Deer Hunter Observation Survey
2014-2020

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Abstract

The North Carolina Deer Hunter Observation Survey (DHOS) provides an economical and statistically robust means of monitoring populations of several wildlife species. During the each of the 7 deer hunting seasons from 2014-2020, approximately 25,000 hunting trips encompassing ~100,000 hours were annually reported by ~1,500 volunteer deer hunters. Deer, gray squirrels, and turkeys were the most observed animals. Results include annual state and regional observation rates, including the effects of baiting and location type (private and game lands).

Introduction

The North Carolina Wildlife Resources Commission (NCWRC) initiated an annual volunteer Deer Hunter Observation Survey (DHOS) in 2014. Hunters were asked to record their daily observations of deer and other wildlife while still-hunting for deer. The primary objective of the DHOS was to provide long-term indices of wildlife occurrences and demographics across North Carolina. These data increase understanding of spatial differences and temporal changes in populations, and supplement other survey, harvest, and biological data collected by the NCWRC to monitor wildlife and evaluate management actions.

Since deer hunters are one of the most common hunter types across the state (~250K hunters) and spend many hours in the field (~3.8 million days, average 15 days/hunter/year), volunteer observers provide an economically viable means of monitoring several species of wildlife while providing statistically robust observation estimates at varying spatial scales for many species. Still-hunting from fixed locations provides an ideal sampling scenario for detecting and counting many wildlife species within relatively comparable sized areas (area located around a stationary hunting location). When combined with measure of time (hours hunted), observation records can provide a standardized measure of sampling effort. Project like this one are used by many state wildlife agencies to provide a robust measure of species abundance and occurrence.

Methods

Participant Recruitment: Potential volunteers were initially identified in 2014 from the NCWRC big game harvest registration database. Avid deer hunters (those hunters registering ≥3 deer during the previous hunting season) were initially selected for the mailing since it was assumed that they also spent more time afield. Because of a pressing question regarding the distribution of fox squirrels in North Carolina, an initial survey design was developed to focus recruitment of

volunteer wildlife observers in known counties of the fox squirrel range. Our initial goal was to obtain approximately 30-40 volunteers in each of North Carolina's priority fox squirrel counties.

An initial statewide sample of 30K avid deer hunters was selected for the 2014 mailing and produced a 4.6% volunteer response rate (1,350 participating hunters). As other species informational needs were recognized by biologists (e.g. deer fawn recruitment), all deer hunters across the state were invited to participate in subsequent years via public news releases, email blasts, and various staff contacts. Annual survey mailings incorporated the previous season respondents and any additional volunteer signups. Additional avid deer hunters were identified and mailed survey forms each season to help boost sampling rates in counties with low participation. As of the 2020-21 season, 3,607 volunteer hunters were enrolled in the project's annual mailing list.

Survey Materials and Logistics: A standardized paper survey form was developed for hunters to report their wildlife observations (Appendix 1). Surveys were mailed just before the start of the archery deer season, and the survey observation period was open until the close of general deer season. Immediately upon the end of deer season, hunters were instructed to fold and submit their form via the incorporated, pre-paid postage business reply address block, which was printed on the back of form. Also, printed on the back of the form were the observation collection instructions, and the original hunter mailing information/identification number, which was used to uniquely account for each response. A small open text block was inserted for the hunter to list the name and address of any other individuals that would also potentially participate in the DHOS in future hunting seasons.

A web-based application was developed as a reporting option for volunteers in 2018 and incorporated a responsive design for use on both full-screen desktop and small-screen mobile devices. Volunteers were required to enter their hunter identification number (license number) and last name to report observations and/or to view their observation log. The application was accessible to all the public and could be used by previously enrolled and new volunteers.

Hunters were asked to record the date they hunted, county, number of hours, location type, use of bait, and the number of animals seen. Hunters were instructed to separate morning and evening hunts when applicable. "Location type" was categorized into two options: 1) Game Lands – which included areas enrolled in the NCWRC Game Lands program, and 2) Private Lands – which included all other private and public lands not enrolled in the NCWRC Game Lands program. "Animal type" categories included antlered deer, adult doe deer, fawn deer (button bucks and doe fawns combined), unknown deer, gray squirrel, fox squirrel, bearded turkey, no beard turkey, unknown turkey, bobcat, red fox, gray fox, coyote, raccoon, adult bear, cub bear, and feral swine. When imprecise responses were recorded by the hunter (e.g. "a lot of squirrels"), a mean data imputation method was used. Mean imputation is a method in which the missing value on a certain variable is replaced by the mean of the available cases. The form also contained a comment field where hunters could write in any other wildlife not listed that they may have observed. Hunters were specifically instructed to list species of special interest which included: armadillo, domestic cat, elk, mink, red squirrel, spotted skunk, and weasel. Hunters were also instructed to report their hunting activity even if no wildlife was observed.

All responses and hunter contact information were entered and stored using the NCWRC's online PAWS (Portal Access to Wildlife System) database for maintenance and processing. A Hunter Observation Survey application was developed to allow staff to dynamically query the raw dataset for any selected survey parameter (e.g. year, location type, date range within season, use of bait) and to produce basic survey summary outputs at any desired scale (e.g.

state, regional or county). For the purposes of this report, most results and analyses are limited to the statewide or management region scale.

Analyses: We refined hunter submitted observations into sampling units in order to reduce the effects of pseudoreplication. Pseudoreplication occurs when some hunters remain in the same hunting stand for multiple days and often repeatedly count the same individual animals each day. We use the term "sampling unit" to describe unique combinations of hunter-location-county-bait observations. As a simple example of the refinement process, if a deer hunter hunts 20 days in County A on private land with bait, observation records are averaged for that single independent sampling unit. If a hunter hunts 20 days (10 days in County A and 10 days in County B, both on private land without bait), those records constitute 2 sampling units. Averaging data into refined sampling units for each scenario decreases sample size and increases variance in some cases, but provides a conservative statistic based on truly independent samples.

Based on the 2020 survey, most sampling unit responses originated from counties within the central part of the state (Figure 1). The unbalanced distribution across counties was likely due to regionally specific recruitment efforts by biologists and actual deer hunter gradients within the state. Sampling units with less than 3 cumulative hunting hours were excluded from this analysis.

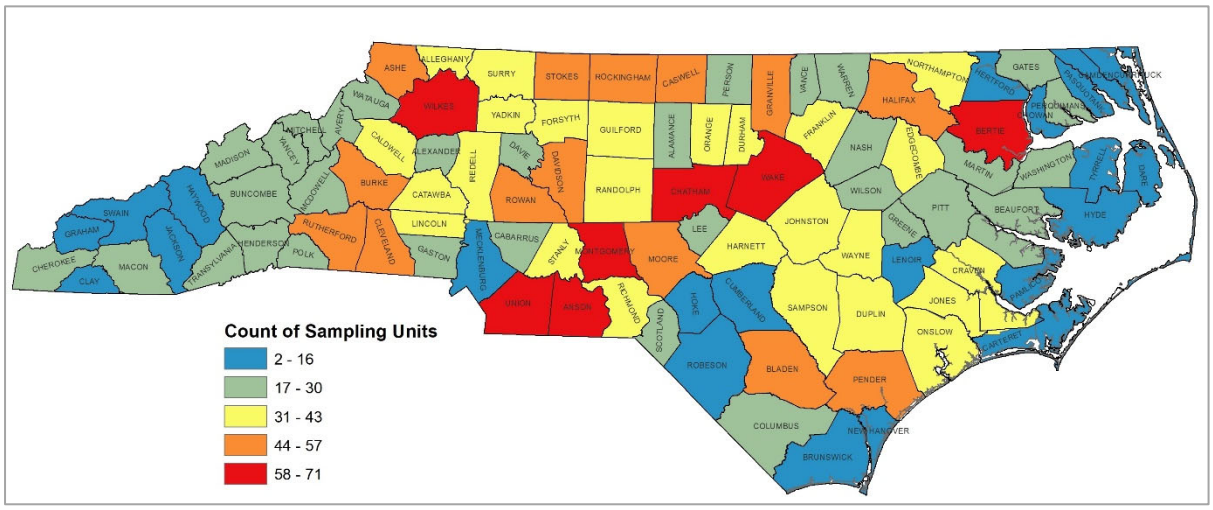

Figure 1. Total number of sampling units by county, North Carolina Deer Hunter Observation Survey, 2020.

Mean annual observation rates were calculated for each county for each animal type. When calculating annual regional and statewide estimates, sampling units were weighted for each county to balance unequal sampling effort. Counties with fewer than 3 sampling units per year were excluded from annual regional and statewide estimates. Inadequate annual sample sizes sometimes occurred in 1-3 counties per year and were often located in the far western and far eastern counties, e.g. Dare, Graham, Jackson, and Swain.

Observation rates were standardized to observations per 1,000 hours, and 95% confidence intervals were computed for each of the 17 animal types. A higher number of records per hunter and a higher number of sampling units within a county generally provided a higher-level of precision within each animal type. Precision among annual estimates for common species, such as gray squirrel and deer was high: proportional standard error (PSE) values were

generally within ±10% at the state scale. However, for less common species, such as swine, bobcat, and fox, statewide precision was lower and there was considerable uncertainty at county scales. The scale within most of the species observation rate maps (Figures 3 – 32) was dictated by the precision of the data and were limited to average PSE values within ±30%.

Inherently, wildlife survey counts do have a measure of imprecision; annual counts may vary due in part to weather, wildlife movements, observer inconsistencies, and other factors that may not be related to wildlife numbers. For the purposes of trend analyses, all 7 years of data were presented in the tables and line graphs within this report. All years of data more accurately reflect the trajectory of populations. Analysis of variance and linear regression were used to determine the effects of year and region within each animal type. However, for distribution mapping and attribute comparisons, analyses were limited to most recent 5 years of data. Averaging annual estimates over a shorter 5-year time frame reduces the risk of long-term population change and improves the precision enough to provide confident biological estimates for most animal types at regional or county scales.

For refined location type and baiting analyses, comparisons were limited to those annual county samples with >3 sampling units within both respective treatment types. Since baiting and location types (private vs. game lands) were not equitably distributed or sampled within counties across the state, Wilcoxon match-pairs signed rank test were used to determine significant effects at a 95% confidence level. Average estimates were presented as medians with their associated quartile ranges. Nonparametric analyses and estimates present a more accurate view of potential differences, since they are typically less affected by large deviations in the data and a high skewness towards zero observations.

Results

During each of the 2014-2020 hunting seasons, approximately 25,000 hunting trips (observation records) encompassing ~100,000 hours were annually reported by ~1,500 volunteer hunters (Table 1). Hunters reported an average of 18.6 hunts per year and hunted 3.4 hours per hunt during the 114-day survey seasons. Each hunter provided an average of 1.8 sampling units within the 2020 season. Total animal counts by year are presented below (Table 2). Other animals reported included (listed in descending order): rabbits, domestic cats, crows, hawks, doves, opossums, ducks, owls, skunks, groundhogs, chipmunks, and quail. In 2020, 22% of the observation records were submitted online via desktop or mobile applications.

More trips and observation hours occurred on private lands (179,978 trips; 595,649 hours hunted) than on game lands (7,779 trips; 37,511 hours hunted). Game land hunting accounted for 4.1% of trips and 5.9% of hunting hours, which is comparable to the overall percentage of the landscape that are game lands (roughly 5%). Use of bait by hunters was very consistent across years. Baiting was reported on approximately half the hunting trips on private lands (7,779 trips; 59.6%), but was not reported on game lands, where its use is prohibited. Since the use of location types were comparable to their availability and use of bait was comparable to other recent deer hunter study estimates, no adjustments were made to statewide observation rates (Table 3).

Table 1. Statewide total survey responses, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	Hunters	Observation Records	Hours Hunted	Hours Hunted /Hunter	Observation Records/Hunter	Hours Hunted/ Observation Record	# of Sampling Units
2014	1,342	27,548	97,845	72.9	20.5	3.6	2,938
2015	1,385	26,498	92,206	66.6	19.1	3.5	2,845
2016	986	20,060	68,101	69.1	20.3	3.4	2,056
2017	1,705	31,646	106,310	62.4	18.6	3.4	3,342
2018	1,463	26,724	88,707	60.6	18.3	3.3	2,818
2019	1,785	28,762	94,908	53.2	16.1	3.3	3,146
2020	1,641	28,416	93,912	57.2	17.3	3.3	2,980
			Average	63.1	18.6	3.4	

Table 2. Statewide estimated total counts of animals observed, North Carolina Deer Hunter Observation Survey, 2014-2020. Counts include mean imputations for imprecise observer responses.

Year	Antlered Buck	Adult Doe	Total Adult Deer	Button Buck & Doe Fawn	Unknown Deer	Total Deer
2014	13,832	33,262	47,095	15,751	6,654	69,500
2015	13,692	34,090	47,782	17,377	7,306	72,464
2016	9,898	21,587	31,485	10,580	4,724	46,789
2017	17,035	40,189	57,224	19,388	8,702	85,314
2018	15,549	34,658	50,207	16,897	7,246	74,350
2019	17,707	40,437	58,144	20,004	8,293	86,441
2020	16,867	38,372	55,239	19,021	8,741	83,000

Year	Gray Squirrel	Fox Squirrel	Total Squirrels
2014	62,713	1,994	64,707
2015	69,225	1,549	70,774
2016	51,745	1,159	52,905
2017	90,284	2,071	92,355
2018	72,741	1,739	74,480
2019	74,805	1,822	76,627
2020	77,500	2,001	79,501

Year	Bearded Turkey	NonBearded Turkey	Total Known Turkey	Unknown Turkey	Total Turkey
2014	6,598	17,697	24,295	8,261	32,556
2015	5,649	17,936	23,585	8,897	32,482
2016	4,403	10,804	15,207	5,365	20,572
2017	6,806	18,625	25,431	8,989	34,420
2018	6,279	17,845	24,124	6,398	30,521
2019	6,520	21,771	28,291	8,294	36,585
2020	7,866	16,774	24,640	6,616	31,257

Year	Coyote	Bobcat	Gray Fox	Red Fox	Raccoon
2014	1,533	346	988	289	2,546
2015	1,190	237	645	310	1,888
2016	982	168	532	151	1,589
2017	1,474	298	713	282	2,682
2018	1,225	212	607	179	2,521
2019	1,073	249	611	211	2,385
2020	988	318	470	192	1,864

Year	Bear Adult	Bear Cub	Feral Swine
2014	791	468	410
2015	724	385	183
2016	401	184	86
2017	672	390	276
2018	559	335	335
2019	483	290	555
2020	464	303	299

Caution should be taken when comparing observation rates between species or species groups. No correction for observer bias has been made and it is very likely that larger, more mobile species that move more during daylight or twilight hours are more likely to be seen than smaller more nocturnal animals. It is also important to note that animal type identifications are made solely by individual hunters and not authenticated by NCWRC staff. Rate estimates were limited to the most recent 5 years of data to minimize temporal biases.

