

2022 GAME & FURBEARER PROGRAM SUMMARY REPORT



N.C. Wildlife Resources Commission
Wildlife Management Division
919-707-0050
ncwildlife.org

The North Carolina Wildlife Resources Commission's Game & Furbearer (G&F) Program is housed within the agency's Wildlife Management Division. Program responsibilities principally include surveys, research and regulations for game and furbearer species. This report represents an overview of many of the recurring survey activities and current research within the G&F Program for fiscal year 2021-22. Information included herein does not represent the full report on these individual activities. For most activities, more thorough and detailed reports are available and can be found on our website (ncwildlife.org) or by request.

Game and Furbearer Program Staff during FY 2021-22:



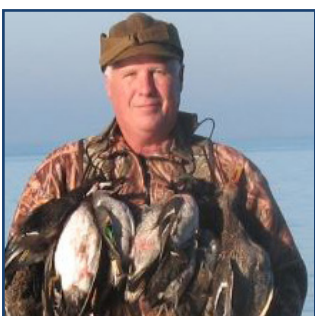
Chris Kreh (CWB®) – Program Coordinator
Surry County
Years with the NCWRC: 20



Joe Fuller (CWB®) – Program Supervisor
Chowan County
Years with the NCWRC: 30



Moriah Boggess (AWB®) – Deer Biologist
Onslow County
Years with the NCWRC: 1



Doug Howell (CWB®) – Migratory Game Bird Coordinator
Chowan County
Years with the NCWRC: 24



Ryan Myers (CWB®) – Wildlife Surveys Biologist
Chatham County
Years with the NCWRC: 21



Colleen Olfenbuttel (CWB®) – Black Bear and Furbearer Biologist
Chatham County
Years with the NCWRC: 15



Hannah Plumpton – Upland Game Bird Biologist
Alamance County
Years with the NCWRC: Hired March 2022



Andrea Shipley – Mammalogist (shared staff with Wildlife Diversity Program)
Nash County
Years with the NCWRC: 4



Sarah Van de Berg – Wildlife Health Biologist
Wake County
Years with the NCWRC: Hired February 2022



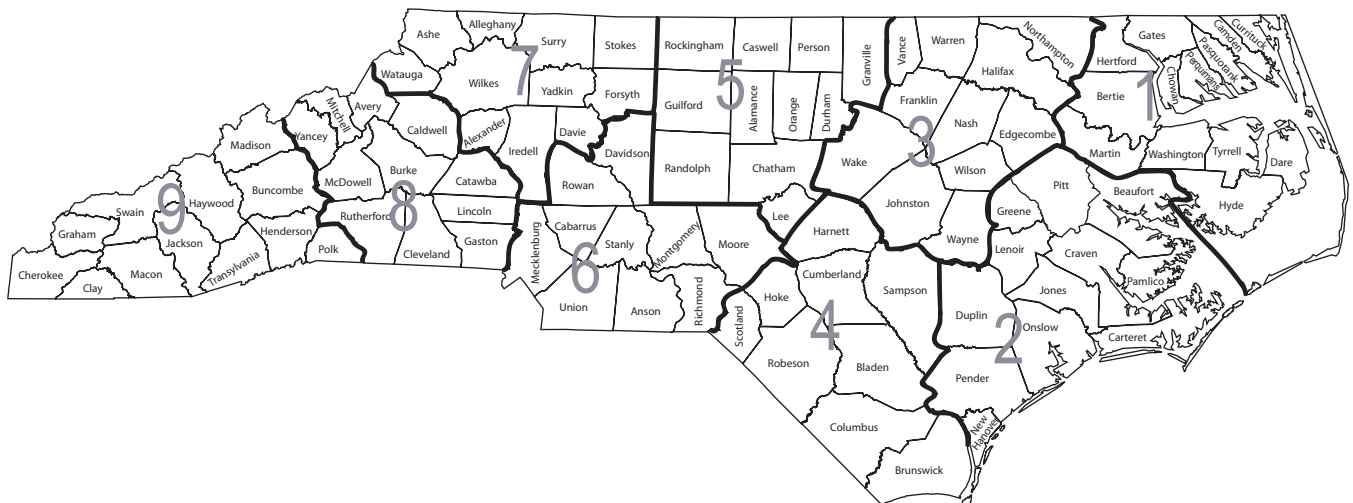
Cover photos (l to r, clockwise): Mikiah Carver (left), PhD student, and lead Capture Technician Jared Lamb from NCSU monitor vitals on an anesthetized doe prior to release. Migratory Game Bird Coordinator Doug Howell (left) and Hunter Morris (Biologist I) attach a transmitter to a hen mallard. Chris Baranski, Land and Water Access Northern Piedmont Management Biologist, attempts to capture a woodcock while night-lighting. (photos: NCWRC) This page: Black bear (Shutterstock)

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NCWRC District Map

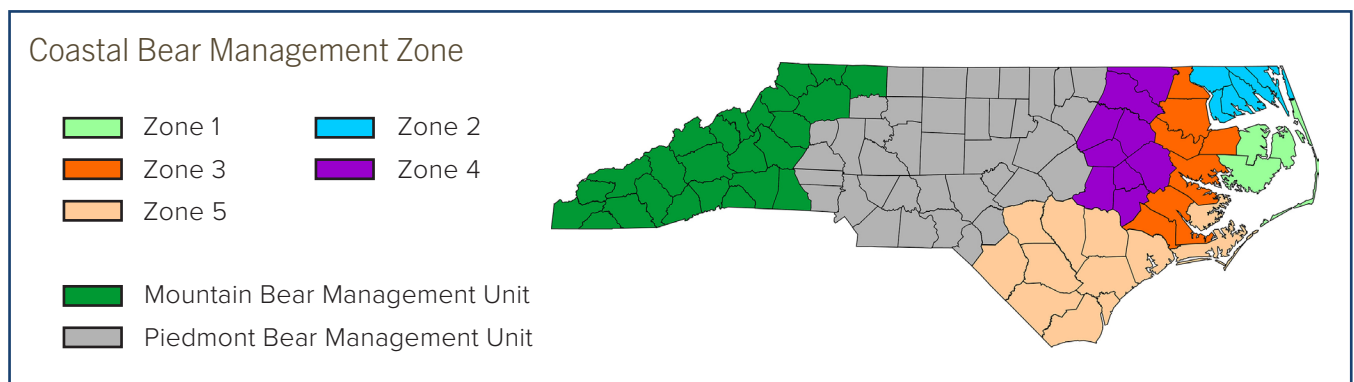


BLACK BEARS

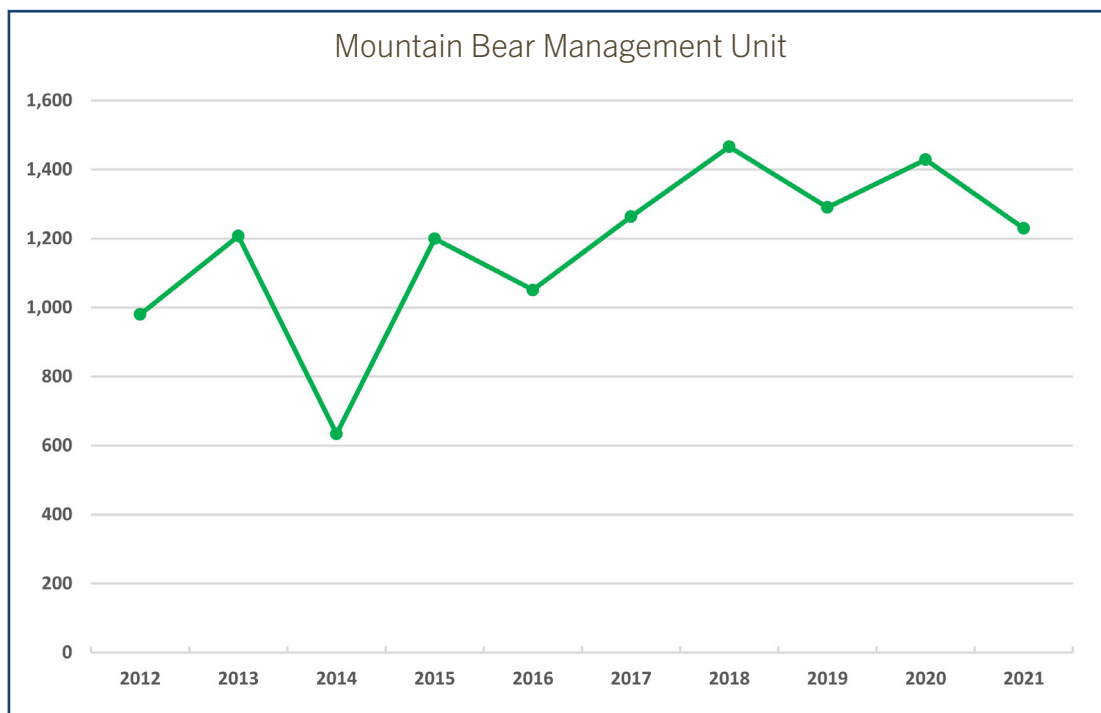
For more information on black bears, including the Black Bear Annual Report in North Carolina, see: ncwildlife.org/bears and visit the “Surveys and Reports” tab.

Bear Harvest and Mortality

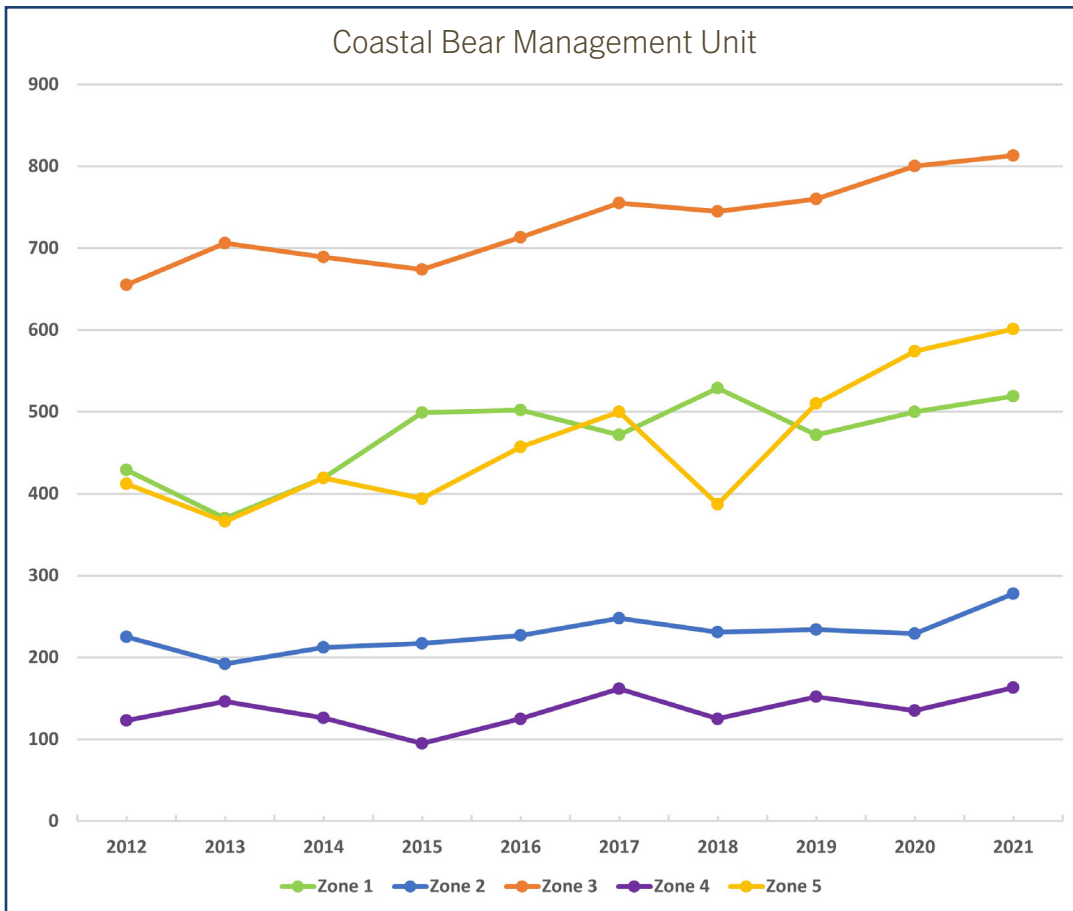
Statewide in 2021, reported black bear harvest was 3,661, consisting of 2,192 male (60%) and 1,469 (40%) female bears. Total statewide harvest was down 2% compared to the record harvest in 2020. The Coastal Bear Management Unit (BMU) harvest increased 6% from the previous year and was a record harvest, while the Mountain BMU harvest decreased 14%, largely due to an increase in mast abundance. The Piedmont BMU harvest decreased 28%.



