 1, 2020. At least three staff were involved in providing posters or giving oral presentations. Approximately 260 participants attended the meeting held in Nauvoo, Alabama at Camp McDowell.

Due to concerns about COVID-19, the NCPARC meeting, planned for March 24-25 in Ellerbe at Camp Millstone, had to be canceled. The NCPARC steering committee will consider whether to hold the 2021 meeting in the same location or move elsewhere. Several NCPARC working groups were able to still meet during the quarter either in person before the coronavirus spread, or after through online Teams meetings.

WD staff visited a landowner in Bladen County to offer technical guidance on management of ponds for amphibian species. Amphibians of interest in the area include Ornate Chorus Frog, Pine Barrens

Other NCPARC News: Reptile & Amphibian Field Surveys Yield Good Results

Treefrog and Mabee's Salamander. The landowner was interested in making his ponds as optimal as possible for these species.

As is often the case, the first quarter was especially busy working with multiple species. Field work included: setting up trail cameras for Eastern Diamondback Rattlesnakes, walking prescribed burn areas for Species of Greatest Conservation Need (SGCN) snakes and lizards, and surveys for Gopher Frogs, Southern Chorus Frogs, Ornate Chorus Frogs and Mabee's Salamanders.

Field sites included Croatan National Forest and Camp Lejeune; Holly Shelter, Sandhills and Voice of America (VOA) game lands; Military Ocean Terminal at Sunny Point (MOTSU); and several others. Although thought to occur there, Southern Chorus Frogs were finally documented by NCWRC staff on the VOA Game Land this February.

Staff had a very productive time walking prescribed burn areas, which yielded many records of the following species: Pigmy Rattlesnake, Timber Rattlesnake, Mole Kingsnake, Eastern Kingsnake and Corn Snake. NCWRC technician Myles Lance spotted a particularly valuable new record for Jones County when he found a Pigmy Rattlesnake, a species never previously documented from that county.

Continuing partnerships with the NC Aquariums, the NC Zoo, NCSU CMAST, and Carteret Community College, NCWRC staff head-started Gopher Frogs from three locations including Croatan, Holly Shelter and Sandhills. Of note, Gopher Frogs returned to breed in a borrow pit in Holly Shelter following significant restoration work that took place in the summer of 2019. They had not bred in the wetland for several years due to degradation of the site. It was very exciting to see the frogs responding to the great conservation efforts of the NCWRC's Land and Water Access staff.

Gopher frog on Croatan National Forest

Southern Chorus Frog on VOA Game Land

Top left, clockwise: Pigmy Rattlesnake; Timber Rattlesnake Mole Kingsnake;

Previous page, Eastern Diamondback Rattlesnake.

Photos: Jeff Hall

NCPARC Meetings Continue Virtually Due to COVID-19 Restrictions

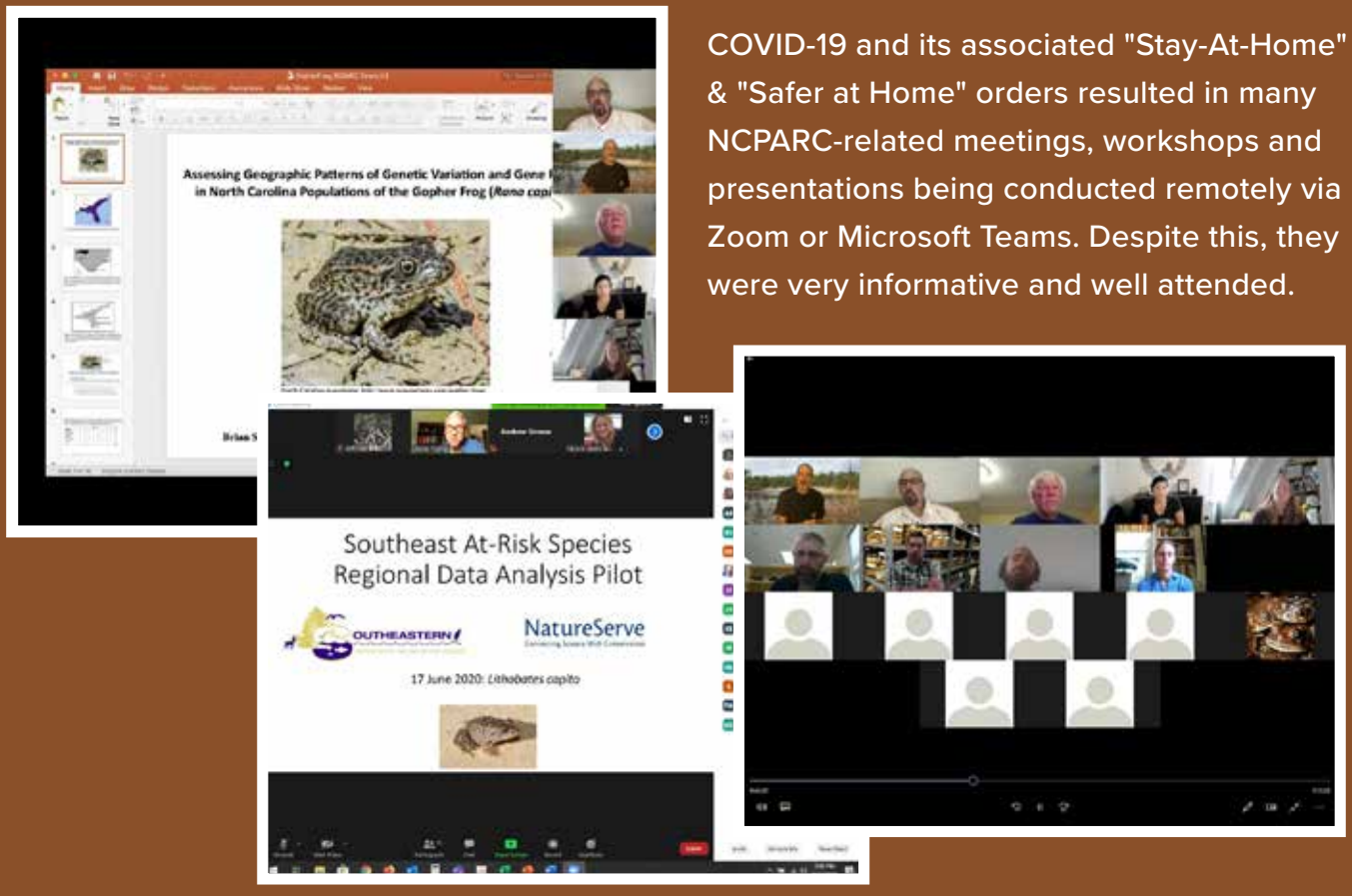
by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