Table 3. Observation rates for animal types, North Carolina Deer Hunter Observation Survey, 2016-2020. Statewide mean estimates derived from annual county averages.

Animal Type	*Observation Rate (animals seen per 1,000 hours)*	*95% Confidence Interval*
All Deer *(including unknown age/sex)*	802.1	*(771.3-832.9)*
Gray Squirrel	783.7	*(755.8-811.7)*
Doe Deer	383.7	*(368.3-399.2)*
All Turkey *(including unknown beard status)*	340.9	*(317-364.8)*
Non-Bearded Turkey	177.6	*(163.7-191.5)*
Fawn Deer	174.7	*(165.7-183.6)*
Antlered Buck	160.5	*(153.9-167)*
Bearded turkey	66.1	*(59.9-72.2)*
Raccoon	25.7	*(23-28.5)*
Fox Squirrel	17.2	*(14.3-20.1)*
Coyote	13.0	*(11.7-14.2)*
Adult Bear	12.1	*(9-15.1)*
Gray Fox	6.7	*(5.9-7.6)*
Cub Bear	6.2	*(4.5-7.9)*
Bobcat	3.3	*(2.8-3.8)*
Red Fox	2.9	*(2.5-3.4)*
Swine	2.7	*(1.7-3.7)*
Doe/Buck	2.45	*(2.36-2.53)*
Fawn/Doe	0.51	*(0.49-0.53)*
Bearded/Non-Bearded Turkey	0.48	*(0.43-0.53)*
Fox Squirrel/Total Squirrel	0.04	*(0.03-0.05)*

Roughly half of observation sampling units occurred from statewide hunts with bait (47.8%, n=9,618) than without bait (52.2%, n=10,516). Use of bait analyses were limited to the most recent 5 years of data to minimize temporal biases. In most cases where significant differences were identified, baiting increased observation rates, except for coyote where the use of bait made observations less likely (Table 4). Many of the less observed species exhibited an average median of zero. Because of the high prevalence of zero observations and unbalanced sampling efforts between treatments, median averaging presents a less biased method than using mean averaging.

Table 4. Species observation rates by use of bait and no bait, North Carolina Deer Hunter Observation Survey, 2016-2020. Statewide median estimates derived from annual county averages. Parentheses indicate interquartile range.

	Animals seen per 1,000 hours				
Animal Type	Bait		No Bait		*P*
Gray Squirrel	**874.0**	**(652.3-1149.9)**	**610.0**	**(403.3-868.8)**	**0.00**
All Deer *(including unknown age/sex)*	**870.2**	**(655.5-1089.9)**	**715.9**	**(507.6-959.8)**	**0.00**
Doe Deer	**404.9**	**(303.5-528)**	**332.6**	**(227.9-476.5)**	**0.00**
All Turkey *(including unknown beard status)*	**296.5**	**(141.9-482.5)**	**229.3**	**(125.4-408.7)**	**0.00**
Fawn Deer	**209.6**	**(138.8-269.1)**	**128.3**	**(79.6-202.8)**	**0.00**
Antlered Buck	**177.1**	**(125-230.3)**	**140.1**	**(97.5-190)**	**0.00**
Non-Bearded Turkey	**144.1**	**(65.2-272.2)**	**104.9**	**(42-193.1)**	**0.00**
Bearded turkey	**51.4**	**(20.1-92.6)**	**40.1**	**(16-83.2)**	**0.00**
Raccoon	**21.6**	**(10.3-42.8)**	**8.8**	**(1.9-21.9)**	**0.00**
Coyote	**7.2**	**(2.3-14.2)**	**10.6**	**(4.5-18.7)**	**0.00**
Gray Fox	**3.5**	**(0-10.2)**	**1.9**	**(0-7.5)**	**0.00**
Adult Bear	0.0	(0-4.8)	0.0	(0-3.4)	0.39
Bobcat	0.6	(0-3.8)	0.3	(0-3.4)	0.85
Cub Bear	**0.0**	**(0-1.1)**	**0.0**	**(0-0)**	**0.02**
Fox Squirrel	0.0	(0-19.5)	0.0	(0-21.4)	0.23
Red Fox	0.0	(0-3.4)	0.0	(0-2.4)	0.43
Swine	0.0	(0-0)	0.0	(0-0)	0.85
Doe/Buck	**2.22**	**(1.83-2.80)**	**2.33**	**(1.90-2.97)**	**0.02**
Fawn/Doe	**0.58**	**(0.44-0.72)**	**0.44**	**(0.32-0.57)**	**0.00**
Bearded/Non-Bearded Turkey	0.30	(0.15-0.56)	0.36	(0.18-0.66)	0.06
Fox Squirrel/Total Squirrel	**0.00**	**(0-0.04)**	**0.00**	**(0-0.08)**	**0.00**

*Significant differences between medians in bold (P<0.05), Wilcoxon matched-pairs signed rank test.

Private land observations comprised of considerably more of the sampling unit location types (92.3%, n=18,306) than game lands (7.7%, n=1,532). Since baiting is prohibited on all game lands and baiting often increased observations rates for most animal types, analyses comparing location types were limited to "no use of bait" sampling units only (Table 5). Location type analyses were limited to the most recent 5 years of data to minimize temporal biases. Private land observation rates for most animal types were higher than game lands. These differences likely occurred because public game lands are often located on less productive habitats and/or often have higher hunting pressure. Many of the less observed species exhibited an average median of zero. Because of the high prevalence of zero observations and unbalanced sampling efforts between treatments, median averaging presents a less biased method than using mean averaging.

Table 5. Species observation rates by location type (private versus game lands), North Carolina Deer Hunter Observation Survey, 2016-2020. Statewide median estimates derived from annual county averages. Parentheses indicate interquartile range.

	Animals seen per 1,000 hours				
Animal Type	Private Land		Game Land		*P*
All Deer ***(including unknown age/sex)***	**717.2**	***(473-932.8)***	**263.2**	***(151.9-372.2)***	***0.00***
Gray Squirrel	**640.7**	***(409.3-948.7)***	**531.9**	***(246-862.1)***	***0.00***
Doe Deer	**333.4**	***(218.5-458.8)***	**107.2**	***(66.7-206.8)***	***0.00***
All Turkey ***(including unknown beard status)***	**262.6**	***(124-436.3)***	**88.9**	***(16.6-250)***	***0.00***
Antlered Buck	**136.3**	***(92.4-192.4)***	**44.7**	***(23.8-75.9)***	***0.00***
Fawn Deer	**132.9**	***(83.6-186.4)***	**23.8**	***(3.8-49.1)***	***0.00***
Non-Bearded Turkey	**113.4**	***(40-230.6)***	**18.0**	***(0-88.9)***	***0.00***
Bearded turkey	**38.1**	***(15.8-81.8)***	**6.3**	***(0-33.3)***	***0.00***
Coyote	**7.4**	***(2.5-17.2)***	**0.0**	***(0-9.9)***	***0.00***
Raccoon	**4.4**	***(0-16.2)***	**0.0**	***(0-6.4)***	***0.00***
Adult Bear	0.0	*(0-3.9)*	0.0	*(0-5.2)*	*0.21*
Bobcat	**0.0**	***(0-3.9)***	**0.0**	***(0-0)***	***0.00***
Cub Bear	0.0	*(0-0)*	0.0	*(0-0)*	*0.51*
Fox Squirrel	**0.0**	***(0-21.9)***	**0.0**	***(0-0)***	***0.00***
Gray Fox	**0.0**	***(0-4.9)***	**0.0**	***(0-0)***	***0.00***
Red Fox	**0.0**	***(0-1.5)***	**0.0**	***(0-0)***	***0.00***
Swine	0.0	*(0-0)*	0.0	*(0-0)*	*0.82*
Doe/Buck	2.40	*(1.97-3.00)*	2.10	*(1.33-3.50)*	*0.68*
Fawn/Doe	**0.43**	***(0.33-0.56)***	**0.28**	***(0.12-0.47)***	***0.00***
Bearded/Non-Bearded Turkey	**0.32**	***(0.15-0.63)***	**0.00**	***(0-0.40)***	***0.00***
Fox Squirrel/Total Squirrel	0.00	*(0-0.05)*	0.00	*(0-0)*	*0.15*

*Significant differences between medians in bold (P<0.05), Wilcoxon matched-pairs signed rank test.

Species Specific Results and Comments:

When looking at each of the following sections and charts, we urge caution in making direct comparisons between regional estimates for any species. Observation rates between regions may reflect population levels but can also be biased by differences in many factors such as habitat, topography, land use, or any other factor affecting the detectability of animals. For each of the selected species, any differences between regions may NOT be entirely related to regional differences in population abundance. We feel that trends within the data (i.e. changes through time within specific areas) generally can be relied on for assessing abundance changes during the 2014-2020 time frame.

Deer

Hunters were asked to report deer they saw according to four categories: Antlered Buck, Adult Doe, Doe Fawn/Button Buck, or Unknown. To account for division errors during analysis, each lone fawn per observation record was assumed to be associated with 0.1 doe. Greater than 10 does per observation record were moved to unknown, assuming age misidentification in the field by some hunters. Both transformations accounted for small number of records. Observation data complement other annual deer data sets (reported harvest, hunter harvest survey, biological data collections) that biologists rely on to manage the herd. These observations provide a baseline to enable biologists to begin to monitor trends in deer observation rates (deer/hour) and ratios (fawns/doe, does/buck) over space and time.

It is important to note these observation data have not been scientifically tested to determine their accuracy as a true measure or estimate of herd demographics, so results should be interpreted with caution. For example, bait appears to inflate fawn observation rates and fawn/doe ratios (Table 5), so if differences in fawns are observed over time or space, those differences could be the result of differences in the use of bait over time or space rather than differences in actual fawns in the population. Even if the use of bait is accounted for, it remains unknown whether observed fawn/doe ratios are an accurate measure of the true fawn/doe ratio of the herd.

In addition to bait, deer observations can vary throughout the deer hunting season, and time of observations should be critically considered before assuming observations are an accurate depiction of population demographics. Deer observation rates and ratios can change over the course of a hunting season because of seasonal changes in 1) deer movements (ex: rut activity, response to hunting pressure, shorter day length, variable food sources, fawns becoming more active), 2) a hunter's ability to detect (ex: leaf fall, crop harvest) deer, 3) correct identification of types of deer (ex: fawns maturing, bucks shedding antlers), and 4) removal of deer from the herd (ex: disproportionate harvest of bucks to does or does to fawns). To further confound this issue, the influence of these factors may vary geographically and between years.

Deer observed per hour is slightly lower near the end of the deer hunting season because many deer have already been harvested (Figure 2). Additionally, diurnal activity may decrease in response to hunting pressure and shortening day length. Because buck movements and home-ranges increase around the rut, the lowest doe/buck ratio is typically observed during that time period. Fawn/doe ratios are highest at the beginning of the season, even though hunters harvest proportionally more adult does than fawns throughout the season. Natural mortality

(predation, disease, etc.) is similar for adult does and fawns older than 3-4 months of age, so the observed decline in the ratio at the end of the season is not likely due to an actual decline in fawns per doe in the herd. The higher early season ratio may indicate hunters have a higher tendency to incorrectly identify fawns as adults as they mature during the season.

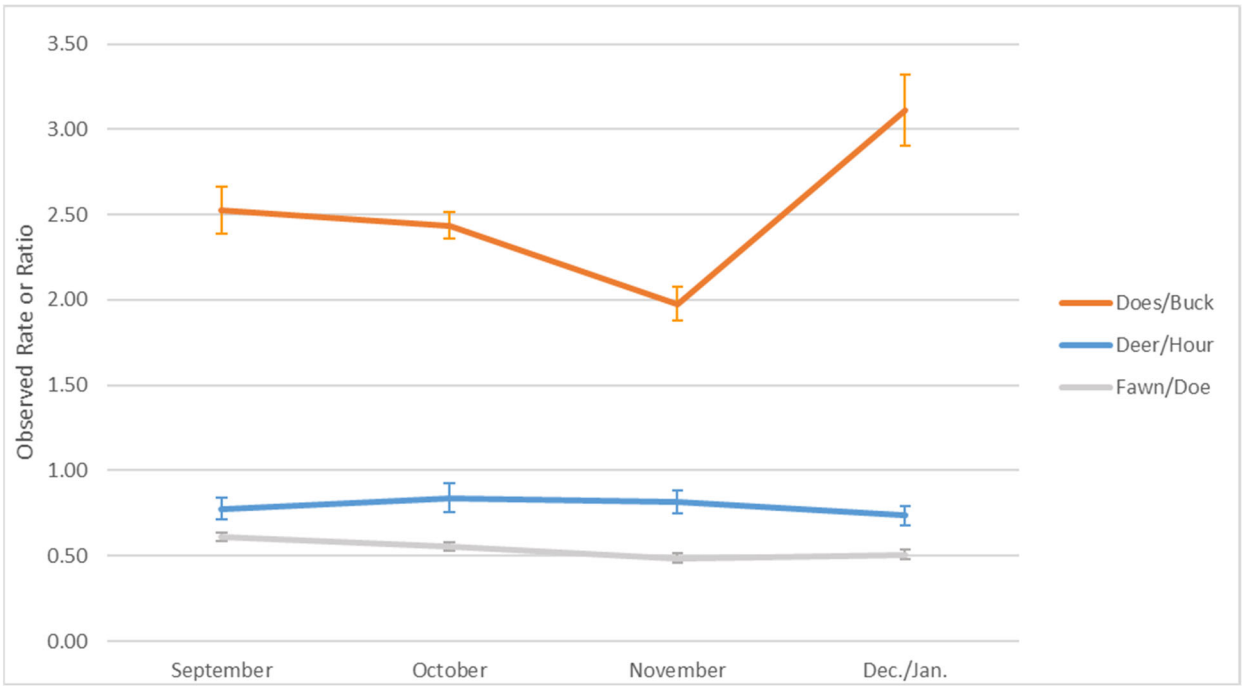

Figure 2. Deer observation rates and ratios by month, North Carolina Deer Hunter Observation Survey, 2016-2020. Deer observations vary over time of year due to changes in deer movements, hunter ability to detect and correctly identify types of deer, and deer harvest. For the raw data used for this chart, see Appendix B1.