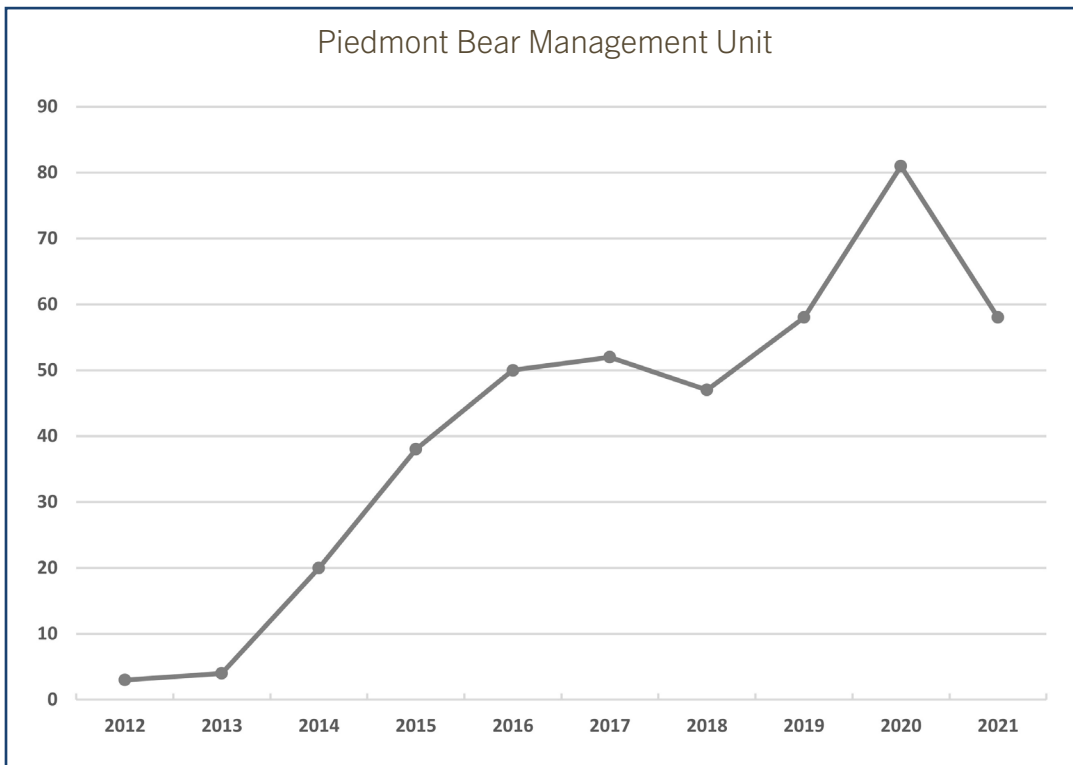
North Carolina Black Bear Management Units



North Carolina reported Black Bear harvest, 2012 through 2021



North Carolina reported Black Bear harvest, 2012 through 2021



North Carolina reported Black Bear harvest, 2012 through 2021

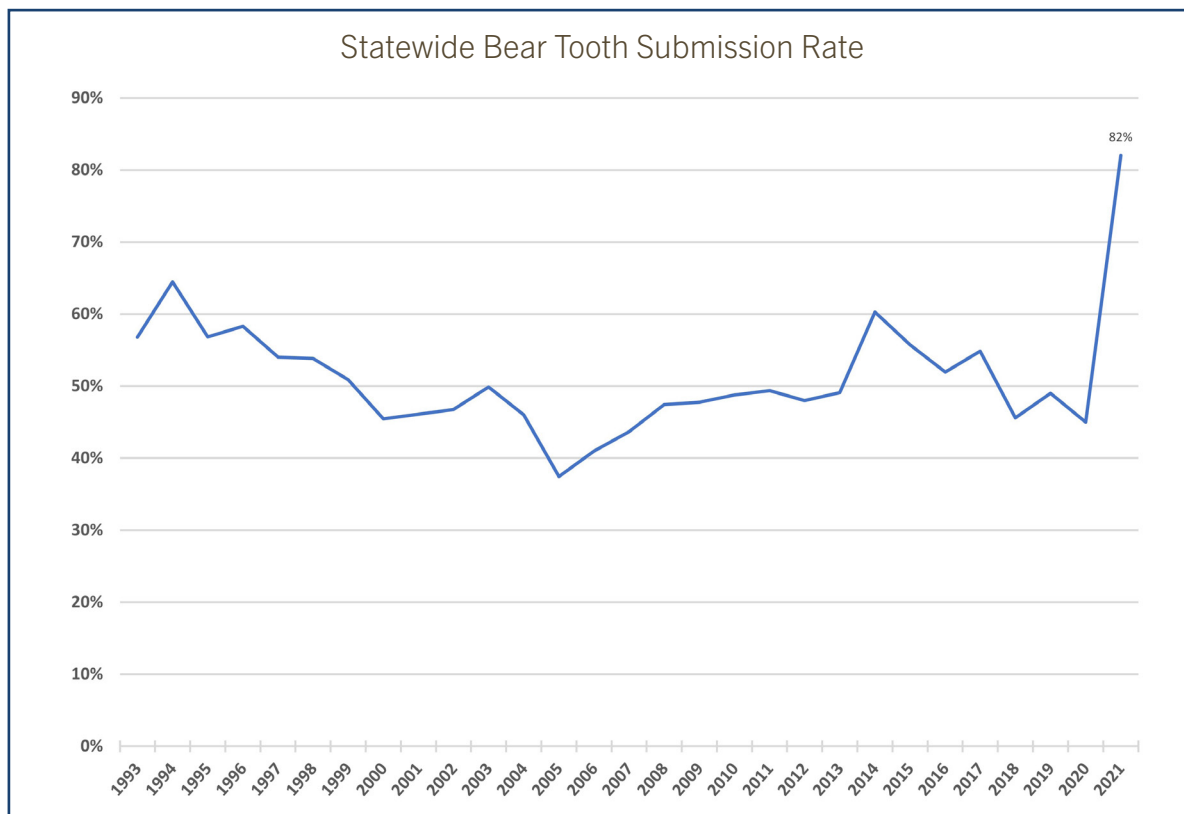
Black Bear Cooperator Program

Collection of biological data from harvested bears began in 1969 under the voluntary Black Bear Cooperator Program. Age and sex information gathered from biological samples is used for analyzing the age structure of the harvested population and for monitoring population growth trends. The 2021 bear hunting season marked the first year of mandatory tooth submissions. For the 2021 season, over 3,000 pre-molars were submitted from cooperating

hunters, representing 82% of the statewide registered harvest and a 79% increase in tooth submission from the previous year. Prior to last season's mandatory tooth submissions, submission rates had been declining over time. The tooth submission rate from

still hunters (78%) was lower than hound hunters (85%). Traditionally, tooth submission rates from hound hunters have been substantially higher than from still hunters. Tooth submission rates were higher in the Coastal BMU than the other BMUs.

BMU	Submission Rate	
	Hound Hunters	Still/stand Hunters
Coastal Plain	86%	82%
Mountains	84%	69%
Piedmont	45%	70%
Statewide	85%	78%



Statewide bear tooth submission rates, 1993-2021

Mast Surveys

Mast is a generic term used to represent the variety of fruits and nuts from wild plants. Hard and soft mast surveys were conducted in the Mountain BMU during summer and fall 2021. The summer soft mast survey is conducted biennially in conjunction with the bear scent station survey, while the fall hard and soft mast survey is conducted annually along 12 established routes. Production of all four summer soft mast species (blueberry, huckleberry, blackberry, pokeberry) was below their long-term averages and poor, while production of fall soft mast (pokeberry, cherry, grape and black gum) was above their long-term averages and rated as fair to good production. The 2021 hard mast crop was rated as fair with an overall index of 2.55, a slight increase from last year's mast crop, which also rated as fair. Since 1983, North Carolina has experienced 25 years out of 39 in which the hard mast index was rated as fair.

Hard and soft mast is an important food source for many species of wildlife and is important to monitor for its multi-species impacts.



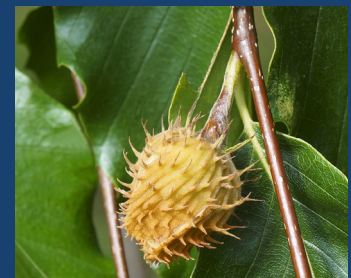
Red Oaks - fair production in 2021 (below long-term average)



White Oaks - fair production in 2021 (above long-term average)



Hickories - fair production in 2021 (above long-term average)



Beech - fair production in 2021 (below long-term average)

All photos: Shutterstock

BearWise® Program

In early 2022, BearWise (bearwise.org) grew from a southeast regional program to becoming a national program, with the Association of Fish and Wildlife Agencies now overseeing the program with financial support from most states with a resident bear population. Whether you are a new North Carolina resident from Minnesota or a tourist visiting our great state from Maine, there is now a good chance you will have been exposed to the BearWise Basics message in all those states.

During 2021-22, we were successful in creating the first Recognized BearWise Business in North Carolina. Sierra Nevada Brewery in Mills River is the first brewery in the United States to achieve BearWise recognition. Sierra Nevada switched to bear-resistant containers throughout its campus and secured dumpsters and waste storage. The brewery will also include BearWise messaging in its brewery tours when they resume.



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We had another first with Camp Merrie-Woode becoming the first recognized BearWise Recreation Area in the country. Staff installed bear-resistant trash enclosures around the camp, rearranged camp sites for better food storage and will train counselors and staff annually on bear safety.

The number of BearWise communities is growing in North Carolina. The first four BearWise communities established in western North Carolina include Highlands, Mountain Meadows I & Mountain Meadows II (Asheville), and Black Mountain Neighborhood. Learn more about how to become a recognized BearWise community or business on the NCWRC's website ncwildlife.org/bearwise and BearWise.org.



NCWRC Biologist Ashley Hobbs with Camp Merrie-Woode Executive Director Jim Dunn at a bear-resistant trash receptacle. Camp Merrie-Woode became the first recognized BearWise Recreation Areas in the US by securing attractants to live responsibly with bears. (Denice Dunn)

Wildlife Underpass Camera Survey

The NCWRC continues its multi-year effort to monitor a 12-mile section of U.S. Highway 64 in Washington County that has three wildlife underpasses and fencing that extends 1/2 mile from each underpass in both directions to keep wildlife off the highway and funnel wildlife toward the underpasses. In October 2021, we completed two years of using remote cameras to monitor wildlife use of 15 gaps found in the fencing along the highway. We are working with the University of North Carolina-Wilmington to review, organize, and analyze 100,000+ photos collected from those 15 cameras. Data from these photos will determine if wildlife is able to access the highway, and if so, is this resulting in decreased use of the underpasses, as well as increasing the risk of a vehicle-wildlife collisions.

In March 2022, NCWRC staff walked the approximately 6 miles of fencing to catalog all deficiencies in the fence (e.g., gaps, damaged fence, etc.). All deficiencies were described, photographed, measured, and the location recorded. We continue to use remote cameras

to monitor wildlife use of the three underpasses to gain more information on how vegetation management, precipitation, traffic volume, temperatures, and other variables impact use of the wildlife underpasses. Results will be used to provide recommendations to NCDOT for maintaining and improving fencing and managing vegetation in and around underpasses. Our study will show the importance of continued monitoring of highway wildlife passages to determine long-term effectiveness and maintenance needs.



Kimberly McCargo (District 1 Wildlife Conservation Biologist) recording data where part of the Highway 64 underpass fencing has fallen due to a car accident that occurred a few years prior (Colleen Olfenbuttel/NCWRC).

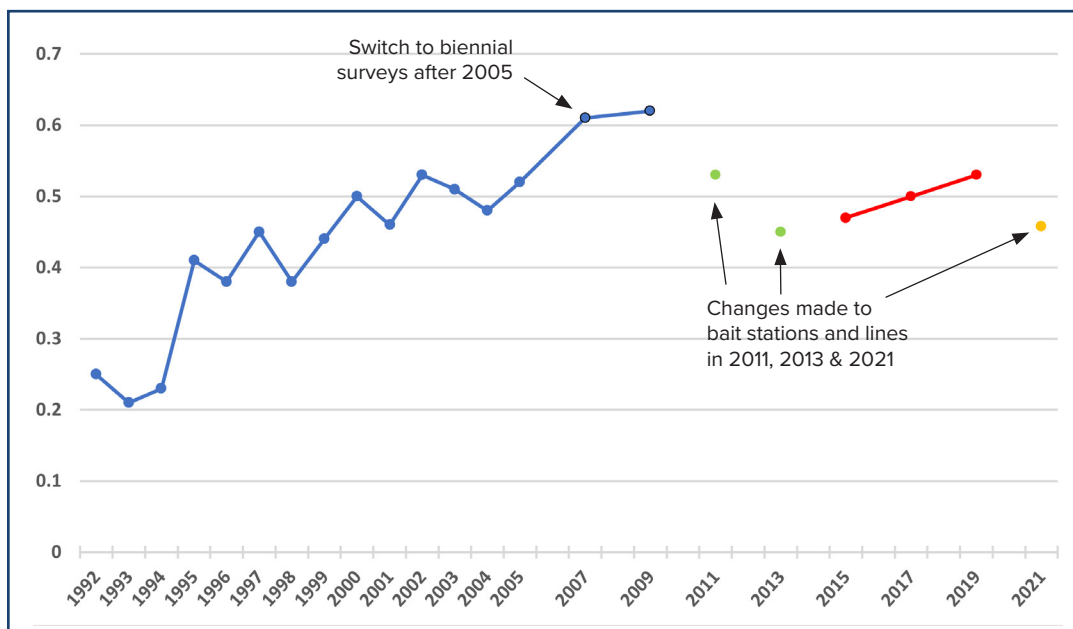
Sardine Bait Station Surveys

Bait station surveys in the Mountain BMU were initiated in 1992 and provide a monitoring tool that is independent of harvest and human-bear interaction data, which both have biases. All surveys are conducted on public lands (i.e., game lands, National Forest), where the NCWRC has long-term access. The most recent bait station survey was conducted in July 2021, and 774 stations were visited 354 times by black bears for a visitation rate of 46%. This is a decrease in visitation rate since 2019. The decline in visitation rates from 2009 through 2013 likely reflects a host of factors, including record rainfall that occurred during summer 2013 and changes made to the survey lines in 2011 and 2013. These changes included the removal of several bait stations and survey lines and the addition of four new survey lines. In 2021, the area experienced another wet summer that may have impacted visitation



Sardine bait station (Colleen Olfenbuttel/NCWRC)

rates. In addition, we removed one line due to increased human disturbance (Lake James State Park) and added a new line at Johns River Game Land.



Mountain BMU Black Bear Survey Visitation Rates, 1992-2021

FURBEARERS

For more information, including reports, on furbearers and trapping in North Carolina, see also: ncwildlife.org/trapping.