Although concerns about COVID-19 led to the cancellation of many in-person meetings, workshops, and presentations, WD staff were able to conduct many of these via on-line platforms such as Teams or Zoom. Staff participated in the hosting of two workshops on frogs, one on salamanders, one on snakes and one on box turtles. All of these on-line offerings were very well attended. Using virtual platforms is an excellent way to reach a larger audience with presentations and holding these types of meetings is likely the path for the future.

In addition to the meetings mentioned above, staff also participated in several targeted scientific virtual presentations. Two workshops were held on Gopher Frog conservation. One targeted at understanding the genetics of Gopher Frogs in North Carolina and the other at fine-tuning the NatureServe ranking for the species rangewide. An additional NatureServe ranking workshop was held virtually to assess the Eastern Diamondback Rattlesnake.

The spring is an active time for many species. Even with COVID-19 restrictions in place, NCWRC staff managed to conduct significant field work involving multiple species including use of trail cameras, walking prescribed burn areas, installation of cover-board sites, and general visual encounter surveys for Species of Greatest Conservation Need (SGCN) reptiles and amphibians.

In light of an impending U.S. Fish and Wildlife Service's species status assessment for the Spotted



COVID-19 and its associated "Stay-At-Home" & "Safer at Home" orders resulted in many NCPARC-related meetings, workshops and presentations being conducted remotely via Zoom or Microsoft Teams. Despite this, they were very informative and well attended.

Reptile & Amphibian Surveys and Head-starting Work Continue

Turtle, NCWRC staff also conducted specific surveys for this species. Staff from multiple divisions helped with this effort. Field sites included many coastal locations.

Gopher Frog head-start work continued through this quarter working with the NC Aquariums, the NC Zoo, NCSU CMAST and Carteret Community College.

With help from the Land and Water Access Division, WD staff were also able to locate a coastal gestational site for Timber Rattlesnakes. Although communal gestational sites are somewhat common in the Mountain region, they are very rare on the Coastal Plain. The site, located in Bladen County, held at least two gravid females basking approximately 6 feet apart. This is the first time this communal basking behavior has been observed in the Coastal Plain by staff, and possibly the first time ever in North Carolina, which is very exciting news for agency.

Clockwise from top left: Spotted Turtles found during spring surveys; Staff from other agency divisions, such as Lt. Mark Cagle, assisted WD staff with Spotted Turtle surveys; Barking Treefrog found in game land pond; One of two female Timber Rattlesnake found at gestational site in Bladen County

Photos: Jeff Hall

REPORTS OF RATTLESNAKE SIGHTINGS INCREASE DRAMATICALLY OVER SUMMER

by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

This summer proved to be very productive for surveys and monitoring of rattlesnakes. In 2009, NCPARC developed a brochure called "Rattlesnake Sightings Wanted" and began handing them out at hunting and fishing expos. While a few accounts have trickled in over the years, during spring and summer 2020, staff received over 100 sightings from the public. These reports have led to over 70 new rattlesnake locations for both Timber and Pigmy Rattlesnakes, as well as several new gestation sites. A gestation site (sometimes also called a rookery) is an area where multiple pregnant rattlesnakes, as well as other snake species exhibiting live birth such as Eastern Garter Snake, Northern Water Snake, and Copperhead, gather so that they can bring their litters to term (i.e., grow their babies). These sites have optimal thermal qualities as well as plenty of areas for protection from predators. NCWRC staff have been conducting rattlesnake surveys in both the Coastal Plain and in the Mountains, with work focused on locating new gestation sites, as well as monitoring known sites, so these citizen reports have been particularly helpful.