Observation Rates of Deer

Deer were the most observed animal type (802.1 deer per 1,000 hours) and were seen in all 100 counties. Adult does were seen at a higher rate (383.7 does per 1,000 hours), than either fawns (174.7 fawns per 1,000 hours), or antlered bucks (160.5 bucks per 1,000 hours). Significantly more deer were observed on stand locations with bait (870.2 per 1,000 hours, than without bait (715.9 deer per 1,000 hours) (Table 5). Significantly more deer were observed on private lands (717.2 per 1,000 hours, than on game lands (263.2 deer per 1,000 hours) (Table 6).

For the 2020 season, the highest observation rates for deer occurred in the Northeastern season zone (1,054.5 deer per 1,000 hours) and were lowest in the Western season zone (540.9 deer per 1,000 hours). Over the past 7 years, there is significant evidence that statewide observation rates have increased over time (+27.9 deer per 1,000 hours annually, $P<0.01$). The rate increase has appeared to be very similar across all 5 season zones with the highest number of deer observed during the most recent season (Figure 3).

Despite observation rate increases, annual county estimates maintained relatively consistent precision within past 5 years (average PSE 11.6%) and were adequate enough to map distributions at the county scale (Figure 4). However, counties in the extreme eastern and western ends of the state exhibited a high amount of annual variation due to small sample sizes.

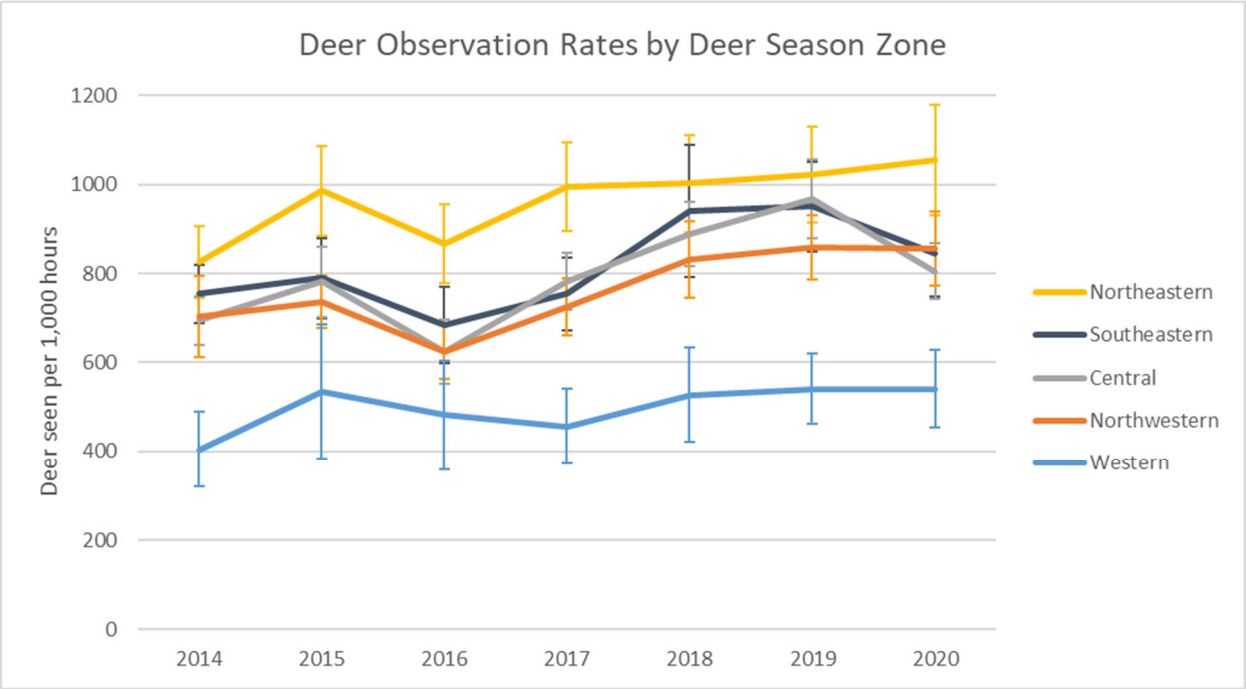

Figure 3. Annual deer observation rates by deer season zone (# of deer seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B2.

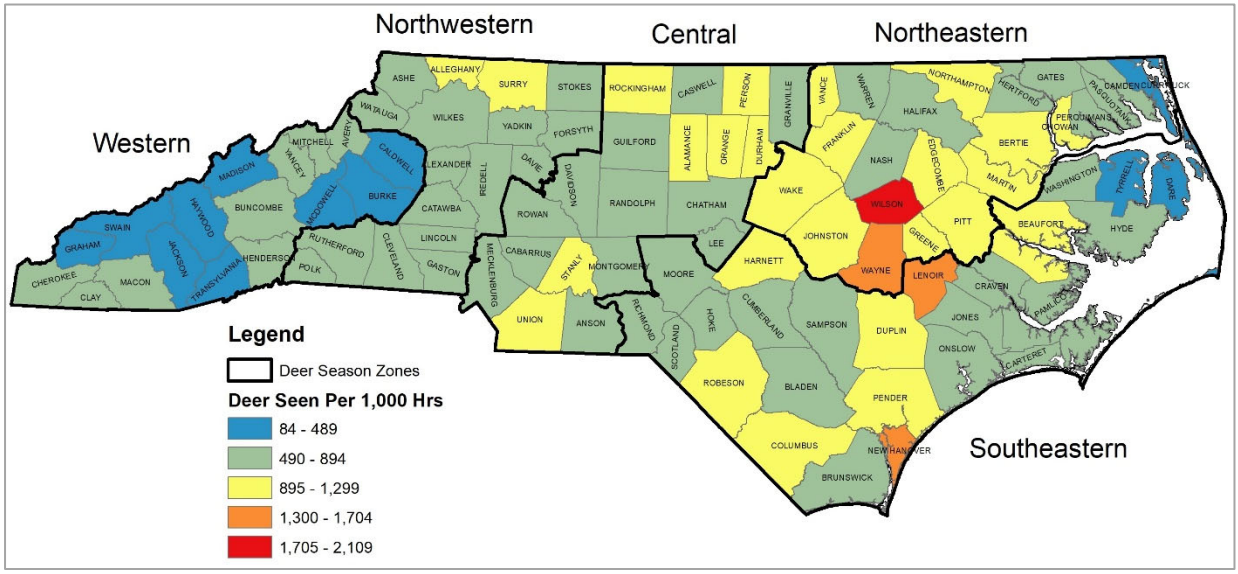

Figure 4. Deer observation rates by county based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Ratio of Fawns Per Doe

This ratio offers insight into deer population recruitment. The two main influences on this ratio are adult doe (1.5+ years) reproductive output and fawn mortality. When changes in the ratio are observed over time, it will never be entirely clear which of these factors might be responsible, i.e. habitat quality, doe age/health, predation, and weather events. However, this ratio is extremely valuable and provides a more comprehensive assessment of deer population dynamics and sustainable harvest rates.

The observed fawn/doe ratio was highest in the Central and Northwestern zones (0.59-0.57 fawns for every adult doe, compared to the other 3 season zones (0.46-0.50 fawns for every adult doe, $P<0.05$) (Figure 5). There is no evidence that statewide ratios have significantly changed within the past 7 years (0.52 fawns for every adult doe, $P=0.24$). Rates within each of the season zones also showed no significant change within the past 7 years ($P>0.05$). Considerable annual variation existed in the Western season zone, most notably a low ratio in 2017. Weather and mast likely influence reproductive output and fawn mortality, but the relationship is complex and currently unclear.

Baiting analyses suggest that the use of bait significantly increases the observed fawn per doe ratio by ~30% (0.58 fawns per doe with bait, 0.44 fawns per doe without bait). This appears to be influenced by fawns having a higher tendency to visit baited sites compared to adult does. Location type analyses also suggest that fawn per doe ratios are higher on private lands by ~50% (0.43 fawns per doe on private lands, 0.28 fawns per doe on game lands).

Within the past 5 years, annual county estimates maintained relatively consistent precision (average PSE 12.5%) and were adequate enough to map distributions at the county scale. (Figure 6). However, several counties in the mountains and coast exhibited a high amount of annual variation due to small sample sizes.

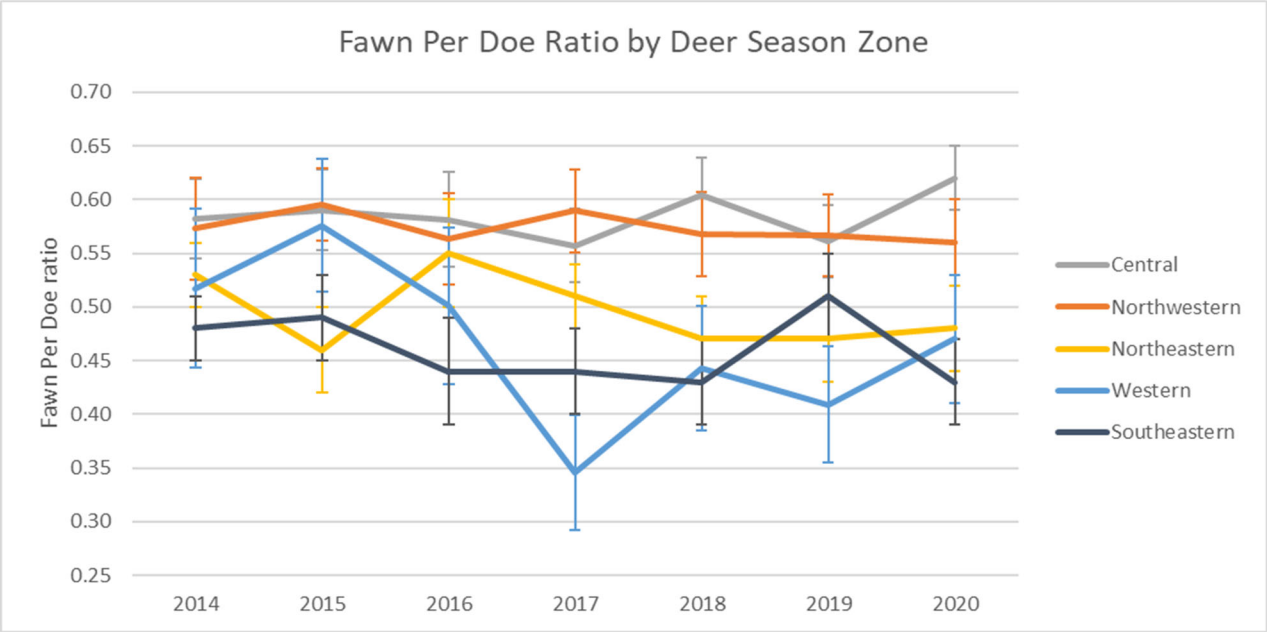

Figure 5. Annual fawn per doe observation rates by deer season zone with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B3.

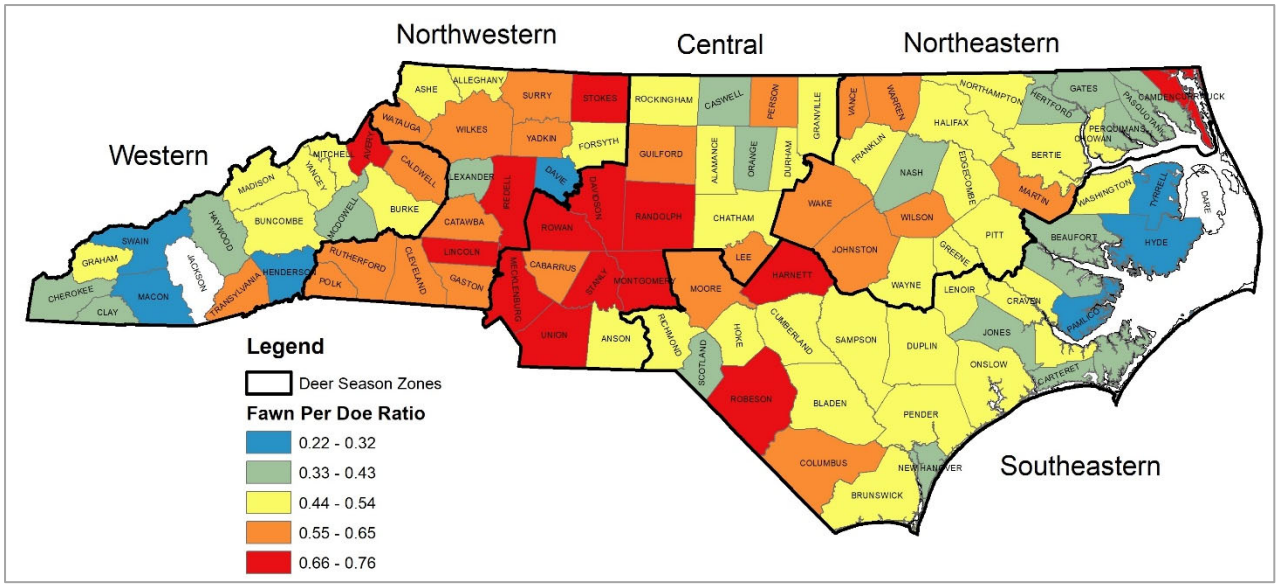

Figure 6. Fawn per doe observation rates by county based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020. Counties with no shading indicate insufficient sample sizes for estimation purposes (<3 sampling units per year).