Eastern Spotted Skunk Population Camera Survey

Since January 2015, North Carolina, in coordination with Clemson University, has conducted a winter camera survey to document the presence of Eastern Spotted Skunks (ESSK). Unlike striped skunks that are distributed nearly statewide, spotted skunks in North Carolina are found only in the western part of the state at mid- to upper elevations. For winter 2022, we re-surveyed 51 sites from 2018 and five new sites. We had 15 detections of ESSKs at five sites, which was our lowest number of detections since 2017, when only eight ESSKs were detected among 51 sites. We have experienced a decline in detections since 2019, which is concerning. We did document a canine-distemper outbreak among ESSKs on Dupont State Forest in spring 2020, which indicates that diseases may be influencing ESSK abundance.

At the 31 sites where we detected ESSKs since 2015, the average number of days to detect the first ESSK was 35 days (range 2–82 days). When two cameras were placed at a site, detection occurred, on average, within 27.3 days

versus 37 days at sites with just one camera. But the proportion of sites where ESSKs were detected was similar between 1-camera (0.16) and 2-camera (0.13) sites. We will be using this information to develop guidelines for future monitoring efforts of ESSK populations.



Eastern spotted skunk (Agnieszka Bacal)



An eastern spotted skunk detected in March 2018 in western North Carolina (NCWRC)

Pilot Camera Survey of Weasels

Weasels are rarely observed in the southeastern United States, and it is unknown if this is because they are rare and declining or because they are secretive and difficult to survey. In North Carolina, we have two species of weasels, the long-tailed weasel, which is a SEAFWA Species of Greatest Conservation Need (SCGN) species, and the least weasel, which was one of two species in Order Carnivora listed as a knowledge-gap priority species (see 2015 Wildlife

Action Plan). A new weasel working group was started in fall 2021 with researchers and state wildlife biologists from 16 states, including North Carolina. The group's primary goal is to identify effective tools for monitoring weasel populations.

To meet the group's goal, seven states conducted an experimental camera survey in winter 2022 to identify a bait and/or lure that was most effective for attracting weasels to a camera site. In February 2022, the NCWRC, along with

researchers from Clemson University, the North Carolina Museum of Natural Sciences, and Appalachian State University, deployed clusters of cameras in six areas of western North Carolina. Seven weasels were detected from February through April, with the majority of these detections occurring at camera sites baited with only salmon oil. The NCWRC kept its weasel cameras deployed year-round to determine if there is a seasonality to weasel detections.

NCWRC biologist, Ashley Hobbs, checking a camera deployed to detect weasels as part of a multi-state camera survey effort
(Colleen Offenbuttel/NCWRC)



Disease Monitoring in Furbearers

Starting in January 2021, the NCWRC partnered with USDA-Wildlife Services (WS) and the Southeastern Cooperative Wildlife Disease Study (SCWDS) to conduct a state-wide survey to determine the prevalence of raccoon roundworm (*Baylisascaris procyonis*) in North Carolina. Since that time, the survey has expanded to detect other diseases, parasites, and contaminants that impact furbearer populations, including canine distemper virus, echinococcus, and

rodenticide. In addition, genetic samples are being collected for the NCWRC, the NC Museum of Natural Sciences, and other researchers.

Furbearers are collected opportunistically by both USDA-WS and NCWRC staff. From September 2021 through June 2022, we sampled 121 furbearers, including raccoons, gray foxes, red foxes, coyotes, bobcats, long-tailed weasels, and muskrats. These were in addition to the 141 raccoons sampled from January 2021

through August 2021. We have detected raccoon roundworm in eight raccoons from six western counties, of which five counties are new detections. To determine if raccoon roundworm has expanded in North Carolina and possibly being exposed to sensitive species (e.g., Allegheny woodrat), we have a goal to opportunistically sample 20-30 raccoons per county in North Carolina, with a focus on the Mountain Furbearer Management Unit.



Staff from the NCWRC and USDA-WS sample furbearers at the Morganton Depot to collect samples to survey for various diseases and parasites, including raccoon roundworm, canine distemper, and echinococcus.

(Colleen Offenbuttel/NCWRC)

Muskrat Sex and Age Ratio

Due to concerns about regional muskrat populations, several southeastern, north-eastern and Canadian fur-bearer biologists have started monitoring muskrat populations in cooperation with licensed trappers. Efforts involve monitoring the age and sex ratio of harvested muskrats, as this may indicate population declines. For example, a high proportion of adults could indicate poor reproduction. Starting

in 2011, North Carolina joined regional efforts by attending fur sales and working with North Carolina fur dealers.

During the 2021-22 season, we sampled 228 muskrats, an increase from the 2020-21 season, mainly due to Covid-19 restrictions being lifted on field-work and travel, which allowed us to meet with fur dealers and attend fur sales. The ratio of juveniles to adults increased and was the highest ratio since

2016-17. The ratio of juveniles to adult females was second highest since the survey was initiated. This indicates good reproduction in the areas where these muskrats were trapped, but a larger sample size would allow better interpretation of the results on a statewide level. We will continue to monitor the age and sex ratio of the harvest and identify whether additional research is needed to monitor the status of muskrat populations.



Examination of hair growth patterns via flesh pigmentation in pelts can be used to determine age of muskrats. The mottled pattern of adult muskrats (right) is distinguished from the linear striped pattern of juveniles. Additionally, close examination of the pelts for teats is indicative of females. (Colleen Olfenbuttel/NCWRC)

Trapper Harvest Survey

Since the 2002-03 trapping season, an annual trapper mail harvest survey has been conducted to track reported statewide furbearer harvest by species. For the 2021-22 trapping season, there was a 9% increase (47,905 estimated harvest) in

the overall furbearer harvest compared to 2020-21. During the 2021-22 season, there were 3,508 trapping licenses sold, a 7% increase in sales compared to the 2020-21 season. This is the third highest number of trapping licenses sold since the 1986-87 season.

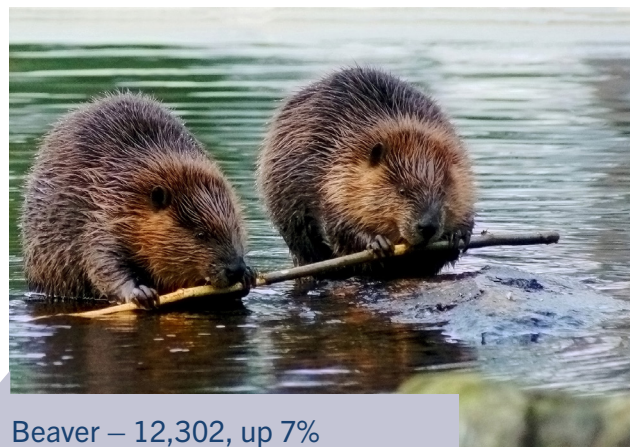
The increase in trapping license sales likely reflects the “COVID effect” that several states, including North Carolina, have experienced. In general, approximately half of all licensed trappers actively trap in a given year.

Top Three Trapper-Harvested Furbearers in 2021-22 with comparison to the previous 3-year average



Raccoon – 9,335, down 14%

Pratish Halady



Beaver – 12,302, up 7%

P. Harstela



Coyote – 8,047, up 4%

Matt Knoth

WHITE-TAILED DEER

For more information on white-tailed deer in North Carolina, see also: ncwildlife.org/deer.

Deer Ecology Across an Urban-Rural Continuum

The deer ecology project is designed to answer pressing questions about deer landscape use, productivity, mortality, density, and public opinion of deer across an urban to rural gradient. The project will collect data via three project components: deer capture and tracking, public opinion surveys, and deer fecal surveys.

The first deer capture season began in January 2022 and ended with 72 adult deer captured and collared in Durham and Orange counties. Adults were captured and chemically immobilized using a combination of drop nets and darting. Adult females were tracked closely

during fawning season, leading to the capture and collaring of 27 fawns. Additionally, 10 fawns were collared opportunistically. Adult capture will resume shortly after the 2022 hunting season.

The survey component of the project will focus on three primary groups: residents, hunters, and industrial landowners across the gradient in Durham County. The resident survey was finalized and sent to 7,500 recipients in spring 2022. Hunter and industrial landowner surveys are nearly finalized. Fecal surveys will be conducted following the 2022 hunting season.



Two fawns are blindfolded to reduce stress before being fit with GPS collars. (NCWRC)



Collared buck in a Durham resident's backyard (Darren Strickland)

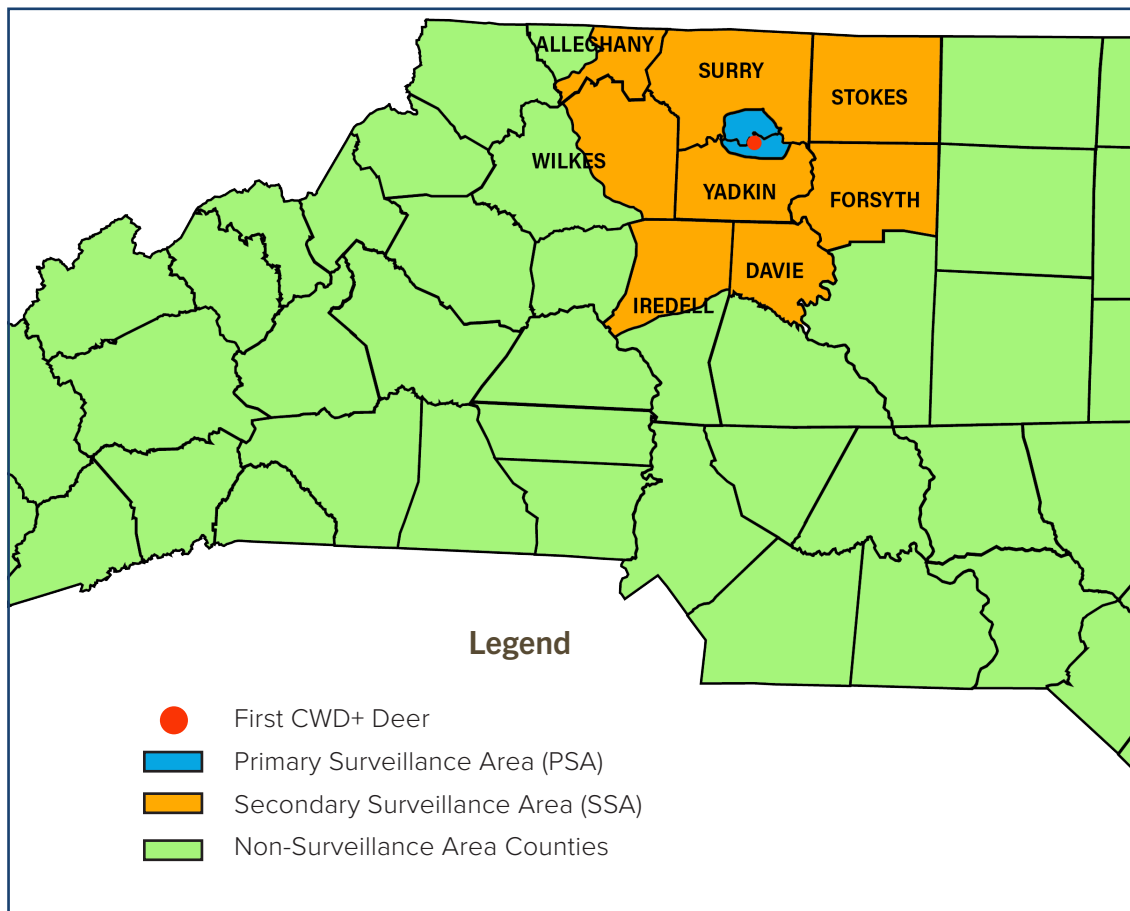
First Detection of Chronic Wasting Disease (CWD) in North Carolina

Following the detection of CWD just over 30 miles from the North Carolina border, in Montgomery County, Virginia, surveillance efforts were increased statewide during the 2021 hunting season. In March 2022, the first detection of CWD in North Carolina was confirmed in a buck harvested in northern Yadkin County. Wildlife law enforcement and biological staff visited the hunter, who showed staff the

harvest location, trail camera photos of the buck, and photos after harvest. Using genetic sequencing, a bone sample from the hunter's skull mount of the buck was matched with the CWD-positive lymph node at the lab.

Executive powers were invoked by the Executive Director in April that established Primary and Secondary Surveillance Areas and implemented a prohibition on

fawn rehabilitation, feeding wildlife outside of deer season, the transport of high-risk carcass parts out of Surveillance Areas, and designated mandatory testing days during blackpowder and gun seasons in the 2022 hunting season. Temporary rules were adopted by the NCWRC that replaced executive powers, establishing these regulations in temporary rule.