Clockwise from left: Two Timber Rattlesnakes at a gestation site; Timber Rattlesnake at a gestation site; two Timber Rattlesnakes at a gestation site. A second snake under the rock is nearly undetectable; female Pigmy Rattlesnake that gave birth to three babies the day after the photo was taken.

Photos: Jeff Hall

Radio-Telemetry Study on Rattlesnakes Conducted with Partners

NCWRC staff partnered with herpetologist John Sealy, as well as NC State Parks, to conduct a radio-telemetry study on Timber Rattlesnakes at Hanging Rock State Park. In addition to staff testing out a new technique for transmitter attachment, this project is focused on learning about behaviors of snakes in areas of high human traffic within the park. Snakes will be tracked until they reach their winter denning sites for brumation (called hibernation in warm-blooded animals) so that appropriate management techniques can be considered for rattlesnakes and their habitats in the area. Interesting behaviors are often discovered during tracking of snakes including hunting (snakes found in ambush postures), feeding events, and courtship.

Clockwise from top: John Sealy conducting radio-telemetry; telemetered Timber Rattlesnake in ambush mode at the base of a tree; telemetered Timber Rattlesnake consuming a Grey Squirrel

Photos: Jeff Hall

NCPARC Presents Achievement Award to Retired Lieutenant

In some exciting staff news during this quarter, Law Enforcement Division Lt. Mark Cagle received the NCPARC Achievement Award from the NCPARC Steering Committee. The award stated, "This award is presented to Mark Cagle on behalf of North Carolina Partners in Amphibian and Reptile Conservation in recognition of outstanding contributions through law enforcement and education to the conservation and protection of North Carolina's reptiles and amphibians."

Congratulations Mark on a well-deserved honor!

Lt. Mark Cagle with NCPARC Achievement Award

NCPARC Says Goodbye and Good Luck to Technician Myles Lance

Myles Lance with a Black Racer (left) and Timber Rattlesnake

The third quarter also saw the transition of former wildlife technician Myles Lance into graduate school at Western Carolina University (WCU). Myles worked as a technician with NCWRC for over three years and has been a terrific worker and colleague. He will be sorely missed by NCWRC staff, but a great addition to WCU. We wish you much luck Myles!

Photos: Jeff Hall

SUCCESSFUL REPRODUCTION OF EASTERN DIAMONDBACK RATTLESNAKE DOCUMENTED FROM ROAD-KILLED SNAKE

by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

Fall snake surveys proved fruitful in the Coastal Plain and Sandhills. However, some species, such as Southern Hognose Snake, were found in fewer numbers. Those species of conservation interest, which were documented during this quarter, included: Eastern Hognose Snake, Eastern Kingsnake, Eastern Ribbon Snake, Eastern Coachwhip, Pigmy Rattlesnake, Timber Rattlesnake and Eastern Diamondback Rattlesnake. The Eastern Diamondback Rattlesnake sighting was a road-killed individual found by Camp Lejeune staff on base, and although unfortunate that it was road-killed, it was an extremely valuable find. The specimen was a young snake, likely a 2-year-old animal. This is especially hopeful since it represents successful reproductive effort for the species, something that biologists have been unable to document prior to this sighting.

WD staff documented several snake species of conservation interest during fall surveys in the Coastal Plain and Sandhills, including the Eastern Coachwhip (top left) and Pigmy Rattlesnake (bottom left).

Photos: Jeff Hall

"FROGLOGGERS" AND TRAIL CAMS DEPLOYED TO DETECT AMPHBIANS AND REPTILE SPECIES

by Jeff Hall, Partners in Amphibian and Reptile Conservation Biologist

Late in the quarter, NCWRC staff deployed numerous automated devices of both audio and photographic design. Approximately 20 automated audio data recorders, AKA "frogloggers," were deployed at wetlands across the Coastal Plain and Sandhills. Staff hope later analysis of the frogloggers will lead to detections of frog species of conservation interest, such as Gopher Frog, Southern Chorus Frog and Ornate Chorus Frog.

Eight automated trail cameras were deployed on Camp Lejeune to continue survey efforts for the Eastern Diamondback Rattlesnake, as well as other snake species of interest. Although a December day when the cameras were installed, it was warm enough that three individual diamondbacks were seen during the visit. Later analysis of head pattern confirmed that all three were individuals that had been sighted before. One of those individuals was first sighted by Lejeune staff in 2011, and it was a large adult at that time. That individual is likely 15-20 years old or older.

Automated audio data logger, AKA "froglogger"

One of three Eastern Diamondback Rattlesnakes found while setting up trail cameras

Photos: Jeff Hall

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 men and women 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.

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