Ratio of Adult Does Per Antlered Buck

This ratio offers insight into the sex ratio of the deer herd. Since birth rates and natural mortality are similar for males and females, skewed ratios in the herd are primarily indicative of hunting harvest rate differences. When changes in the ratio are observed over time, changes in harvest management strategies are likely responsible.

The central and northwestern zones had significantly lower adult doe per antlered buck ratios than the other 3 season zones, after accounting for annual affects ($P<0.05$, Figure 7). There is no evidence that statewide ratios have changed over the past 7 years (2.50 does per buck, $P=0.16$), or within each of the 5 season zones ($P>0.05$).

Baiting analyses suggested that the use of bait significantly reduces the observed doe per buck ratio (2.22 does per buck with bait, 2.33 does per buck without bait, $P=0.02$). This difference likely occurs because antlered bucks had a slightly higher tendency to visit baited sites (26% higher with bait) compared to adult does (22% higher without bait). Location type analyses showed no significant evidence that the doe per buck ratio is different on private lands than on game lands.

Within the past 5 years, annual county estimates maintained relatively consistent precision (average PSE 11.1%) and were adequate to map distributions at the county scale (Figure 8). However, several counties in the mountains and coast exhibited the highest amount of annual variation due to small sample sizes.

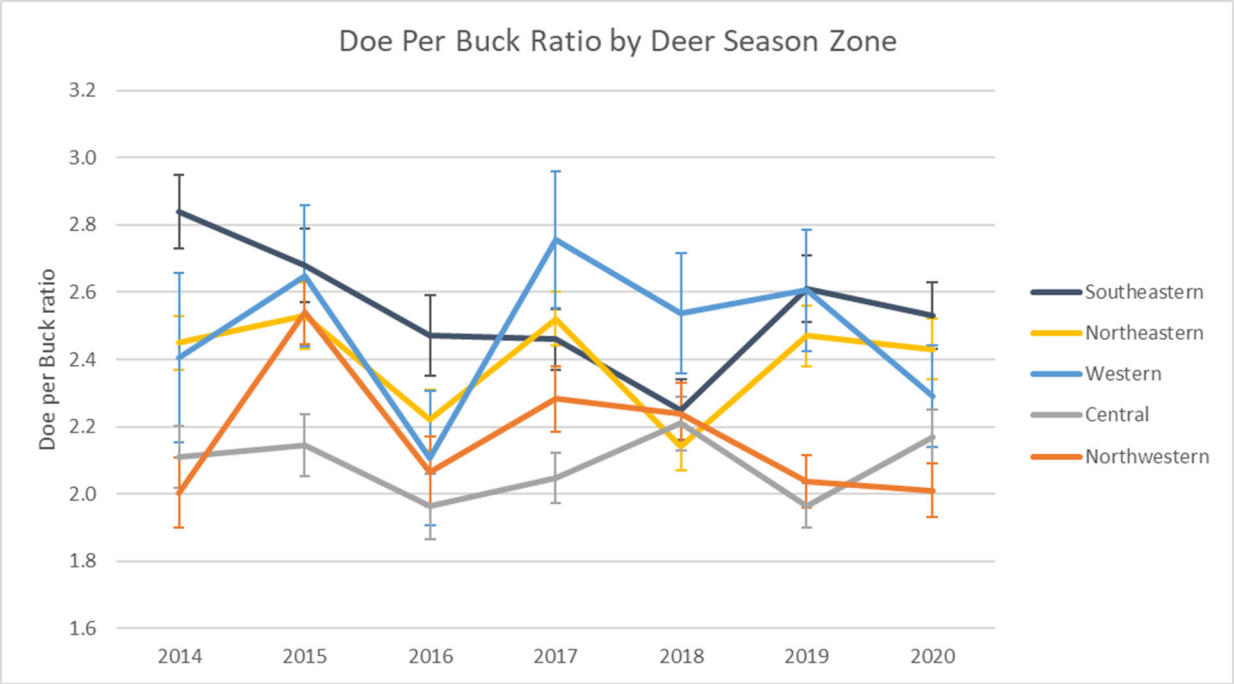

Figure 7. Adult doe per antlered buck observation rates by deer season zone with 95% confidence intervals), North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B4.

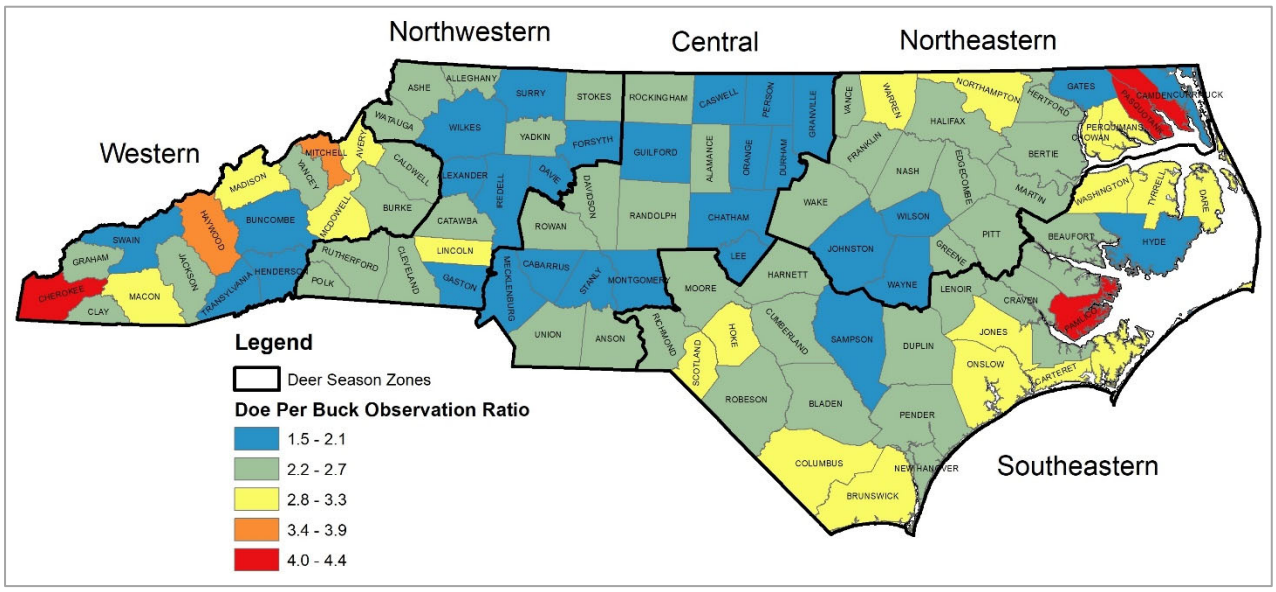

Figure 8. Adult does per antlered buck observation rates by county based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Gray Squirrel

Gray squirrels were the second most commonly observed animal type (783.7 squirrels per 1,000 hours) and were seen in all 100 counties (Table 4). Significantly more gray squirrels were observed on stand locations with bait (874.0 squirrels per 1,000 hours), than without bait (610.0 squirrels per 1,000 hours), since squirrels appear to utilize bait as a direct food source (Table 5). Significantly more gray squirrels were also observed on private lands (640.7 squirrels per 1,000 hours), than on game lands (531.9 squirrels per 1,000 hours, Table 6).

There is significant evidence that statewide observation rates have increased over time ($P<0.03$, Figure 9). Within the past 5 years, annual county estimates maintained relatively consistent precision (average PSE 11.5%) and were adequate to map distributions at the county scale (Figure 10). Highest observations rates occurred in the central piedmont of the state.

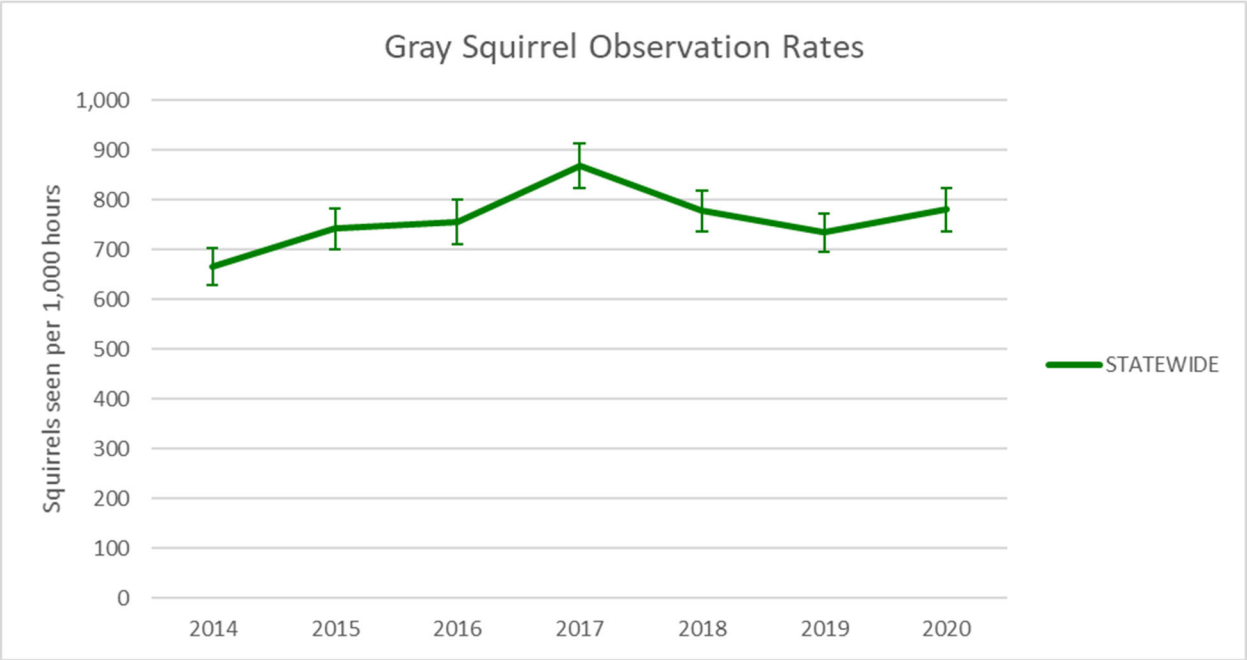

Figure 9. Annual statewide gray squirrel observation rates (# of gray squirrels seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B5.

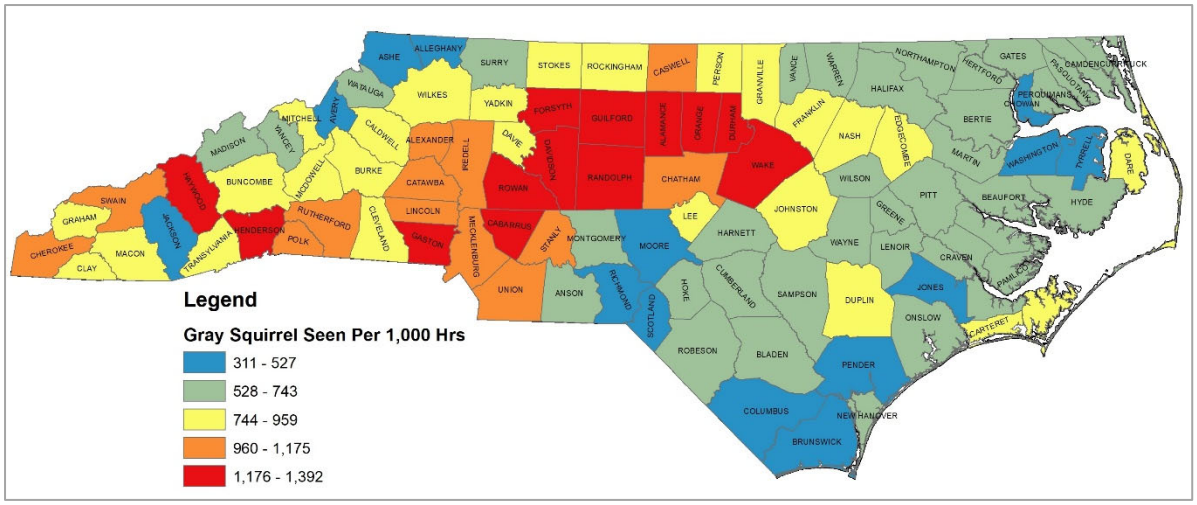

Figure 10. North Carolina gray squirrel observation rates by county based on 5-year averages (# of gray squirrels seen per 1,000 hours), Deer Hunter Observation Survey 2016-2020.

Fox Squirrel

Fox squirrels were a relatively uncommon animal type (17.2 squirrels per 1,000 hours) and were seen in 74 counties (Table 4). Since the known fox squirrel population distribution only covers a portion of the state, most annual county hunter observation rates were zero. As opposed to gray squirrels, the use of bait did not appear to have a significant influence on observation rates (Table 5). Despite statewide private lands and game lands median averages being zero, there was significant evidence that there were more fox squirrels observed on private lands than on game lands (Table 6, $Z=3.4$, $P<0.01$).

There was no significant evidence that statewide observation rates have changed within the past 7 years ($P=0.64$, Figure 11). Within the past 5 years, annual county estimates across the state maintained relatively poor precision (average PSE 49.2%) but were adequate within the core population to map at the county scale (Figure 12). Counties along the border of population ranges often exhibited high imprecision due to the scarcity of observation occurrences. Highest observations rates occurred in the Sandhills region and the central coastal area of the state. Many of the deer hunter survey observations have included new occurrences outside of the previous known historical ranges and have been used to update the agency's fox squirrel distribution maps.