Primary and Secondary CWD Surveillance Areas established around the first CWD-positive deer detection in northern Yadkin County

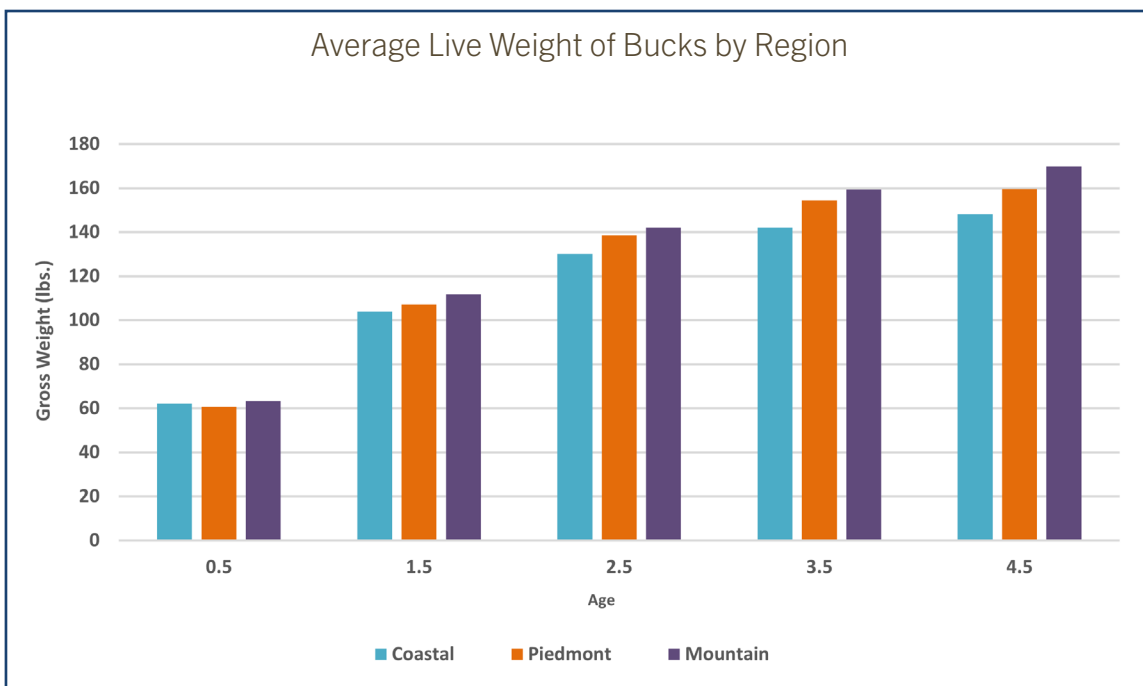
Biological Data Collection

The NCWRC annually collects deer biological data, which is used to monitor populations statewide against biological objectives and to evaluate the effectiveness of current regulations and potential changes to them. These data are collected through a variety of sources and include such metrics as deer age, antler measurements, lactation status, etc.

Source	Deer
Meat Processor	2,316
Taxidermist	1,100
DMAP	1,015
Voluntary Check Station	716
Vehicle-killed Collection	481
Voluntary Hunter Submission	352
Jawbone Survey	326
Voluntary Hunt Club (non-DMAP)	203
Depredation Permit	98
Disease Evaluation	91
Employee Harvest	81
Other	42
TOTAL	6,821



Chris Kent, District 2 Biologist, records antler measurements at a voluntary check station on Camp Lejeune. (NCWRC)



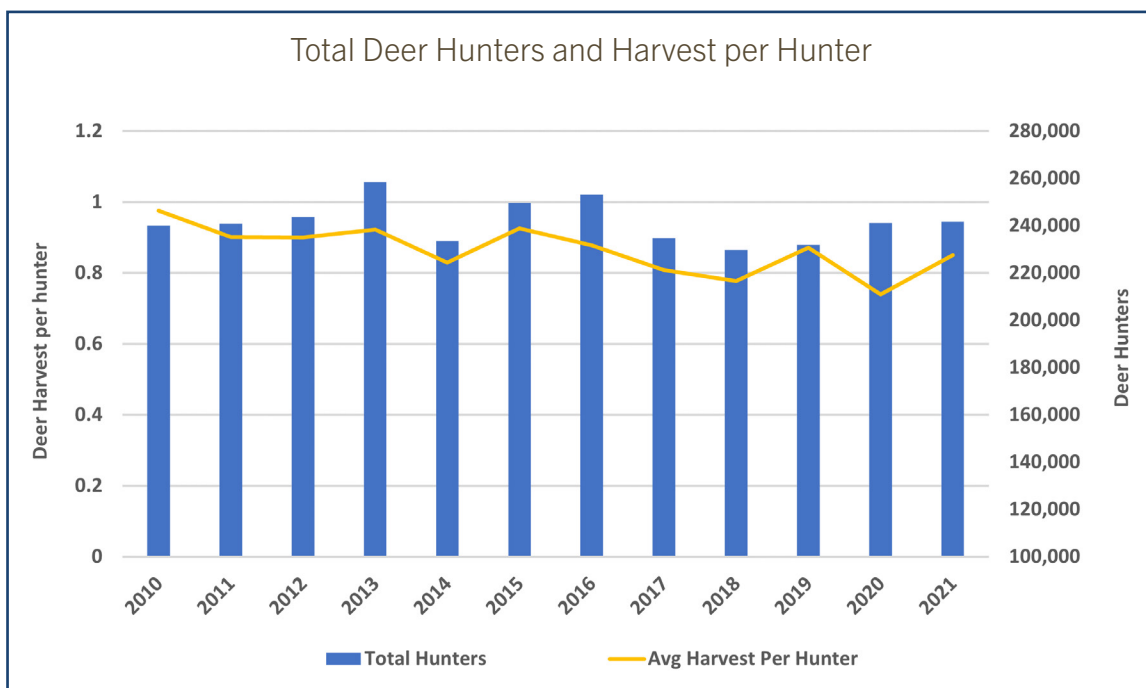
Average live weight of bucks harvested across the Coastal, Piedmont, and Mountain regions summarized from biological data collected on 44,297 bucks since 1995

Deer Harvest & Hunter Harvest Survey

In addition to mandatory big game harvest reporting, since 2010, the NCWRC has annually conducted a Hunter Harvest Survey by randomly selecting hunting license holders and surveying them on their harvest and hunting efforts for multiple game species. From this survey, estimates of harvest reporting compliance, number of hunters afield, and days pursuing various game species are estimated.

Reported Harvest	2021-22	3-year average
Antlered Buck	89,246 (53%)	80,995 (51%)
Doe	71,692 (43%)	70,175 (44%)
Button Buck	7,489 (4%)	7,311 (5%)
TOTAL	168,427	158,481

Antlered buck, doe, and button buck harvest reported through the Big Game Harvest Reporting System during the 2021-22 hunting season compared to the average over the three years prior



Estimated number of deer hunters and average harvest per hunter statewide, estimated by the Hunter Harvest Survey, 2010-2021

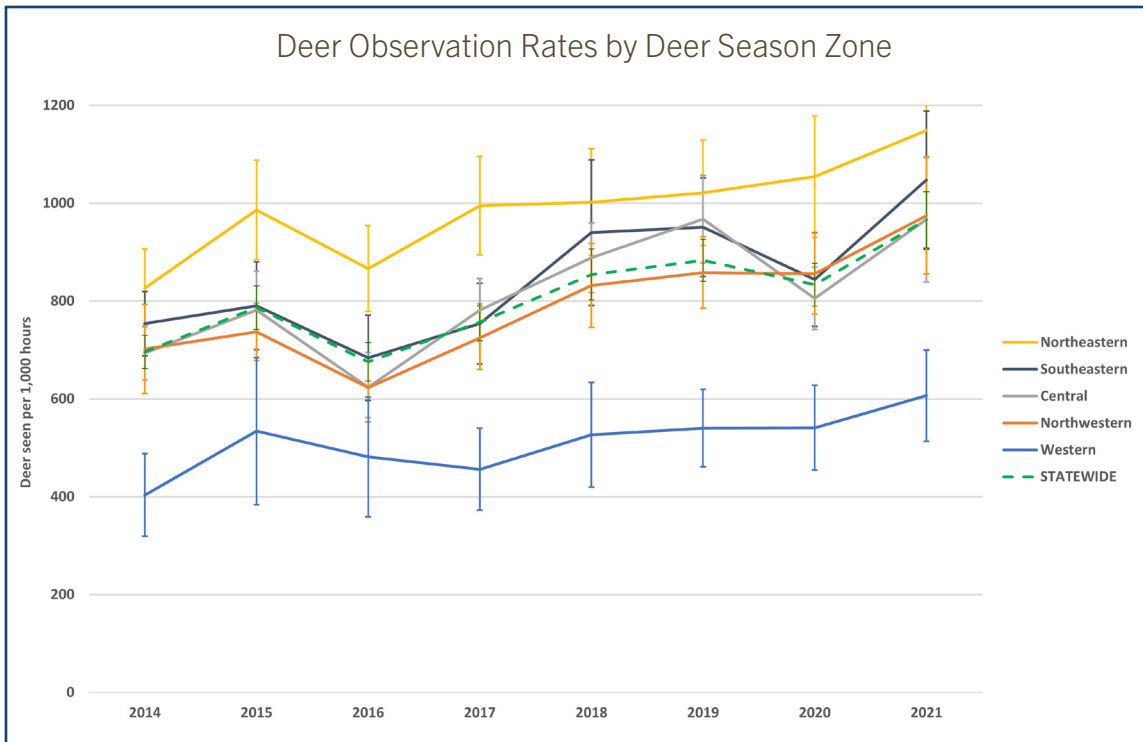
Deer Hunter Observation Survey

In 2014, the North Carolina Deer Hunter Observation Survey (DHOS) was initiated to provide an economical and statistically robust annual estimate of relative observation rates of several game species (including white-tailed deer). These observation data provide valuable insight into variation in deer herd parameters across regions and time, which may be more representative of trends in deer populations than those observed in hunter harvest, which is affected by hunter selectivity.

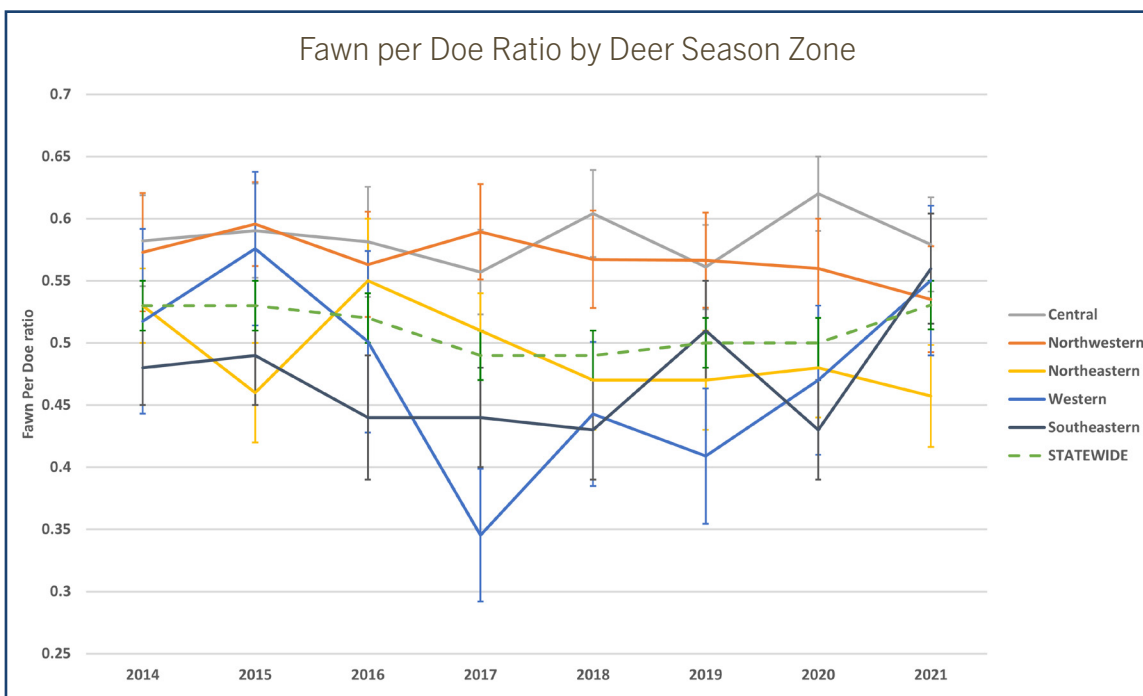
During the 2021 hunting season, 1,367 deer hunters participated in the survey, logging 77,727 hunting hours and reported 75,908 deer observations. In the 2021 hunting season, deer observation rates continued to show an upward trend in all five season zones (+33.8 deer per 1,000 hours annually, $P < 0.01$).

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The ratio of fawns observed per adult doe by hunters assisting in the Deer Hunter Observation Survey provides an estimate of fawn recruitment. While there is considerable variation in fawn-per-doe ratios across seasons and season zones, the statewide average ratio remains relatively stable (0.52 fawns for every adult doe).



Annual deer observation rates by deer season zone (# of deer seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2021



Annual fawn per doe observation rates by deer season zone with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2021

UPLAND GAME BIRDS & SMALL GAME MAMMALS

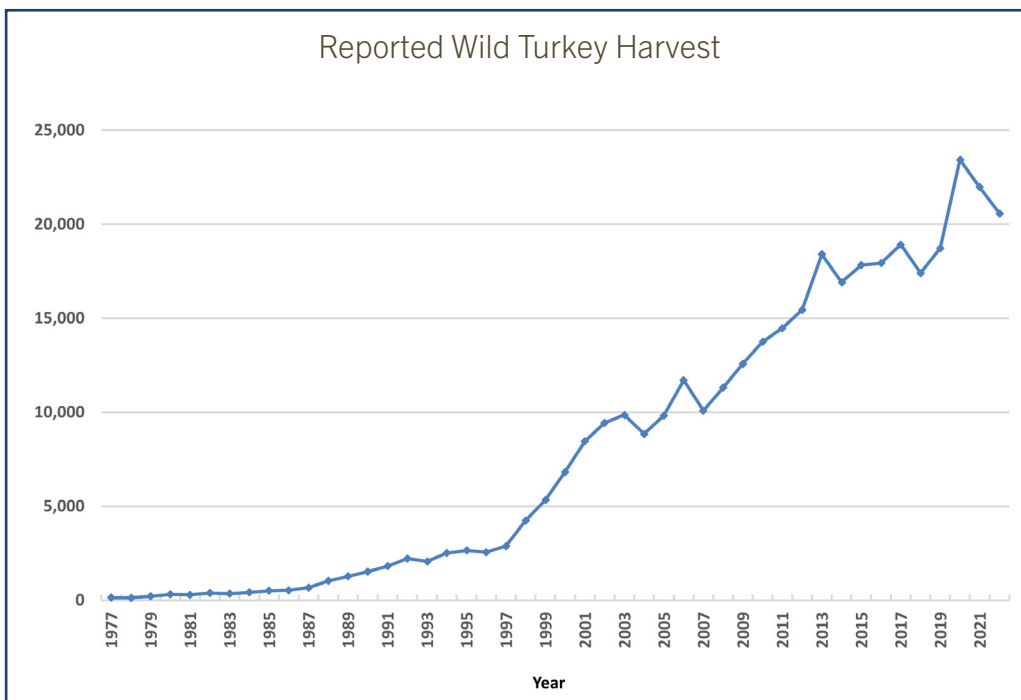
Wild Turkey Harvest

Reporting of wild turkey harvests is mandatory via our agency's telephone or online reporting systems. Including 1,777 birds harvested during the Youth Season, the 2022 reported spring turkey harvest was 20,576 birds. This year's total statewide harvest was down 12% from the record harvest in 2020 but still 8% higher than the previous high set in 2017. We believe all the issues associated with COVID-19 undoubtedly had a major influence on hunting pressure and harvest during the spring 2020 and 2021 seasons. The top five counties for the number of turkeys harvested were Duplin (748), Bladen (569), Pender (565), Columbus (541), and Brunswick (518).