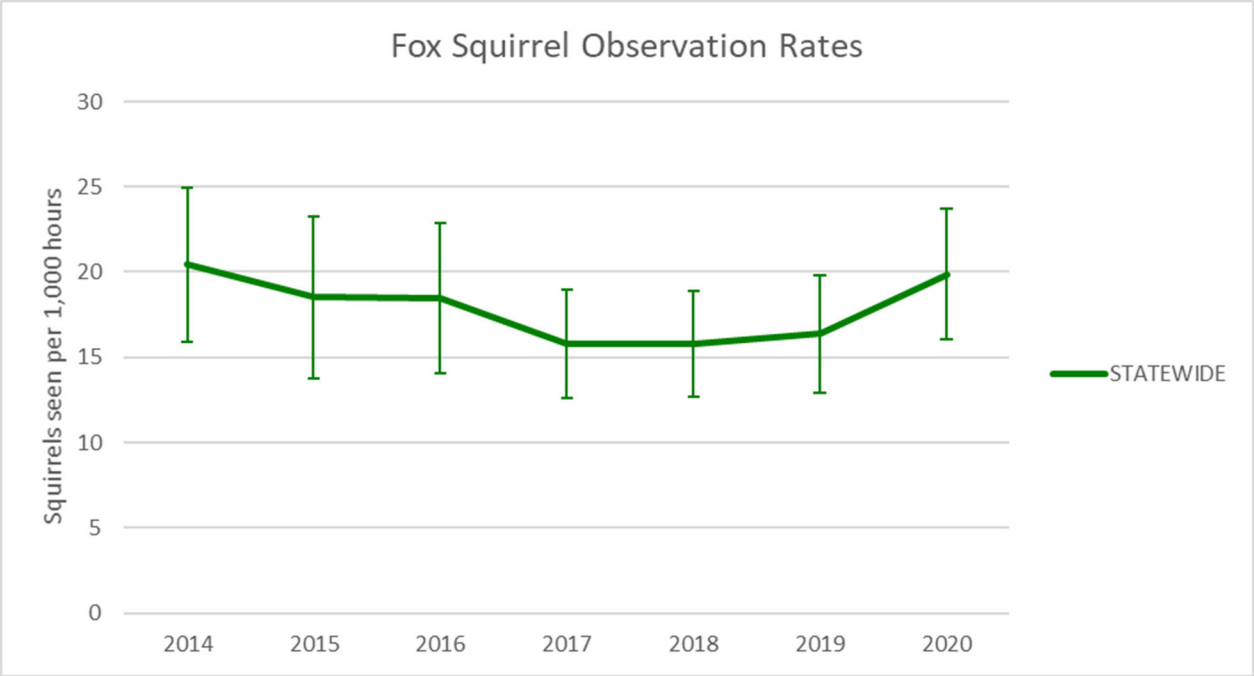

Figure 11. Annual statewide fox squirrel observation rates (# of fox squirrels seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B6.

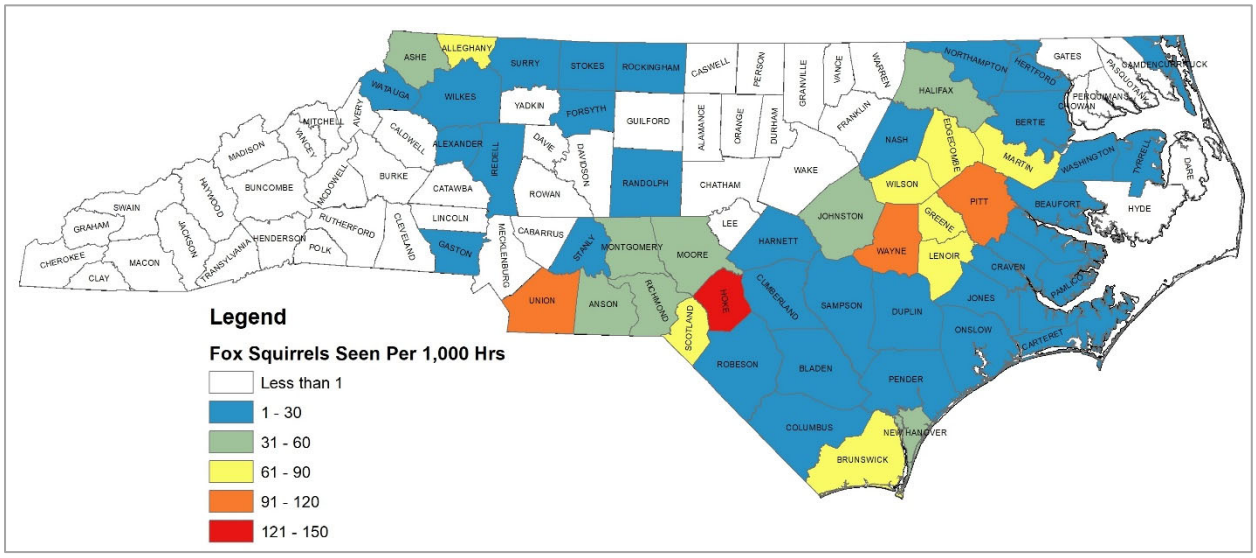

Figure 12. North Carolina fox squirrel observation rates by county based on 5-year averages (# of fox squirrels seen per 1,000 hours), Deer Hunter Observation Survey 2016-2020.

Turkey

Hunters were asked to report all turkeys they saw according to three categories: Bearded, No Beard, or Unknown. Turkey observation data can be used in several ways. Primarily, they are used to compute observation rates (i.e., turkeys seen/1,000 hours) and a ratio of bearded (adult males) to non-bearded (females and young of the year).

Observation Rates of Turkeys

Turkeys were a commonly observed animal type (340.9 turkeys per 1,000 hours) and were seen in all 100 counties (Table 4). Hunters reported seeing more non-bearded turkeys (177.6 turkeys per 1,000 hours) than bearded turkeys (66.1 turkeys per 1,000 hours). Turkey observations contained a relatively high degree of variance due to the flocking characteristic of turkeys making estimates less precise. Significantly more turkeys were observed when bait was used (296.5 turkeys per 1,000 hours with bait, 229.3 turkeys per 1,000 hours without bait, Table 5). There was significant evidence that observation rates for turkeys were different between location types (262.6 turkeys per 1,000 hours on private lands, 88.9 turkeys per 1,000 hours on game lands, Table 6).

There was no significant evidence that turkey observation rates have changed at the statewide scale within the past 7 years ($P=0.41$, Figure 13). However, observation rates have shown a significant increase in the coastal management region (+23.3 turkeys per 1,000 hours annually, $P=0.03$, Figure 14), while rates in the mountains have significantly decreased (-26.8 turkeys per 1,000 hours annually, $P=0.03$). There was no significant evidence that rates have changed in the piedmont region ($P=0.91$).

For the past 5 years, annual county estimates maintained relatively consistent observation rates (average PSE 22.3%) and were precise enough to map distributions at the county scale. (Figure 14). Observation rates for turkeys were significantly higher in the coastal region (475.7 turkeys per 1,000 hours, $P<0.01$) and were lowest in the piedmont (224.1 turkeys per 1,000 hours, $P<0.01$).

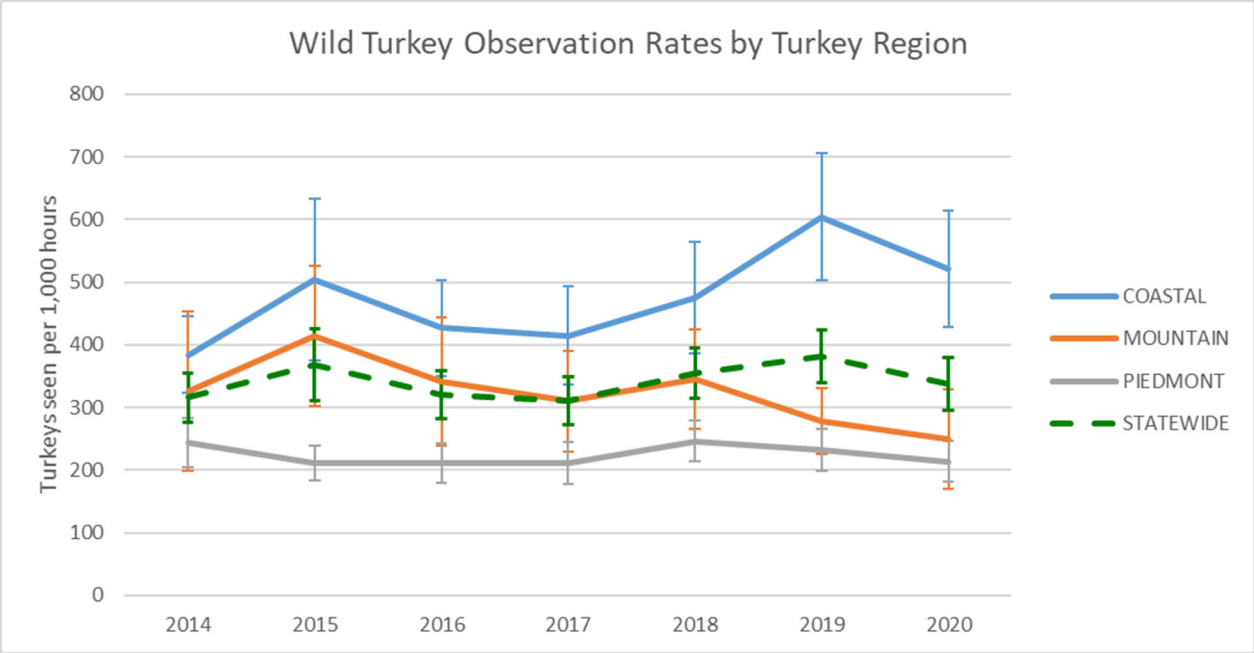

Figure 13. Annual turkey observation rates (# of turkeys seen per 1,000 hours) by turkey management region with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B7.

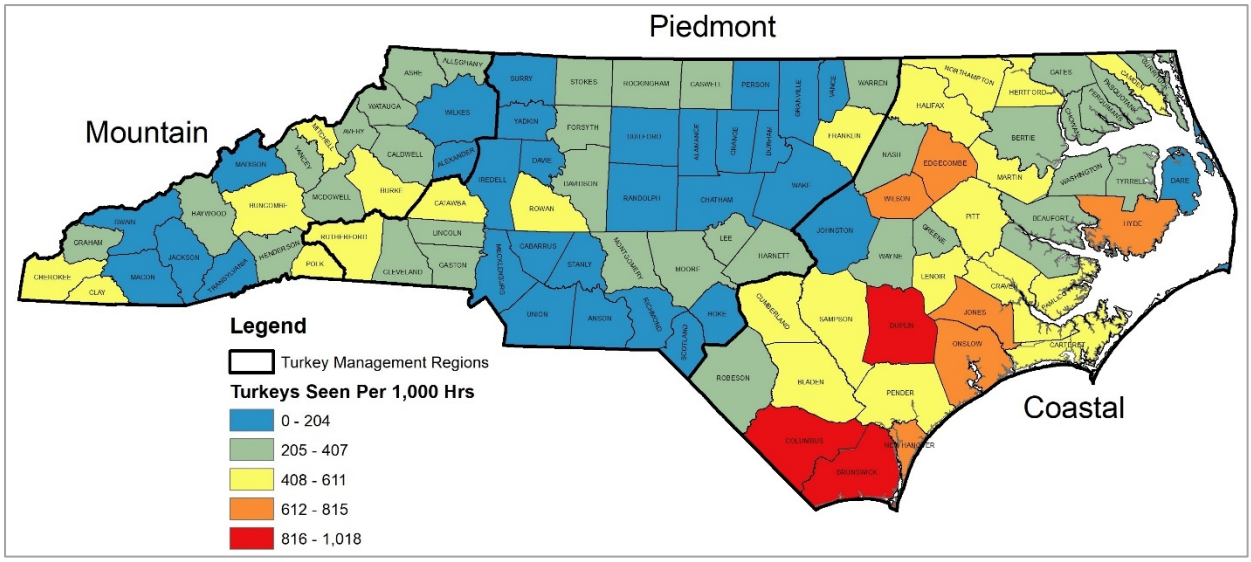

Figure 14. North Carolina turkey observation rates by county based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Ratio of Bearded/No Beard Turkeys

This ratio offers insight into turkey population dynamics. This ratio can be influenced by the survival/harvest rates of males, survival of females, and production of young turkeys during summer nesting and brood rearing. Changes in the ratio over time may indicate changes in these parameters, though it may not be clear which parameters have changed. For example, if

the ratio of bearded to non-bearded turkeys decreased over time, over-harvest of males during the spring hunting season might be responsible. Data from the DHOS are extremely valuable and can be used in combination with information from our annual Summer Wild Turkey Observation Survey and reported annual spring harvest numbers to provide a more comprehensive assessment of the turkey population and management strategies.

The statewide bearded to non-bearded turkey ratio was highest in the coastal and piedmont zones (0.52 bearded per no beard turkey, P<0.01) and lowest in the mountains (0.34 bearded per no beard turkey, P<0.01). Observation rates in the piedmont and coastal zones were not significantly different (P=0.48). Baiting analyses suggest that the use of bait does not significantly affect the bearded/no beard turkey ratio (P=0.06). If ratios were significantly different, inferences may suggest that bearded and no beard turkeys use bait at the same relative proportional rate. Location type analyses show significant evidence that the median ratio is significantly higher on private lands than on game lands (0.32 bearded per non-bearded turkey on private lands, 0.00 bearded per non-bearded turkey on game lands, Table 6). These comparisons are relatively imprecise due to the low availability of game land observation ratios, but significant differences may be the result of gobblers having higher harvest rates on public game lands as compared to private lands.

There is no significant evidence that ratios have changed at the statewide scale over the past 7 years (P=0.10, Figure 15), but significantly small declines have been seen in the mountain management zone (-0.04 bearded per no beard turkey per year, P<0.01). No differences in trends exist within the piedmont and coastal zones (P=0.33), which both experienced a notable increase during the 2020 season. Within the past 5 years, annual county observation ratios only maintained marginal consistency (average PSE 32.5%), so the mapping presented at the county scale should be interpreted cautiously (Figure 16). Counties in the far mountains and coast exhibited the highest amount of annual variation due to small sample sizes.