The 2022 statewide wild turkey harvest in North Carolina was down 12% from the record harvest in 2020 but still 8% higher than the previous high, set in 2017.



Ryan Jacobs/NCWRC



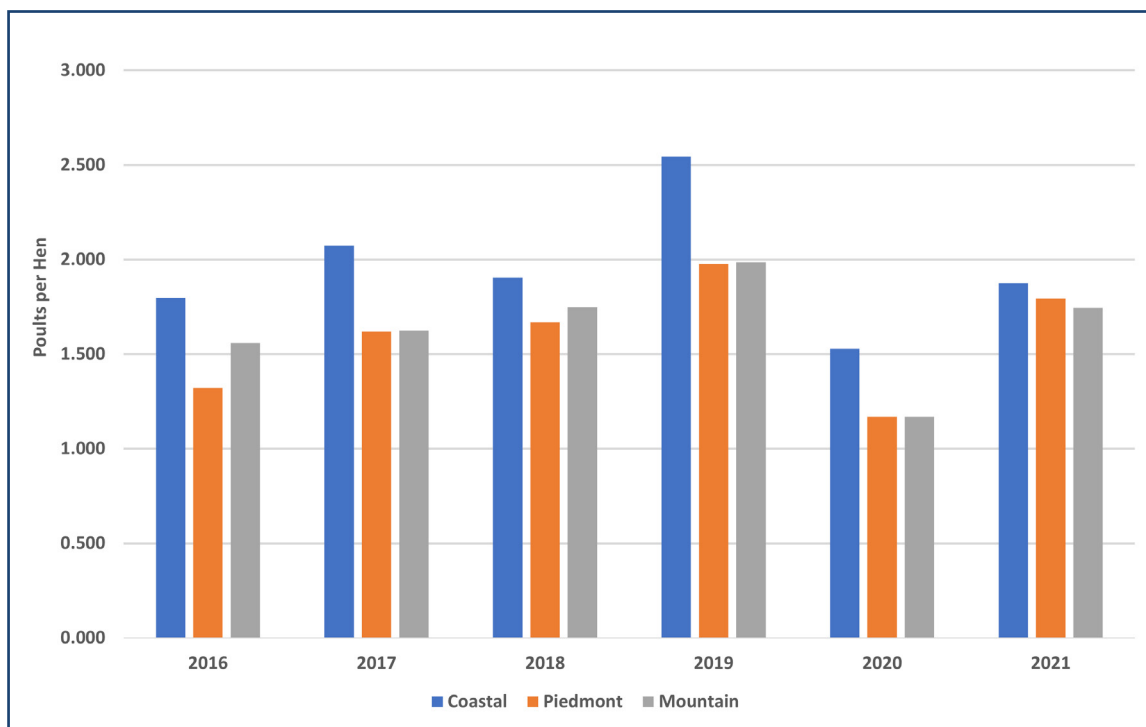
Reported spring turkey harvest, 1977 through 2022

Wild Turkey Summer Observation Survey

Each summer (July – August), the NCWRC coordinates an observation survey to gain insight into wild turkey productivity and carryover of gobblers from the previous spring turkey season. In 2021, 1,754 individuals helped with the survey, including a mix of NCWRC employees, National

Wild Turkey Federation members, and other individuals who had participated in the survey previously. Participants recorded 8,646 unique observations totaling 50,914 turkeys. Productivity statewide was estimated to be 1.8 poult/hen, consistent across regions, and an increase from the 1.3

poults/hen recorded in 2020. Poults survival state-wide was 3.5 poults per brood, consistent across regions, higher than the 3.1 poults per brood recorded in 2020. Estimates of turkey reproduction in 2021 were similar to what we have observed over the course of the last decade.



Regional observations of turkey production, 2016 through 2021

Wild Turkey Research

For the past three years, North Carolina State University, the National Wild Turkey Federation, and the NCWRC have collaborated to better understand several key

aspects of wild turkey ecology. Primary objectives for the project are to: 1) determine nesting chronology in each of three regions within the state, with emphasis on identifying

the range and mean dates of egg-laying, incubation, hatching, and re-nesting; 2) determine nesting success for each of three regions within the state; and 3) determine

continued on next page

seasonal and annual survival rates in each of three regions within the state, partitioning mortality by cause (e.g., hunter harvest, predation, disease, and other causes), for juvenile and adult turkeys of each sex. The primary means of data

collection includes capture of wild turkeys and attachment of several types of tracking transmitters. Field work began in earnest in January 2020 with rocket netting and capture of turkeys. As of July 2022, more than 685 turkeys have been

captured and radio-tracked, 410 nesting attempts have been documented, and 98 broods have been tracked. Additional capture, marking, and tracking continued through August 2022.

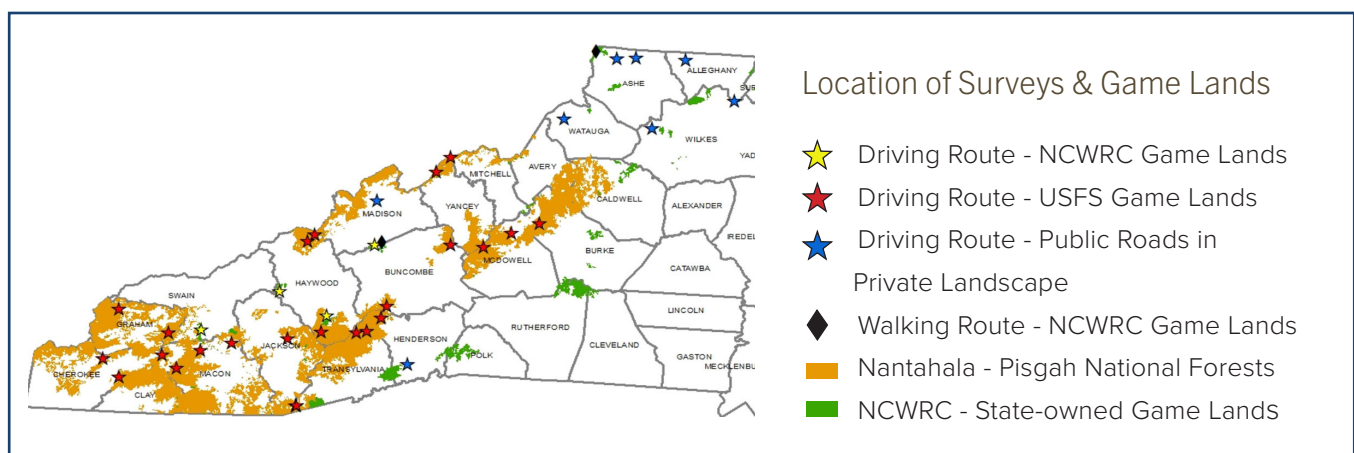
Grouse Drumming Survey

Since 2002, staff have conducted an annual drumming survey to monitor ruffed grouse populations. Each spring (late March/early April), we listen for drumming grouse on U.S. Forest Service property, state-owned game lands, and private lands via roadside surveys. In 2022, ruffed grouse were monitored by counting drumming males at 412 listening stations distributed across 23 routes on the Nantahala-Pisgah National Forests. Additionally, we surveyed routes on Cold Mountain, Needmore, Sandy Mush, and Silver game lands (54 stations in total). All survey routes were driven twice. On national forest routes, 58 drumming males were heard, lower than the rate observed in 2021. On state-owned game lands, 13 drumming males were heard, a slightly lower rate than in 2021, but similar to 2019. A walking survey was conducted on Sandy Mush Game Land as it provides insight into the local population. Staff

also conducted seven grouse drumming survey routes on private lands via roadside surveys. These routes occurred on lightly traveled, state-maintained roads in six counties, in areas that have been underrepresented in our surveys due to the lack of national forests in that portion of the state. These 126 listening stations (106 surveyed twice) yielded four drumming grouse.



View of forested habitat from the private lands, roadside grouse survey in Watauga County (NCWRC)



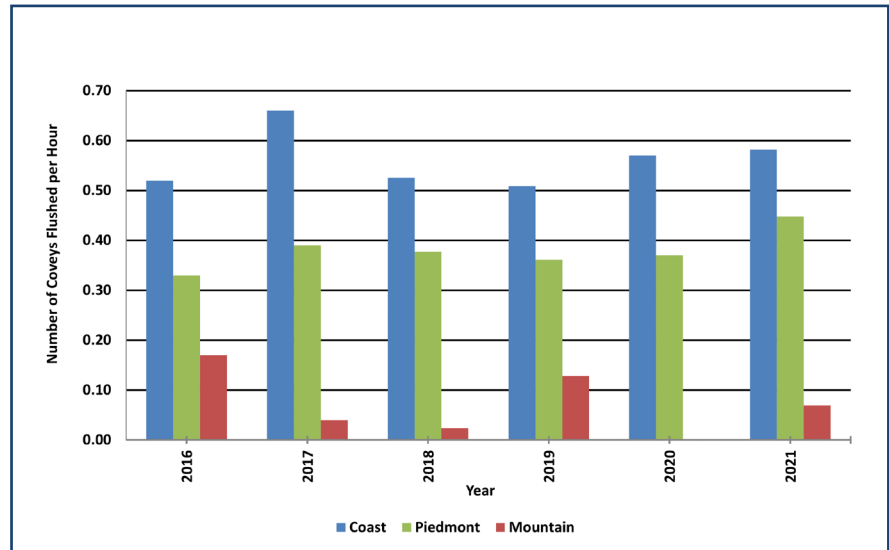
Location of grouse drumming survey routes in western North Carolina

Avid Quail and Grouse Hunter Surveys

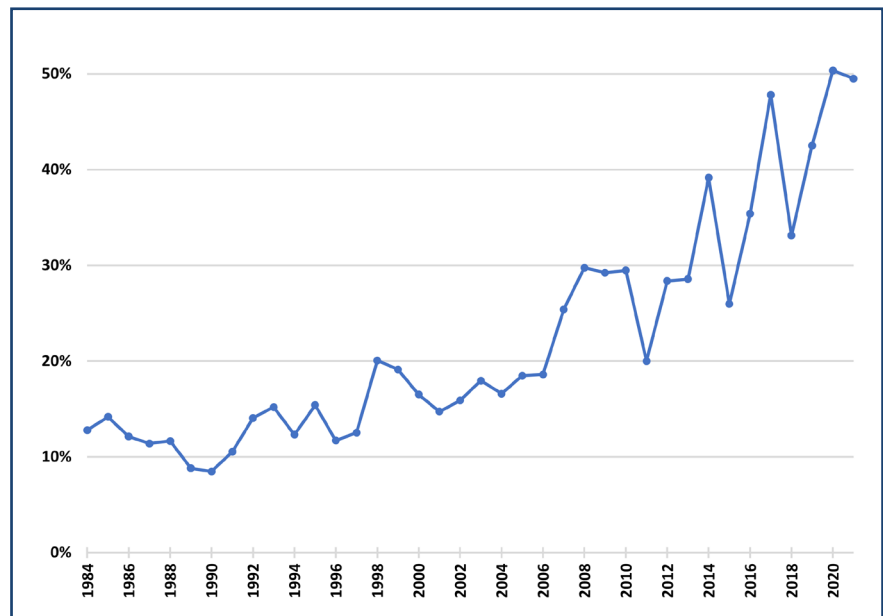
Forty-four avid quail hunters provided hunting data during the 2021-22 hunting season on 601 quail hunting trips. On an average hunt day, 1.7 coveys were flushed and 1.5 quail bagged per hunt party, essentially unchanged from the previous year. As is typical, quail hunting success varied within the state depending on the region. By region, flush rates were 0.58 coveys per hour in the Coastal Plain, 0.38 coveys per hour in the Piedmont, and 0.07 coveys per hour in the mountains, representing minimal increases from the previous season. Coveys flushed per trip were highest in the central coastal plain (4.34) and lowest in the southern mountains (0.14).

Fifty-two avid grouse hunters submitted hunt data during the 2021-22 hunting season, providing statistics for 416 hunting trips. Since 1984, grouse flush rates have generally declined over time from a high of 1.4 flushed per hour (recorded in 1990) and a high of 6.3 flushed per trip (recorded in 1989 and 1990). In 2021-22, participants flushed, on average, 0.5 grouse per hour

and 1.6 grouse per hunting trip, essentially unchanged from the previous year. Flush rates are typically higher on private lands. During the 2021-22 hunting season, respondents reported 50% of hunts with no grouse flushed compared to 51% of hunts the previous year.