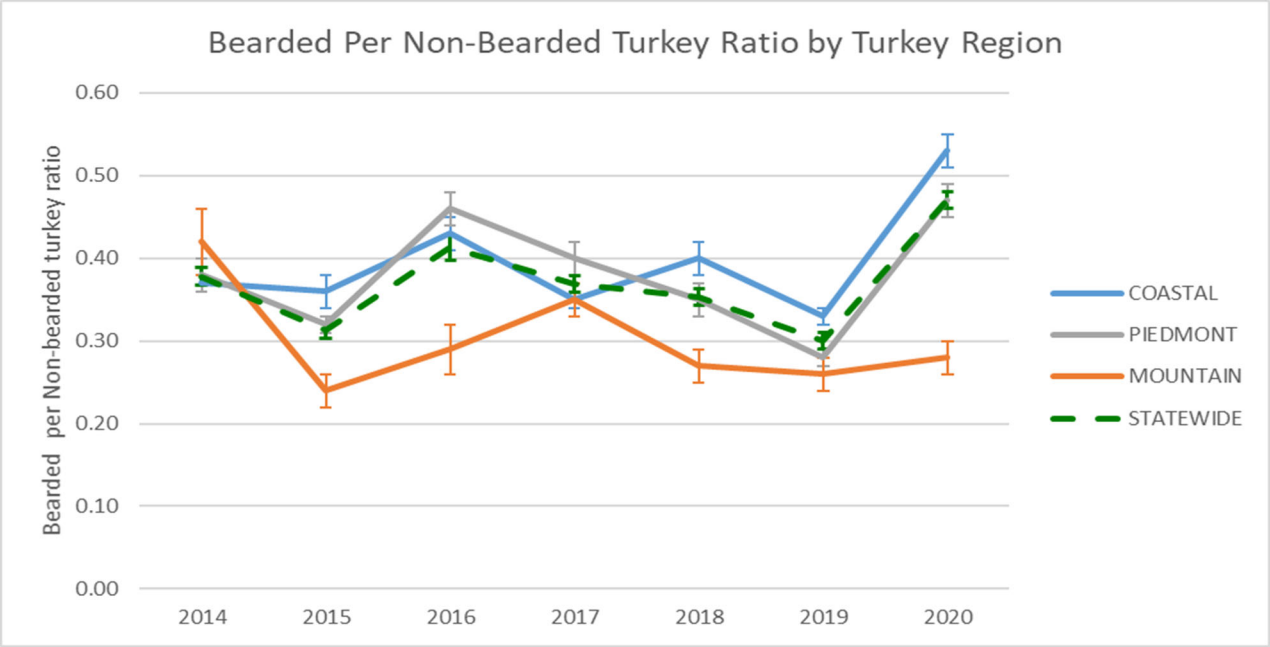

Figure 15. Annual bearded per non-bearded turkey observation rates with 95% confidence intervals by turkey management region, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B8.

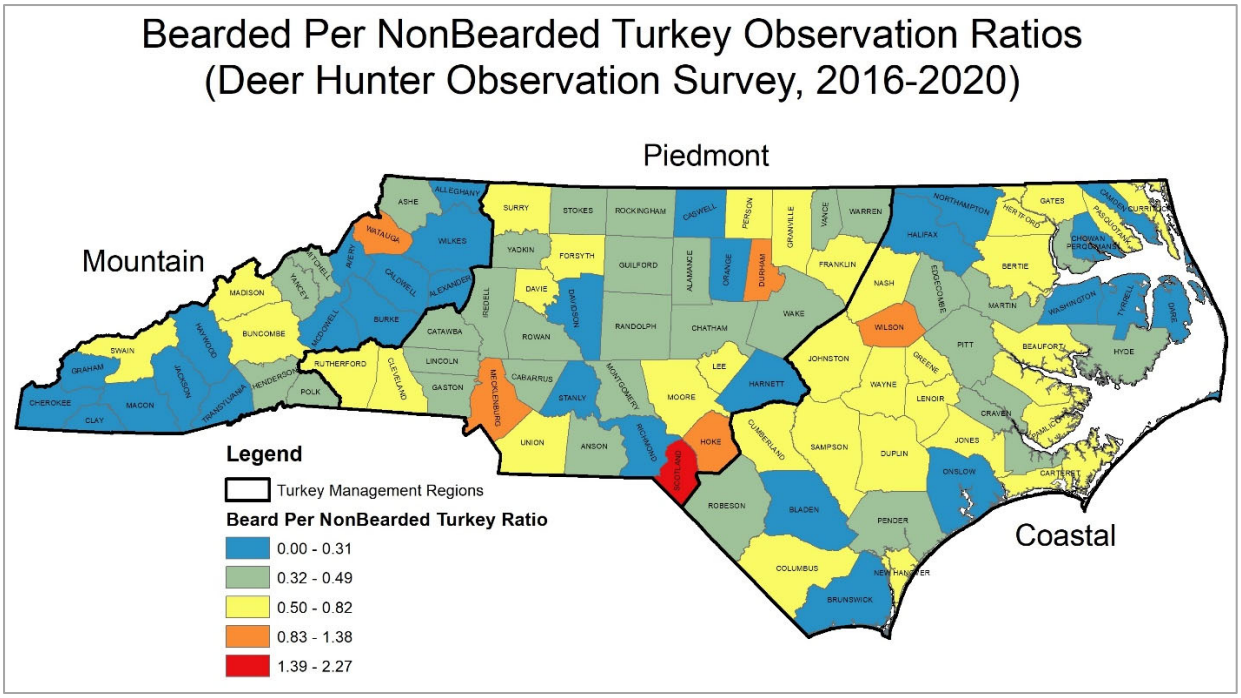

Figure 16. Bearded turkey per non-bearded turkey observation ratio by turkey management region based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Raccoon

Observations of raccoon have generally followed their statewide range and were recorded in 99 of the 100 counties. Statewide raccoon observation rates were the highest for any furbearer species but were still relatively rare (25.7 raccoons per 1,000 hours), especially when compared to other game species, including deer, gray squirrel and turkey (Table 4). Low observation rates likely occur because raccoons are primarily nocturnal, and deer hunter observations are made during the day. Significantly more raccoons were observed on stand locations with bait (21.6 raccoons per 1,000 hours), than without bait (8.8 raccoons per 1,000 hours, Table 5). Baited sites were highly attractive to raccoons since they provided a direct food source. Location type analyses show significant evidence that observation rates is significantly higher on private lands than on game lands (4.4 raccoons per 1,000 hours on private lands, 0.00 raccoons per 1,000 hours on game lands, Table 6). These comparisons are relatively imprecise due to the low availability of raccoon observations on game lands, but significant differences are likely the result of harvest rate or habitat differences between public game lands and private lands.

Raccoon observation rates were significantly different within each of the 3 Furbearer Management Units (FMU), ($P<0.05$). Rates were highest in the coastal plain (40.6 raccoons per 1,000 hours), followed by the piedmont (19.4 raccoons per 1,000 hours), and lowest in the mountain FMU (12.5 raccoons per 1,000 hours) (Figure 17). There was no significant evidence that statewide or regional observation rates have changed within the past 7 years ($P>0.05$).

Within the past 5 years, annual county observation rates only maintained marginal consistency (average PSE 32.8%), but mapping was presented at the county scale (Figure 18).

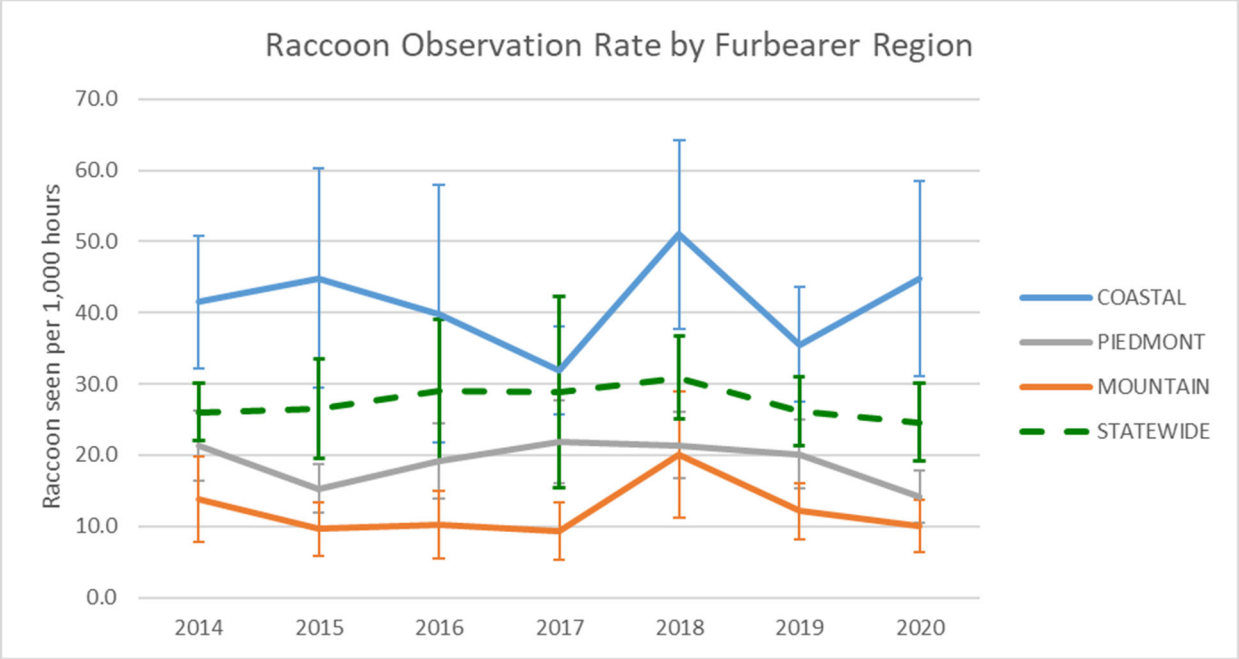

Figure 17. Annual raccoon observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B9.

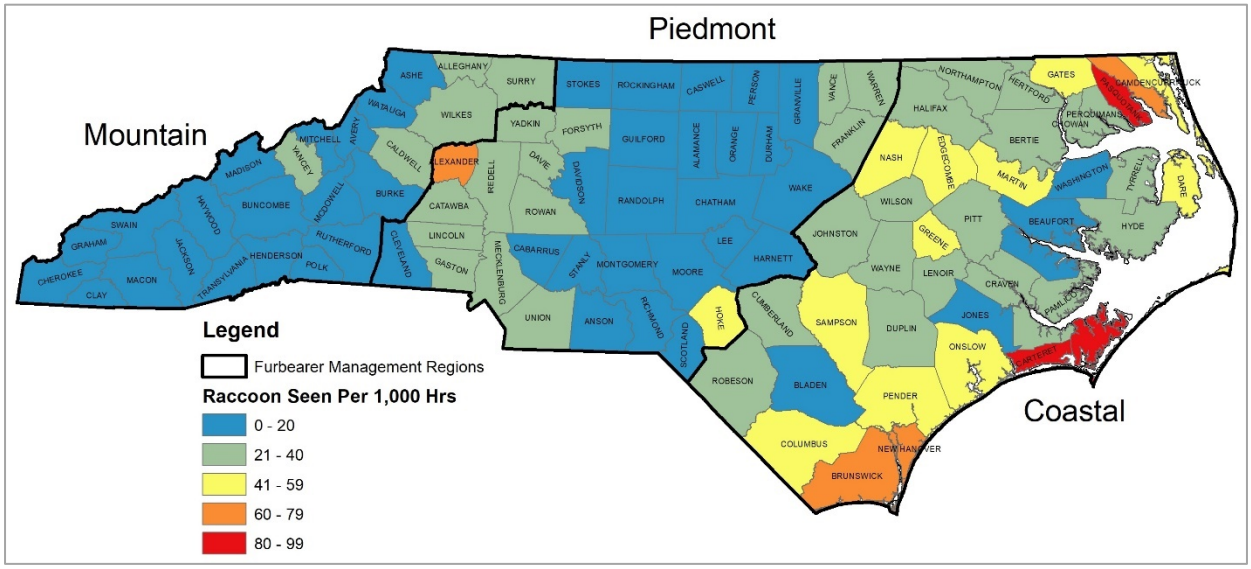

Figure 18. North Carolina raccoon observation rates by county based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020. For the raw data used for this chart, see Appendix B10.

Coyote

Observations for coyote have generally followed their statewide range and were observed all 100 counties. Statewide coyote observation rates were generally rare compared to other species (13.3 coyotes per 1,000 hours, Table 4). Significantly less coyotes were observed on stand locations with bait (7.2 coyotes per 1,000 hours, than without bait (10.6 coyotes per 1,000 hours, Table 5). Coyotes were the only species to have a significant negative response to the use of bait. Location type analyses show significant evidence that the median rates were significantly higher on private lands than on public game lands (7.4 coyotes per 1,000 hours on private lands, 0.00 coyotes per 1,000 hours on game lands, Table 6). These comparisons are relatively imprecise due to the low availability of coyote observations on game lands, but significant differences are likely the result of the coyote's avoidance of locations that have higher human activity (e.g., hikers, dog walkers, hunters, anglers).

There is no evidence that statewide rates have changed within the past 7 years ($P>0.05$), but a significantly small declines have been seen in the coastal management zone (-1.2 coyotes seen per 1,000 hours per year, $P<0.01$) (Figure 19). Despite trend differences, there is no evidence that coyote observation rates are different between the three furbearer management units. These results match that of other indices the Commission uses to track coyote population trends and indicate that at a statewide and regional level, coyote populations are fully distributed and relatively stable.

For the past 5 years, annual county observation rates only maintained marginal precision (average PSE 32.0%) primarily due to low observation rates, but mapping was presented at the county scale (Figure 20).