Regional number of coveys flushed per hour according to avid quail hunter surveys, 2016 through 2021



Percentage of hunts where no grouse were flushed according to the avid grouse hunter survey 1984 through 2021

Avid Rabbit Hunter Survey

Forty hunters participated in the avid rabbit hunter survey for the 2021-22 hunting season. They reported harvesting 2,347 rabbits on 511 hunting trips in 68 counties. Marsh rabbits accounted for nearly 12%

of the reported harvest. State-wide, hunters jumped approximately 1.7 rabbits per hour and 8.5 rabbits per hunt. Both rabbits jumped per hour and rabbits jumped per hunt increased compared to the previous

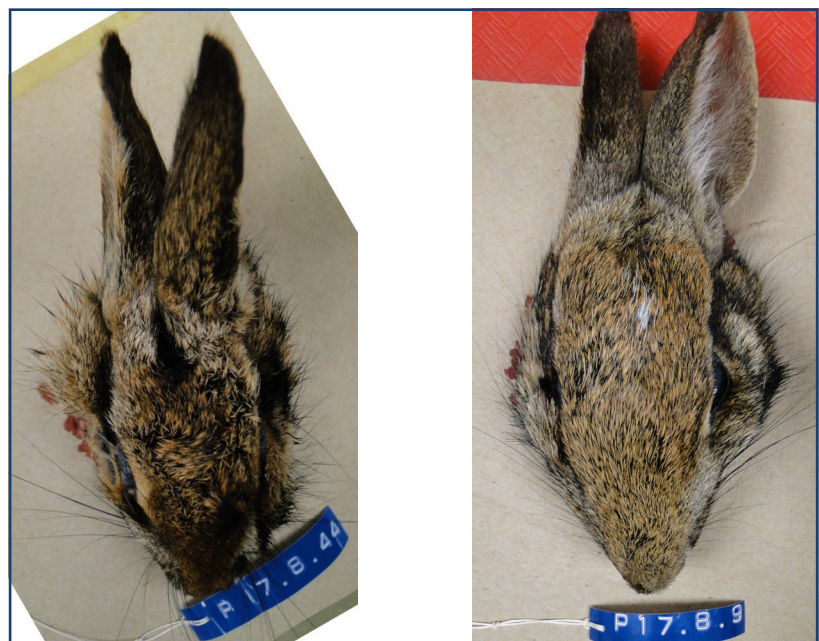
hunting season. As is typical, hunting effort increased as the season progressed (October through February) with 52% of the harvest occurring in February alone.

Mountain Region Rabbit Survey

Work continues in the effort to learn more about the distribution and status of Appalachian cottontails. Appalachian cottontail (*Sylvilagus obscurus*) range extends from northern Pennsylvania to northern Alabama, following the Appalachian Mountains. Appalachian cottontails occur in fragmented patches of habitat across their range where they're considered a rare species with populations on the decline. Based on previous research, it is estimated that North Carolina has three main populations of Appalachian cottontail with little genetic flow between the populations. There remains a considerable lack of information regarding the current distribution and the impact of hunting mortality on Appalachian cottontails in North Carolina. In 2021, we completed a project started in 2014 looking at the harvest of Appalachian cottontails through voluntary hunter submissions of rabbit heads. Over three years, we

collected 182 heads to aid in species identification. Although not foolproof, distinguishing between Appalachian cottontails and the more common eastern cottontail can be accomplished by looking at multiple characteristics including ear length, head fur coloration and bone structure of bare skulls. Based on initial morphological examinations, six Appalachian cottontails were identified from

the submitted samples (3.3%). In 2021, we completed genetic testing on the same samples. Through genetic testing, we detected four additional Appalachian cottontails, increasing the harvest to 5.0% of volunteer hunter-submitted samples. Results of this work complement past and ongoing work and provide insight into Appalachian cottontail distribution and harvest rate.



Appalachian cottontail (left) and Eastern cottontail (right) collected from voluntary hunter submissions (NC Museum of Natural Sciences)

MIGRATORY GAME BIRDS

Waterfowl Surveys

Sea Duck Fecundity Survey

Demographic parameters for migratory game birds such as survival, reproductive output, and population abundance are estimated using population surveys, banding and recovery programs, and hunter harvest statistics. These measures often guide annual harvest management decisions. However, few of these population-level estimates for sea ducks (scoters, eiders, and long-tailed ducks) are available due to the species' remote breeding areas and off-shore wintering areas. More precise estimates of productivity are needed to improve harvest management for sea duck populations in eastern North America. Age-ratio estimates obtained from direct counts of birds are useful for species like sea ducks that are difficult to study during the breeding season. During winter, sea ducks have differential plumage between adults and juveniles, and this can be

used to assign individual sea ducks to age classes, and infer the population age-ratio, which is an index of reproductive success. In 2021, after several years of trials, Atlantic Flyway waterfowl biologists began an operational Sea Duck Fecundity Survey. Survey efforts are conducted during late fall and early winter and are focused in areas of importance to wintering sea ducks along the coast of the Atlantic Ocean, from Maine to North Carolina.

Biologists determined that photography was the best method to collect samples of individual birds for identification to age and sex class. From photos, wintering sea ducks can be classified into three cohorts: adult male, adult female, and juvenile. Adult males are easily distinguished from the latter two cohorts, and adult females can be distinguished from juveniles by plumage

characteristics on the underside of a bird. All photos from participating state wildlife agencies are then combined, analyzed, and an age-ratio for the Atlantic Flyway population of sea ducks is generated. The data from this photo survey will represent precise estimates of annual productivity for use in sea duck population modeling, or for use in correcting annual estimates of United States Fish and Wildlife Service Parts Collection Data, a component of the federal Harvest Information Program (aka HIP).

From Oct. – Dec. 2021, staff used a high-speed camera equipped with a telephoto lens to capture over 2,000 individual photos of black scoters, surf scoters, white-winged scoters, and long-tailed ducks in the Atlantic Ocean from fishing piers along the Outer Banks in Kitty Hawk, Nags Head, and Rodanthe.



Black scoters at Jennette's Pier, Nags Head. Photo taken as part of the Atlantic Flyway Sea Duck Fecundity Survey. (Hunter Morris/NCWRC)

Mid-Winter Waterfowl Survey

The mid-winter waterfowl survey is a fixed-wing aerial survey conducted annually in cooperation with the U.S. Fish & Wildlife Service (USFWS) that estimates numbers of wintering tundra swans and Atlantic brant. Permit allocation among tundra swan hunt states is based on the combined Atlantic and Mississippi Flyway mid-winter surveys, while the observed numbers of brant in the Atlantic Flyway is used in part to set annual brant hunting regulations.

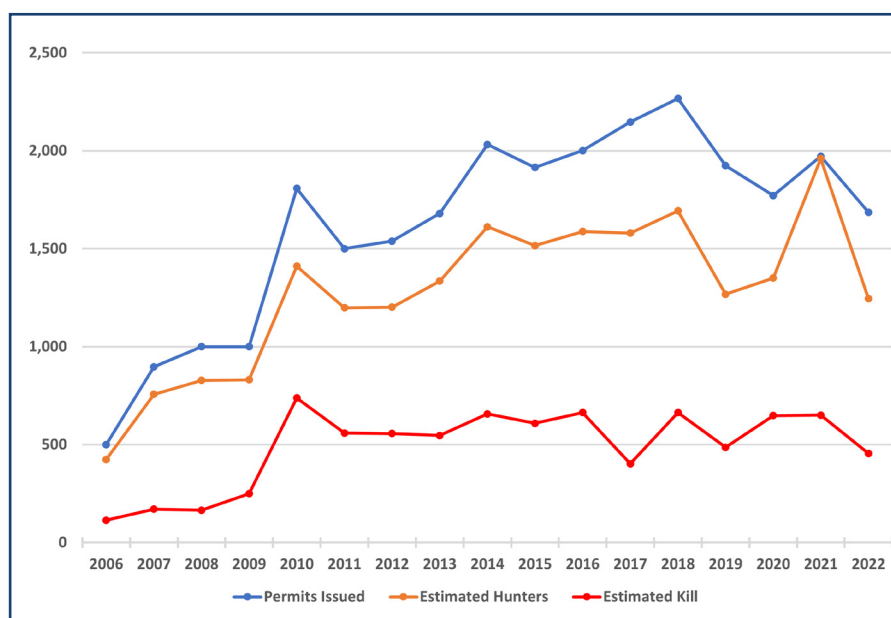
During the January 2022 survey, staff observed 71,452 tundra swans, 17% higher than numbers recorded in 2021, and 13% above the 1982-2021 long-term average. Only 250 brant were observed in 2022, but staff suspect this estimate is annually biased low due to the difficulty of locating brant from an aircraft in the wide expanses of Pamlico Sound.

Northeast Canada Goose Hunt Zone Harvest and Participation Survey

Due to poor reproduction across multiple years resulting in significant declines in the Atlantic Population (AP) of Canada geese, sport harvest of this goose stock was suspended from 1995-2002 in the Atlantic Flyway. In North Carolina, hunting remained closed in the Northeast Canada Goose Hunt Zone (NEHZ) until 2005. The NEHZ included all or parts of Northampton, Bertie, Chow-

an, Perquimans, Pasquotank, Camden, Currituck, Washington, Tyrrell, Dare and Hyde counties. So biologists could monitor future trends in AP Canada goose hunter harvest and participation in the NEHZ, a permit-only season was established in 2005. All permitted hunters were asked to complete a harvest and participation survey questionnaire at the completion of each goose hunting season.

The 2021-22 season marked the final year for the NEHZ permit requirement. Starting in 2022-23, no permit or follow-up survey will be required. Future season length and bag limits will be based on a recently revised Atlantic Population Canada Goose Harvest Strategy that aligns North Carolina more closely with other AP goose hunting areas in the Atlantic Flyway.



Permits issued and Hunting estimates for the Northeast Goose Hunt Zone (2005-06 through 2021-22). Note: Permits were limited to 500 during the 2005-06 season and limited to 1,000 for 2006-07 through 2008-09, with unlimited permits thereafter.

Waterfowl and Webless Species Monitoring

Wood Duck Banding

As part of our long-term and ongoing monitoring efforts, agency staff continue to capture and band wood ducks each summer July-September. When combined with similar efforts by other state wildlife agencies and the U.S. Fish and Wildlife Service, the data obtained from hunter band recoveries provide critical information (harvest and survival rates) that is needed to appropriately monitor and manage the harvest of wood duck populations. During the 2021 banding period, staff captured and banded 881 wood ducks statewide, including 399 from the Coastal Districts, 258 from the Piedmont, and 224 from the Mountains.



A female wood duck being fitted with a U.S. Fish and Wildlife Service aluminum leg band (Doug Howell/NCWRC)

A total of 160 wood ducks banded in North Carolina by NCWRC staff and NCWRC banding cooperators were recovered (shot by hunters) from October 2021 through January 2022. These recoveries include bandings from nest boxes (March-June) and those during the preseason banding period (July-September). Band recoveries were from 14 states (AL, AR, DE, FL, GA, LA, ME, MI, MS, NC, NH, NY, SC, VA) and one Canadian province (Ontario). Eighty-nine percent of band recoveries were from North Carolina, South Carolina, and Georgia.

Mourning Dove Banding

Since 2003, and as part of a nationwide program, agency staff capture and band mourning doves each summer (July – August) to establish a breeding population estimate and to better understand harvest and survival rates. Data obtained from these efforts directly inform a harvest strategy used to guide hunting

seasons in the Eastern Dove Management Unit (EMU), an administrative boundary that includes all dove hunting states east of the Mississippi River. In summer 2021, staff and cooperators banded 1,226 mourning doves. Not included in this total are 200 reward/control bands, which are part of a study being



Youth dove hunter with one of 137 dove band recoveries during the 2021-22 dove hunting season (Greg Queen/NCWRC)

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conducted by the EMU to understand the current band reporting rate. Accurate estimates of band reporting rates are critical when estimating the annual breeding population size for doves in the

EMU. The three-year reward banding study is now completed, and the current band reporting rate has increased to almost 100%. Hunters shot and reported 137 banded doves during the 2021-22

dove hunting season that were banded in North Carolina by NCWRC staff and cooperators. All but two of the 137 dove band recoveries were from in-state dove hunters.

Waterfowl and Webless Species Research

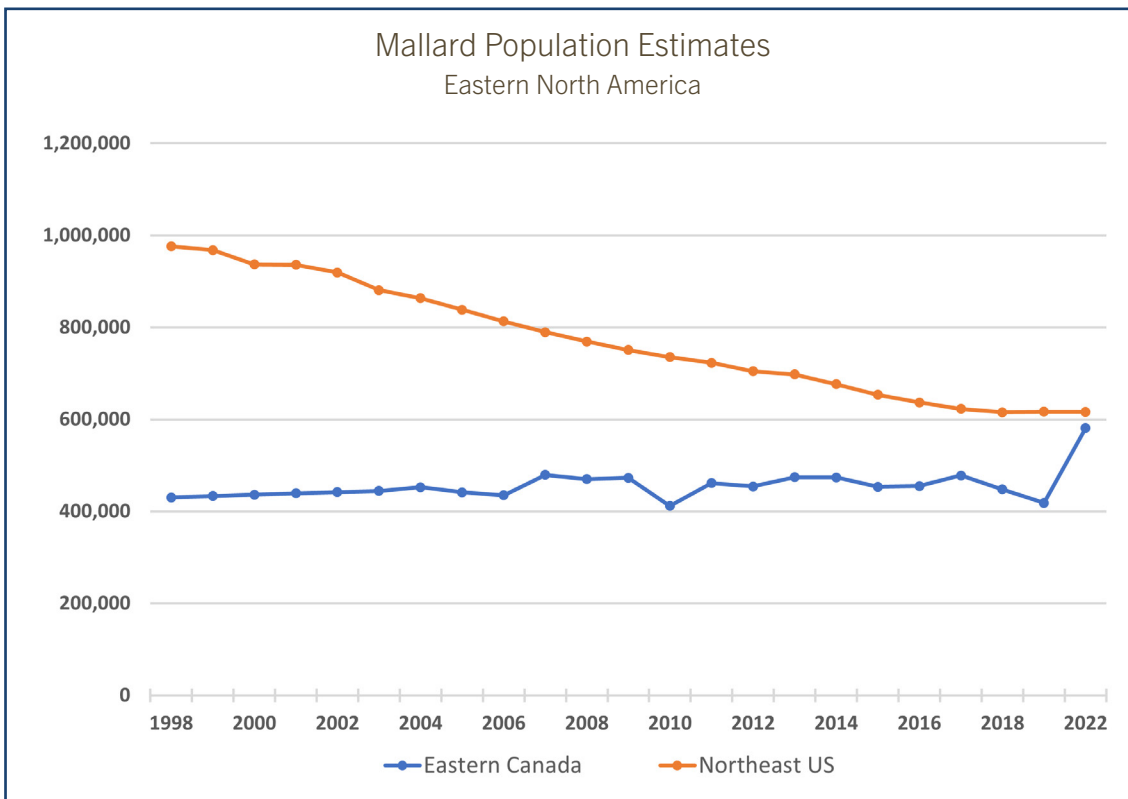
Migration Ecology and Demographics of Eastern Mallards

Migratory game bird staff are currently collaborating in a large-scale research project with other Atlantic Flyway states to better understand recent declines in mallard populations in the core U.S. breeding areas of the north-

east and mid-Atlantic. During the mid-1990s, eastern mallard breeding populations peaked at approximately 1.4 million followed by a steady decline of approximately 1% annually to 1.05 million in 2019. Although the overall trend is worrisome

to managers, the greater concern is that the sub-population of breeding mallards in the northeastern U.S. is declining rapidly (36% decline over 20 years), while the sub-population in eastern Canada remains relatively stable.