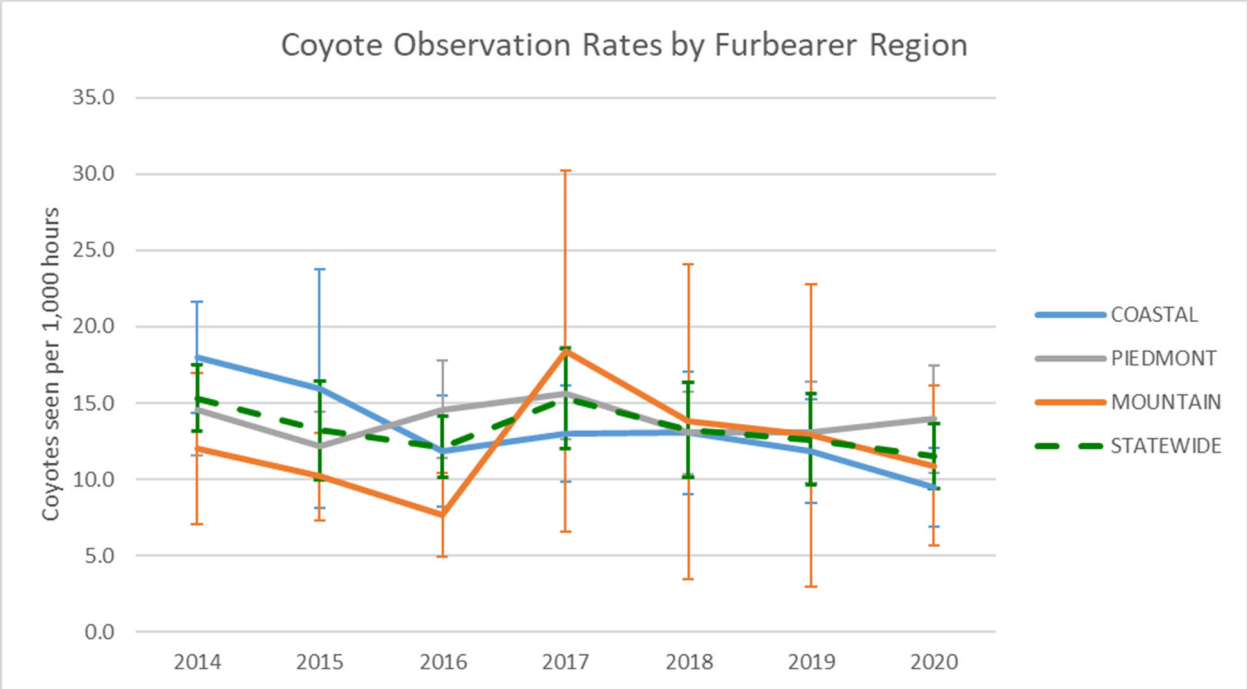

Figure 19. Annual coyote observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B10.

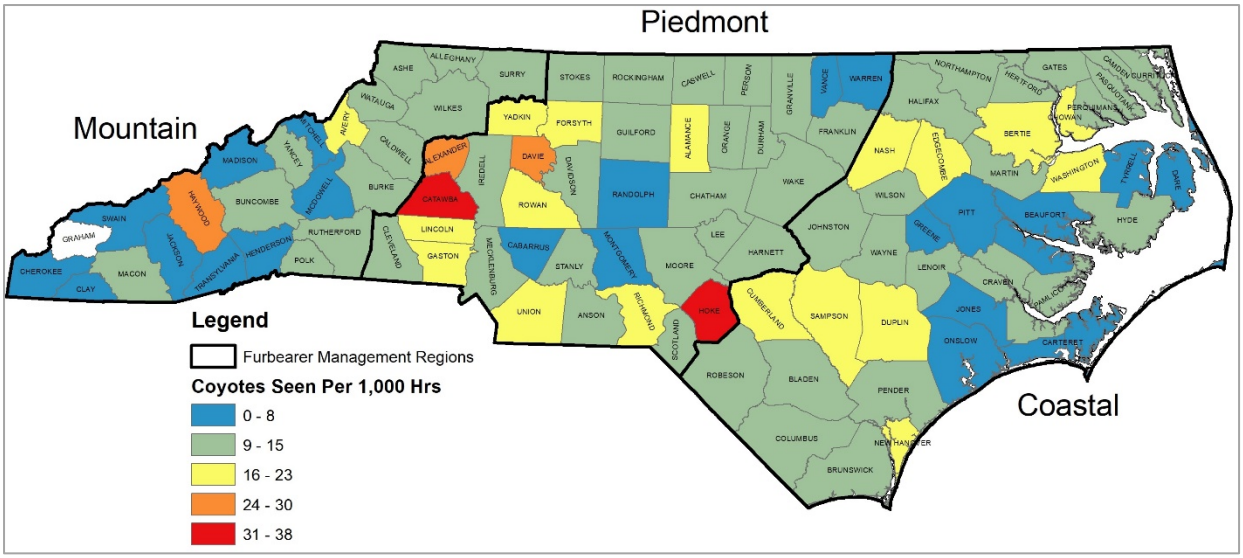

Figure 20. Coyote observation rates by furbearer management unit based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Gray Fox

Observations of gray fox have generally followed their statewide range and were seen in 95 of the 100 counties. Statewide gray fox observation rates were relatively rare compared to other species (6.7 gray fox per 1,000 hours, Table 4). The median observation rates for gray fox were significantly higher for stand locations with bait (3.5 gray fox per 1,000 hours, than without bait (1.9 gray fox per 1,000 hours, Table 5). As baited sites likely attract more bird and small mammal activity, gray foxes may be attracted both indirectly and directly to these food resources. Location type analyses show significant evidence that observation rates are significantly higher on private lands than on game lands (Table 6). These comparisons were relatively imprecise due to the low availability of observations, but significant differences are likely the result of higher harvest rates and/or habitat differences between public game lands and private lands.

Gray observation rates within the past 5 years were significantly lower in the mountain FMU (1.6 gray fox per 1,000 hours) than the coastal and piedmont FMUs (8.3 gray fox per 1,000 hours, $P<0.01$, Figure 21). There was not significant difference in observation rates between the coastal and piedmont FMUs ($P=0.66$). Within the past 7 years, there is significant evidence that statewide observation rates have declined over time (-0.6 gray fox seen per 1,000 hours annually, $P<0.01$). This decline was primarily driven by the significant decrease occurring in the coastal FMU, (-1.24 gray fox seen per 1,000 hours annually). There was no significant evidence that gray fox observation rates have changed over time within either the Mountain ($P=0.17$) or the Piedmont ($P=0.26$).

Within the past 5 years, annual county estimates did not maintain consistent precision (average PSE 49.4%) primarily due to low observation rates and were only adequate enough to map distributions at the regional scale (Figure 22).

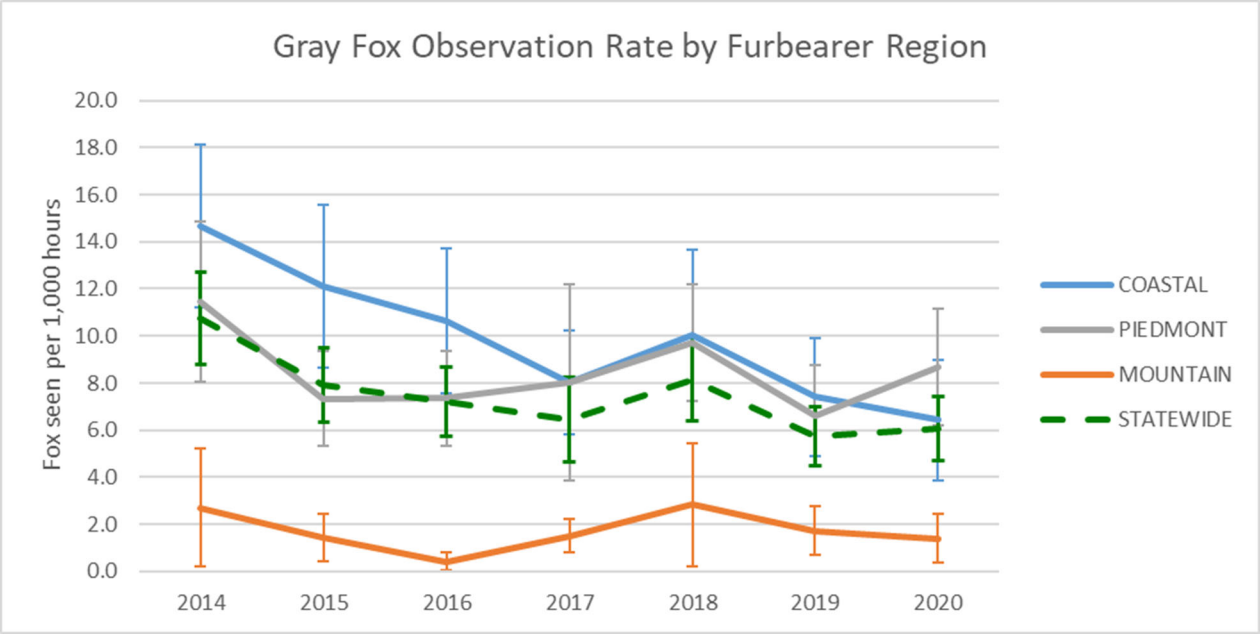

Figure 21. Annual gray fox observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B11.

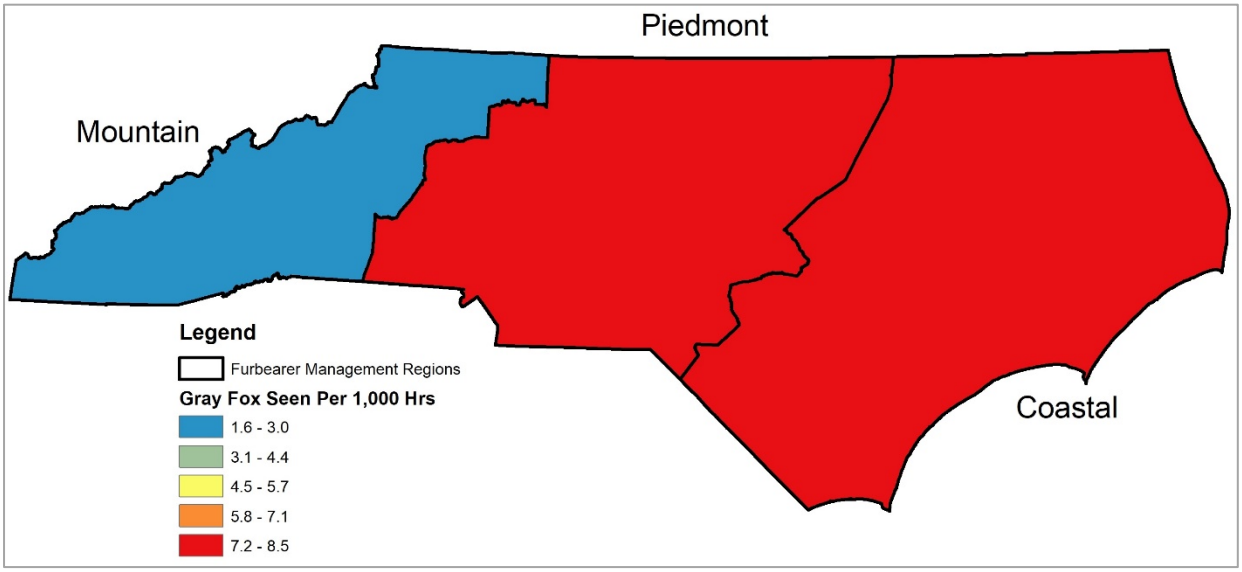

Figure 22. Gray fox observation rates by furbearer management unit based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Red Fox

Observations for red foxes have generally followed their statewide range and were seen in 93 of the 100 counties. Red foxes were a relatively rare observation for deer hunters (2.9 red fox per 1,000 hours, Table 4). There is no significant evidence that baited sites has any influence on red fox observation rates (P=0.43), as compared to coyotes or gray fox (Table 5). Location type analyses show significant evidence that observation rates are significantly higher on private lands than on game lands (Table 6). These comparisons were relatively imprecise due to the low availability of observations, but significant differences are likely the result of higher harvest rates and/or habitat differences between public game lands and private lands.

Red fox observation rates within the past 5 years were significantly lower in the mountain FMU (1.5 gray fox per 1,000 hours) than the coastal and piedmont FMUs (3.3 gray fox per 1,000 hours, P<0.01, Figure 23). There was not significant difference in observation rates between the coastal and piedmont FMUs (P=0.49). Within the past 7 years, there is also no significant evidence that statewide (P=0.30) or regional observation (P>0.05) rates have changed over time. Regional annual estimates are relatively imprecise generally due to the scarcity of observations.

Within the past 5 years, annual county estimates did not maintain consistent precision (average PSE 53.9%) primarily due to low observation rates and were only adequate enough to map distributions at the regional scale (Figure 24).

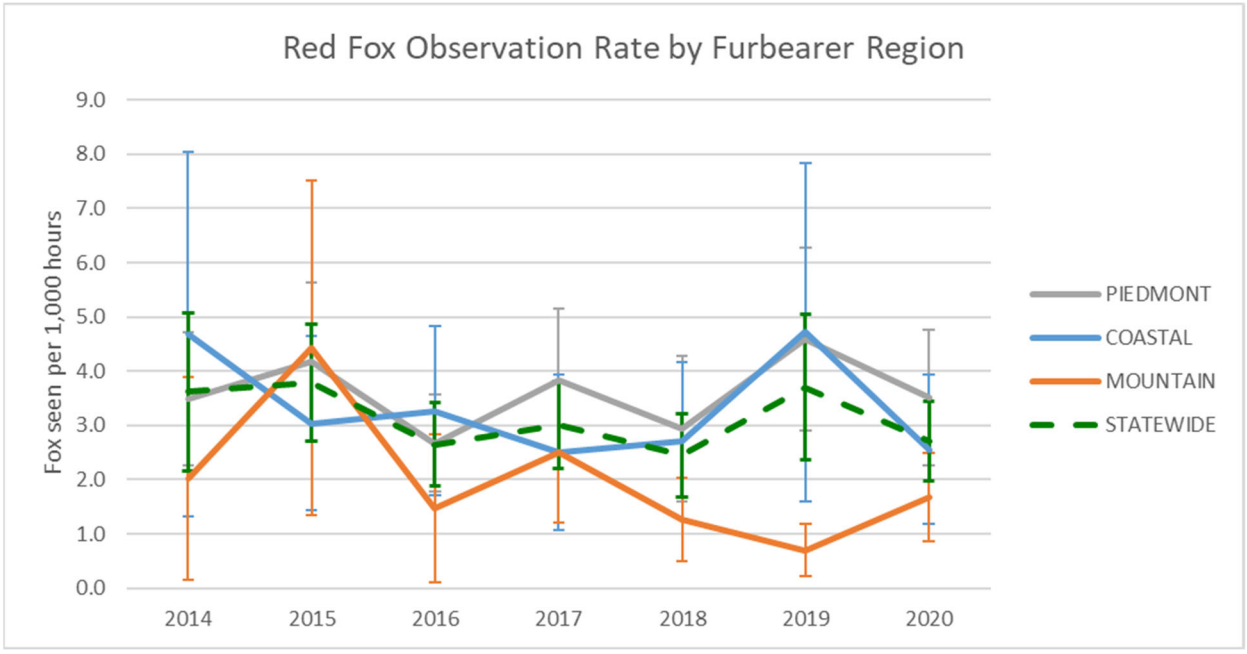

Figure 23. Annual red fox observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B12.