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Waterfowl biologists have posed a variety of explanations as to why eastern mallards have been declining. Recent genetic assessments suggest eastern mallards in the core breeding areas of the mid-Atlantic (New York, Pennsylvania, Virginia, and Maryland) are now genetically more similar to game farm mallards (i.e. those raised and released domestically to augment hunting opportunities) than mallards once presumed to be wild and native to North America. Over time, a “hybrid swarm” of domestically raised game farm mallards released in the core eastern U.S. breeding population may have resulted in lower survival, lower reproductive success, and higher harvest rates for wild mallards due to hybridization with game farm mallards. Another potential explanation is the amount of quality nesting and brood-rearing habitat in the northeastern U.S. is limiting population growth.



Mallards at rocket net trap site, Mackay Island National Wildlife Refuge (NCWRC)

Over the next five years, Atlantic Flyway biologists will mark 180 female mallards in eastern Canada/Maine and 857 adult females in the U.S. portion of the eastern mallard range with 15-g Ornitela Global Positioning System (GPS)-Global System for Mobile communication (GSM) transmitters to better understand demographic rates, migration chronology, and habitat usage differences between the two sub-populations throughout the year. Understanding demographic rates of eastern mallards and potential important differences between populations in eastern Canada and the eastern

U.S. is imperative for managers to effectively model population dynamics and subsequent harvest strategies.

As part of the NCWRC’s collaboration, staff will capture and mark female mallards each year of the project (80 over four years) in January-February with GPS-GSM transmitters at capture sites in North Carolina that historically winter large numbers of mallards. In January 2022, staff captured and marked 20 mallards at Mackay Island National Wildlife Refuge (NWR). Capture and marking will be expanded to Pee Dee NWR in future years.

American Woodcock Migration Ecology

The American woodcock is a migratory forest bird that has experienced population declines of 0.8% per year for the past five decades. Relatively little is known about woodcock migration compared to other

life phases, but recent advances in tracking technology have facilitated the ability to follow movements of individual woodcock during migration at a level not previously possible. During the year, NCWRC continued its

collaboration with the University of Maine, Atlantic and Mississippi Flyway states, and eastern Canadian provinces that represent the woodcock breeding, stopover, and wintering range in eastern North America.

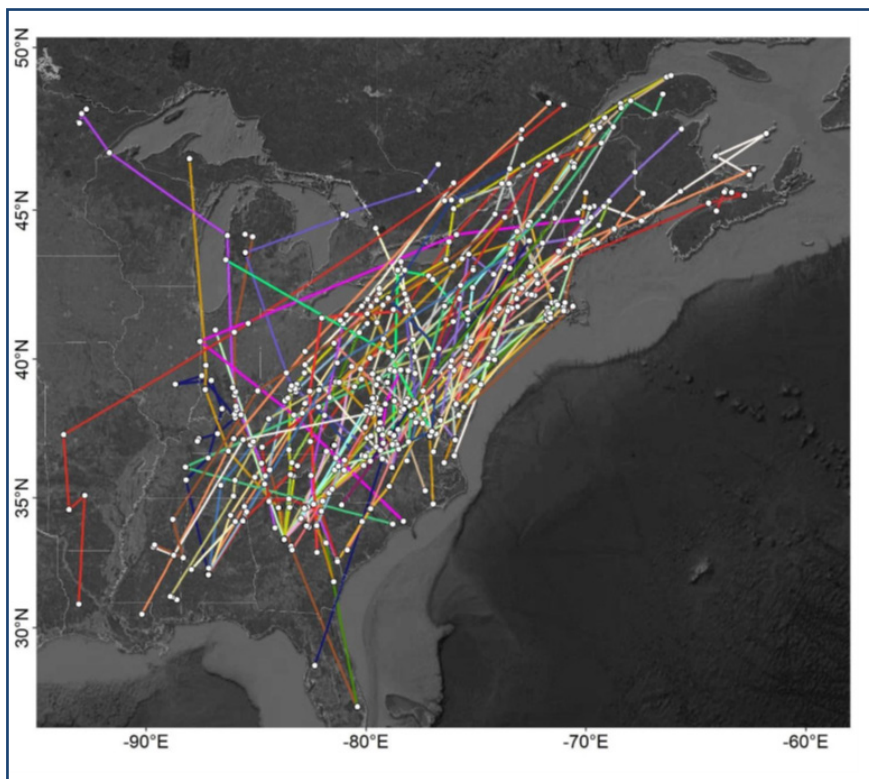
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One objective of the Eastern Woodcock Migration Research Cooperative was to describe the migration ecology of American woodcock over five years (2017-2022). Woodcock were captured and fitted with Global Positioning System (GPS) transmitters, allowing biologists to follow their migration routes and identify important stopover locations along the way. The final year of collaborative marking occurred during winter 2022.

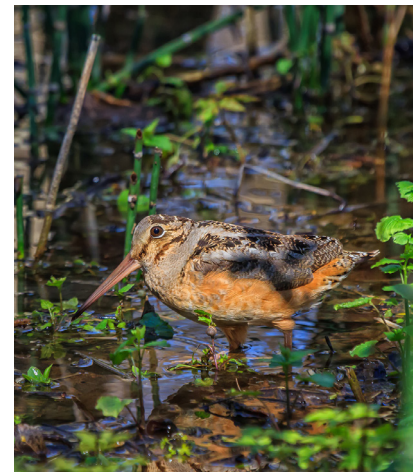
Woodcock were captured at night using handheld spotlights and nets, then fitted with a GPS transmitter before being released. Since 2017, 515 woodcock have been marked with GPS transmitters in 15 states and three Canadian provinces. This effort has yielded almost 32,000 locations across 33 states and seven Canadian provinces. Data from subsequent woodcock migrations have covered more than 700,000 miles of total migration distance, in-

cluding hundreds of stopover sites. An informative summary of the project can be found at woodcockmigration.org.

In North Carolina, NCWRC biologists and staff captured and fitted 15 woodcock with transmitters during February 2022 at Mackey Island National Wildlife Refuge in Currituck County and at Butner Falls of Neuse Game Land in Granville County. Over five years, the NCWRC has marked 61 woodcock with transmitters as part of this collaborative research.



Spring 2022 migratory movements of woodcock marked with GPS transmitters
(Eastern Woodcock Migration Research Cooperative)



American woodcock (Paul Roeding)

MULTI-SPECIES SURVEYS & RESEARCH

Disease Surveillance

NCWRC staff submitted 156 specimens to the Southeast Collaborative Wildlife Disease Study (SCWDS) in Athens, GA for necropsy, disease diagnosis, and regional pathogen surveillance. Necropsy reports were returned for 49 different species including 26 deer, 13 raccoons, eight black vultures, seven bald eagles, and six eastern cottontails. Of those submissions, 10 were diagnosed or presumed to be positive for H5N1 highly pathogenic avian influenza (HPAI), eight for canine distemper virus, five for toxigenic *Aspergillus* species, and three for *Aspergillus* species. Parasites were detected in 65 of the 156 submissions, including the Asian Longhorn tick on a deer and a red-tailed hawk in Ashe and Alexander counties, respectively.

The HPAI results are notable this year. While low pathogenic avian influenza circulates naturally through wild bird populations, particularly in waterfowl, the strain identified in 2021 was highly pathogenic H5N1 of Eurasian origin. This virus had been circulating in other parts of the world but no

Eurasian H5 virus had been detected in a wild bird in the United States since 2016. USDA-Wildlife Services (WS) routinely tests dabbling ducks in North Carolina as part of its national-level surveillance for avian influenza viruses. WS had a quota of 1,010 ducks to

In March 2022, North Carolina became the 29th state to detect Chronic Wasting Disease (CWD) in its deer population.

test over the fall and winter seasons in three watersheds: Chowan-Roanoke, Neuse-Pamlico, and Cape Fear. From that quota, 143 hunter-harvested and live-trapped ducks tested positive for Eurasian lineage H5 avian influenza when testing was completed in February 2022. Shortly after, the U.S. Fish and Wildlife Service announced the death of a snow goose in Dare County, NC to HPAI. NCWRC field staff began investigating and submitting birds, primarily raptors, without obvious cause

of death and those displaying neurological symptoms for HPAI testing. Of the 72 birds and one gray fox submitted to SCWDS for necropsy and/or HPAI testing, 10 were given positive results. Those positive results were from four bald eagles, one redhead duck, one red-shouldered hawk, one brown pelican, one ruddy duck, one great blue heron, and one wood duck. The gray fox was tested and found to be not detected for HPAI after red fox kits were found to be positive and symptomatic for HPAI in Minnesota in May 2022.

In March 2022, North Carolina became the 29th state to detect Chronic Wasting Disease (CWD) in its deer population. The hunter-harvested deer from Yadkin County was taken to a Cervid Health Cooperator, and tissue samples were submitted for testing, ultimately being given a positive test result by the Wisconsin Veterinary Diagnostics Laboratory and the National Veterinary Services Laboratories. The current five-year CWD surveillance plan was adjust-

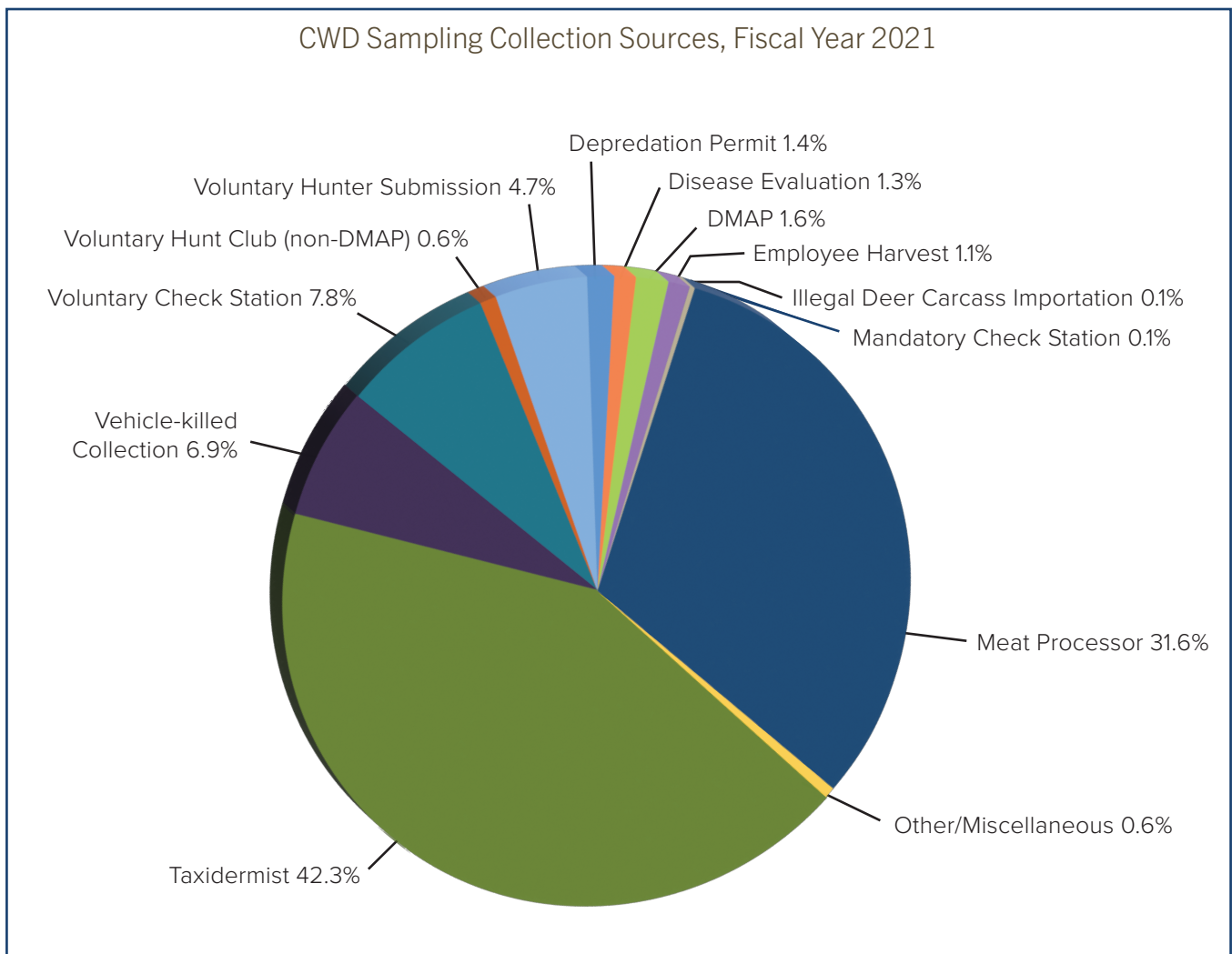
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ed in its fourth sampling year (2021-22) in response to positive detections in Montgomery County in Virginia. A four-county area along that portion of the North Carolina border with Virginia (Alleghany, Surry, Stokes, and Rockingham counties) was focused on, though no specific goals were dictated, and all counties in the state that had not yet completed their

five-year sampling goals were instructed to complete their goals with an additional 10% increase. 97 of the 100 counties completed the fiscal year at or above that expanded goal.

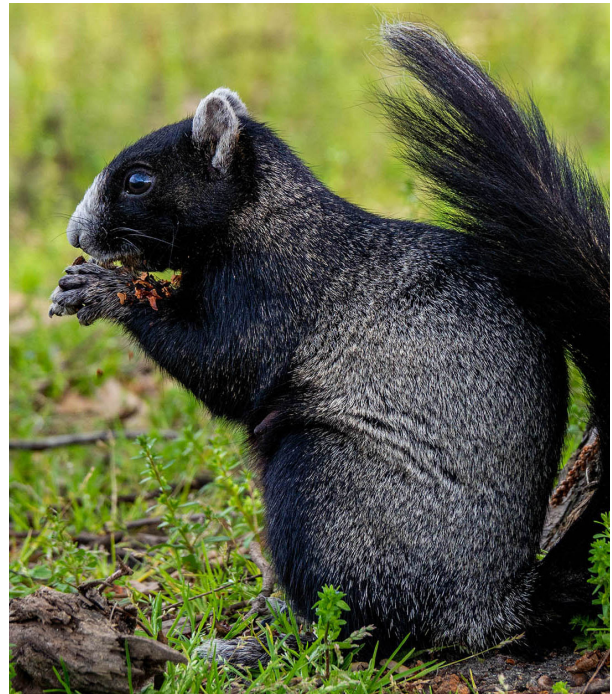
To assist with the increase in testing, the Cervid Health Cooperator program grew to include commercial deer processors and whole deer heads. This collaborative program

expanded substantially in 2021 in both participation and sample submissions. The program ended the 2021 season with 108 contributing participants and 4,895 tissue samples. Two-thirds (66%) of the total number of CWD samples collected statewide (n=7,354) came through the Cervid Health Cooperator program.

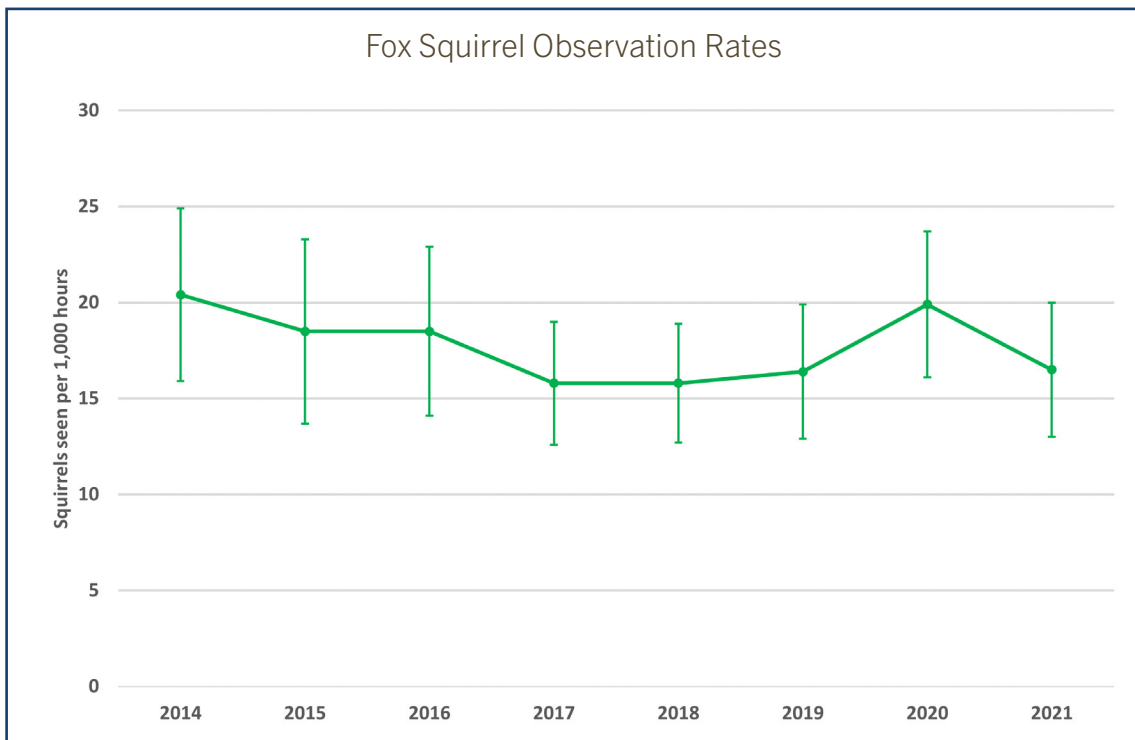


Deer Hunter Observation Survey

As mentioned on page 21, a deer hunter observation survey has been conducted each year since 2014. During the 2021 deer hunting season, 1,367 volunteer deer hunters recorded wildlife observations on nearly 24,000 hunting trips encompassing over 77,000 observation hours. While the survey provides insight into deer herd parameters, it also has long-term utility in monitoring many additional game and furbearer species that are normally difficult to monitor. Not only are participants asked to record observations of deer, but they are also asked to record observations of many other species. We believe that over time this survey will provide insight into changes in species abundance that may occur from both a spatial and temporal perspective. Below we highlight the observation trend and distribution of fox squirrels.

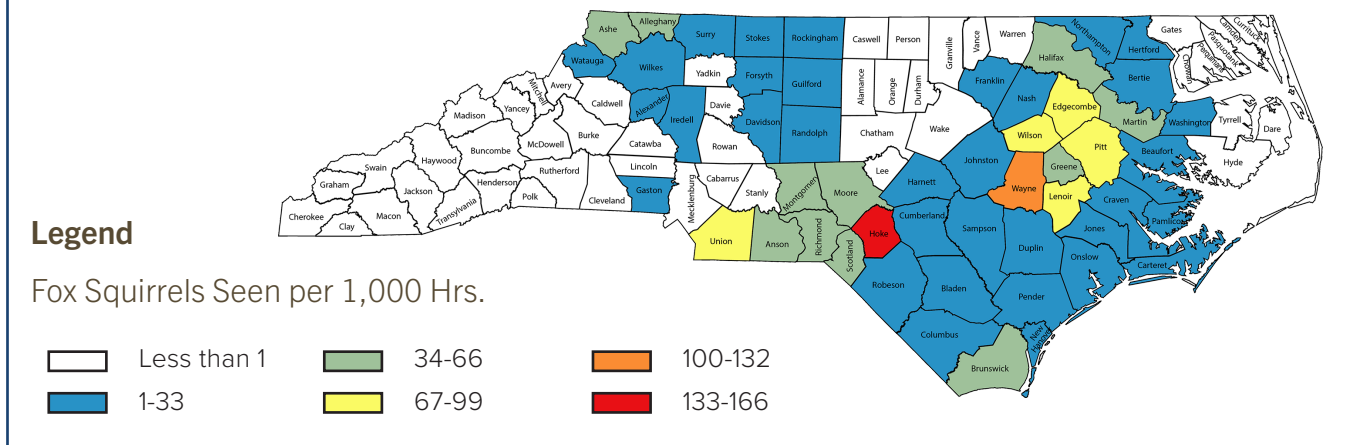


Fox Squirrel (Shutterstock)



Statewide fox squirrel observation rates (with 95% confidence intervals) as determined from the annual Deer Hunter Observation Survey

Fox Squirrel Observation Rates (Deer Hunter Observation Survey, 2017-2021)



Average number of fox squirrels seen per 1,000 hours of observation as determined from the annual Deer Hunter Observation Survey, 2017-2021

Annual Hunter Harvest Survey

Each year, the NCWRC conducts a survey of randomly selected hunting license holders for the purpose of estimating hunter participation and harvest of multiple species. While reported harvests of big game species can be tallied through our mandatory reporting systems, this survey provides a separate independent reference for harvest estimates and reporting compliance. Below, we highlight hunter participation and harvest estimates for many of our small game species for the 2021-22 hunting seasons. *Note that bobcat, coyote, fox, and raccoon may also be harvested by trappers. Trapper harvest estimates for these species are tallied separately.*

Species	Total Hunters	% change from previous 3-year average	Total Harvest	% change from previous 3-year average
Mourning Dove	66,563	+7%	831,353	+9%
Gray Squirrel	51,117	-1%	345,663	-7%
Rabbit	30,807	-6%	166,254	-13%
Coyote	27,137	+4%	45,401	+12%
Raccoon	8,363	-12%	35,282	-36%
Crow	7,595	-9%	52,130	-24%
Bobwhite Quail	5,632	-7%	37,037	+75%
Fox Squirrel	5,120	+14%	5,547	+23%
Ruffed Grouse	3,926	+14%	1,396	-50%
Fox (Gray & Red)	2,645	+24%	3,615	+58%
Woodcock	2,475	unchanged	13,313	+20%
Bobcat	2,475	+13%	1,591	+2%
Common Snipe	427	-21%	683	-77%

Game & Furbearer Program *(those highlighted in red are described in this report)* Annual Surveys

Raccoon Field Trial Survey

Eastern Spotted Skunk Camera Survey

Eastern Spotted Skunk Observation Project

Armadillo Observation Project

Bobcat and River Otter Sex & Age Ratios

Muskrat Sex and Age Ratios

Trapper Harvest Survey

Fur Dealer Transactions

Fur Tag Sales

Furbearer Pelt Prices

Furbearer Depredation Take

Furbearer Disease Monitoring

White-tailed Deer Reported Harvest

Deer Hunter Observation Survey

Deer Biological Data Collection

(age & reproduction)

Chronic Wasting Disease Surveillance

Avid Rabbit Hunter Survey

Wild Turkey Reported Harvest

Wild Turkey Summer Observation Survey

Grouse Drumming Survey

Avid Grouse Hunter Survey

Avid Quail Hunter Survey

*Mid-winter Aerial Survey for Tundra Swans
& Atlantic Brant*

Tundra Swan Productivity Survey

*Northeast Canada Goose Hunt Zone Hunter
Harvest & Participation Survey*

Tundra Swan Hunter Harvest & Participation
Survey

Light Goose Conservation Order Hunter
Harvest & Participation Survey

American Black Duck Spring Breeding
Population Survey

Sea Duck Fecundity Survey

Wood Duck Banding

Mourning Dove Banding

*Black Bear Reported Harvest & non-harvest
mortality*

*Black Bear Cooperator Program
(tooth collections)*

Bear E-stamp Holder Survey

Hard and Soft Mast survey

Human-Bear Interactions Tracking

Hunter Harvest Survey (all game species)

General Disease Surveillance

Periodic & Limited Duration Surveys & Research

(Conducted in-house or in conjunction with university or partner research projects)

Weasel Camera Survey

Prevalence of Raccoon Roundworm

Ecological Studies and Monitoring Strategies for Eastern Spotted Skunks in North Carolina -
in collaboration with Clemson University

Prevalence and Occurrence of Canine Distemper Virus

Comparison of Raccoon Field Trial Survey Data to Deer Hunter Observation Data to Track Trends
in Raccoon Populations

Deer Ecology Across an Urban-Rural Continuum Research – in collaboration with N.C. State University

Hunter Perspectives on Chronic Wasting Disease Management in North Carolina – in collaboration with
N.C. State University

Wild Turkey Reproductive Ecology Research – in collaboration with N.C. State University

Mountain Rabbit Survey (Appalachian cottontail)

Migration Patterns of American Woodcock Research – in collaboration with Atlantic Flyway partners

Black Duck Brood Survival and Movements Research – in collaboration with University of Delaware

Migration Ecology of Eastern Mallards Research – in collaboration with Atlantic Flyway partners

Fine-scale Resource Selection, Diet, and Reproduction of Urban Black Bears and a Before-after Design
to Evaluate the Impacts of BearWise Outreach - in collaboration with N.C. State University

SEAFWA Bear-Resistant Products Testing Program

Highway 64 Underpass Camera Survey – in collaboration with UNC Wilmington

Sardine Bear Bait Station Survey – every other year

Movements and Survivorship of Rehabilitated Black Bear Cubs



Many of the activities highlighted in this report could not be accomplished without the commitment and effort of numerous employees throughout all divisions of the agency. We especially want to acknowledge staff of the Operations Program in the Wildlife Management Division and staff of the Land & Water Access Division for their year-round commitment to many of these projects.

North Carolina Wildlife Resources Commission Mission Statement

To conserve North Carolina's wildlife resources and their habitats and provide programs and opportunities that allow hunters, anglers, boaters and other outdoor enthusiasts to enjoy wildlife-associated recreation.

Game and Furbearer Program Mission Statement

The mission of the Game and Furbearer Program is to 1) ensure the long term viability and sustained harvest of game and furbearer populations by providing the best possible scientific information on the status and management of each species and its habitats so that regulations and management are based on objective data; and 2) participate in planning and coordination of management directives based on sound science.



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