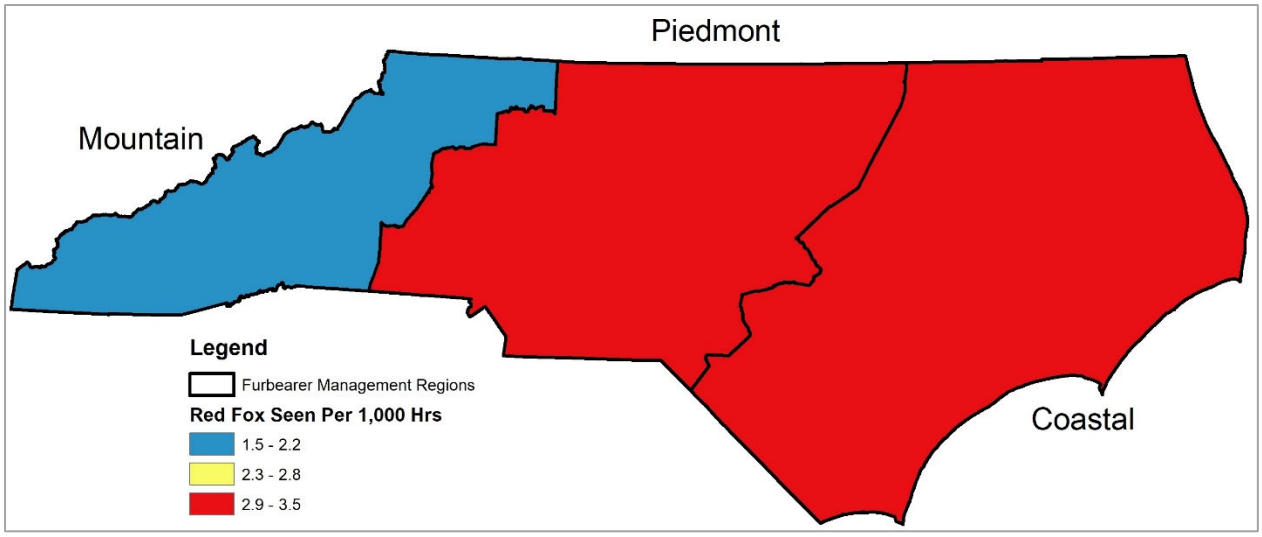

Figure 24. Red fox observation rates by furbearer management unit based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Bobcat

Observations of bobcat have generally followed their statewide range and were seen in 98 of the 100 counties. Bobcat observations were relatively rare (3.3 bobcat per 1,000 hours, Table 4). There is no significant evidence that baited sites has any influence on bobcat observation rates (P=0.85), as compared to coyotes or gray fox (Table 5). Location type analyses show significant evidence that observation rates are significantly higher on private lands than on game lands (Table 6). These comparisons were relatively imprecise due to the low availability of observations, but significant differences are likely the result of higher harvest rates and/or habitat differences between public game lands and private lands.

Bobcat observation rates within the past 5 years were significantly different between each of the furbearer management FMUs (P<0.05). Observation rates were highest in the coastal FMU (4.6 bobcat per 1,000 hours), followed by the mountain FMU (3.4 bobcat per 1,000 hours), and lowest in the piedmont FMU (1.9 bobcat per 1,000 hours) (Figure 25). There has been no evidence that statewide or regional observation rates have changed over time within the past 7 years (P>0.05).

Within the past 5 years, annual county estimates did not maintain consistent precision (average PSE 53.2%) primarily due to low observation rates and were only adequate enough to map distributions at the regional scale (Figure 26).

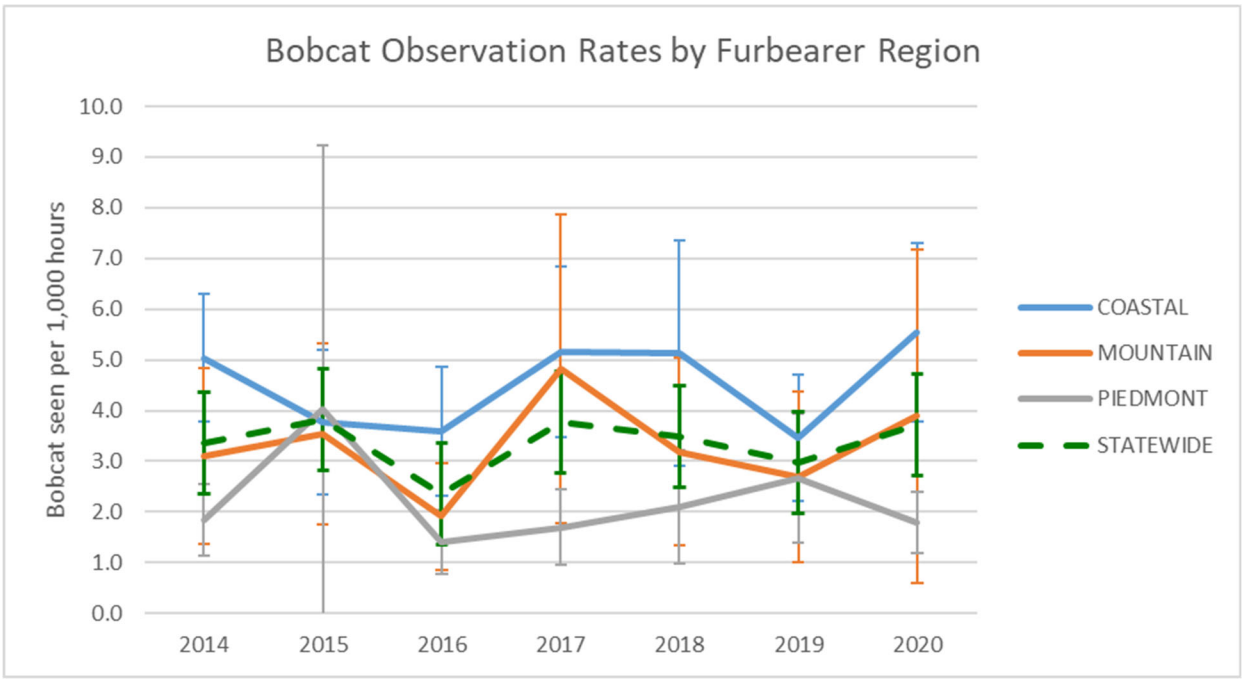

Figure 25. Annual bobcat observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B13.

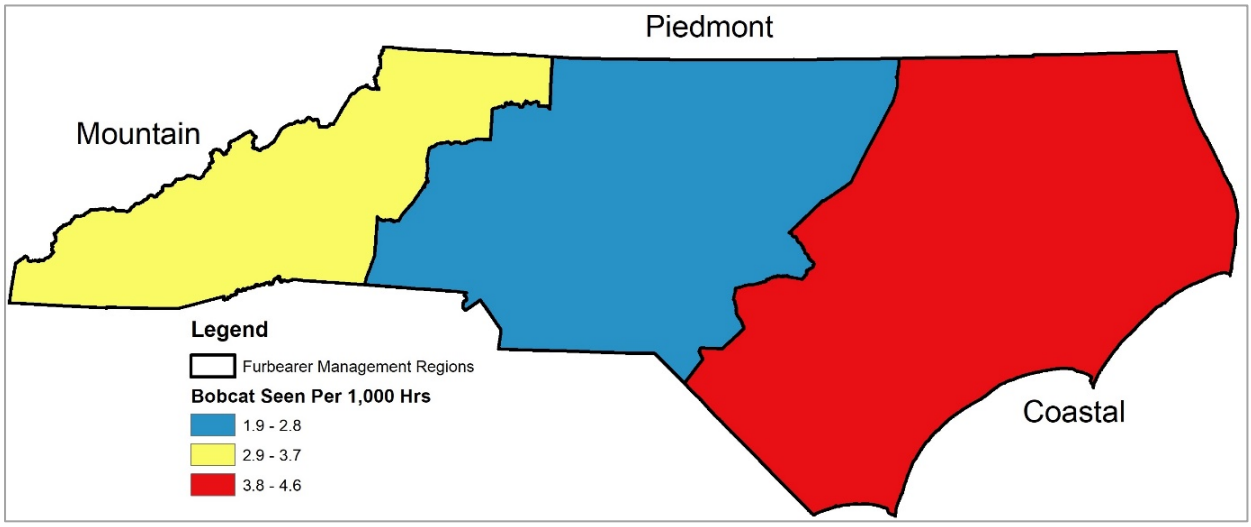

Figure 26. Bobcat observation rates by furbearer management unit based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

Bear

Adult bears were observed in 78 of the 100 counties. Bear observations were relatively rare (12.1 adult bears per 1,000 hours and 6.2 cub bears per 1,000 hours, Table 4). There was no significant evidence that the use of bait had any influence on adult bear observation rates, but significantly small increases in rates were found for cub bears (Table 5). There is no significant evidence that location type had any influence on either adult or cub bear observation rates by deer hunters (Table 6).

The bulk of the bear observations within the past 5 years occurred in the Coastal Bear Management Unit (CBMU) and observation rates were significantly higher in the CBMU (28.5 adult bears per 1,000 hours) versus the other two bear management units (2.5 adult bears per 1,000 hours $P<0.01$, Figure 27). There was not significant difference in observation rates between the mountain and piedmont management units ($P=0.11$). While there is a well-established bear population in the Mountain Bear Management Unit (MBMU), the bear population in the MBMU is lower than the CBMU, likely resulting in fewer observations. In addition, the more open habitat (e.g., agricultural fields), coupled with the more widespread use of bait also resulted in higher bear observation rates in the CBMU vs. the MBMU. There is no statistical evidence that statewide observation rates have changed over time within the past 7 years ($P>0.05$). However adult bear observation rates have significantly increased in the MBMU ($P<0.01$).

Within the past 5 years, annual county estimates did not maintain consistent precision (average PSE 52.4%) and were only adequate enough to map distributions at the regional scale. (Figure 28). Counties along the border of population ranges often exhibited high imprecision due to the scarcity of observation occurrences. Observations of adult bears generally followed their known presence within counties across the state, including the Piedmont Bear Management Unit (PBMU), which are a combination of transient or new colonized young males and an expanding bear population, especially along the Virginia and North Carolina state line (Figure 29). Cubs of the year were observed in 58 of the 100 counties (Figure 30). The presence of cub bears is used to determine the establishment of a locally reproducing and established bear population. Hunter observations of cubs generally followed the known presence of bears across the state, including the upper PBMU.

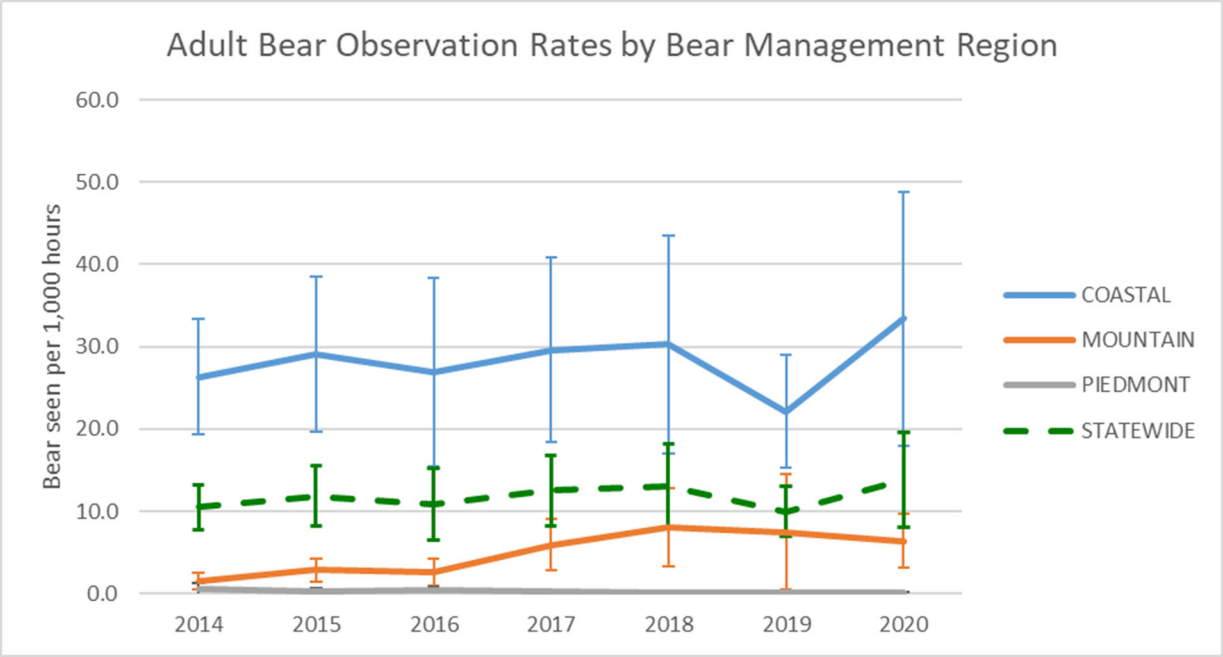

Figure 27. Adult bear observation rates by bear management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B14.

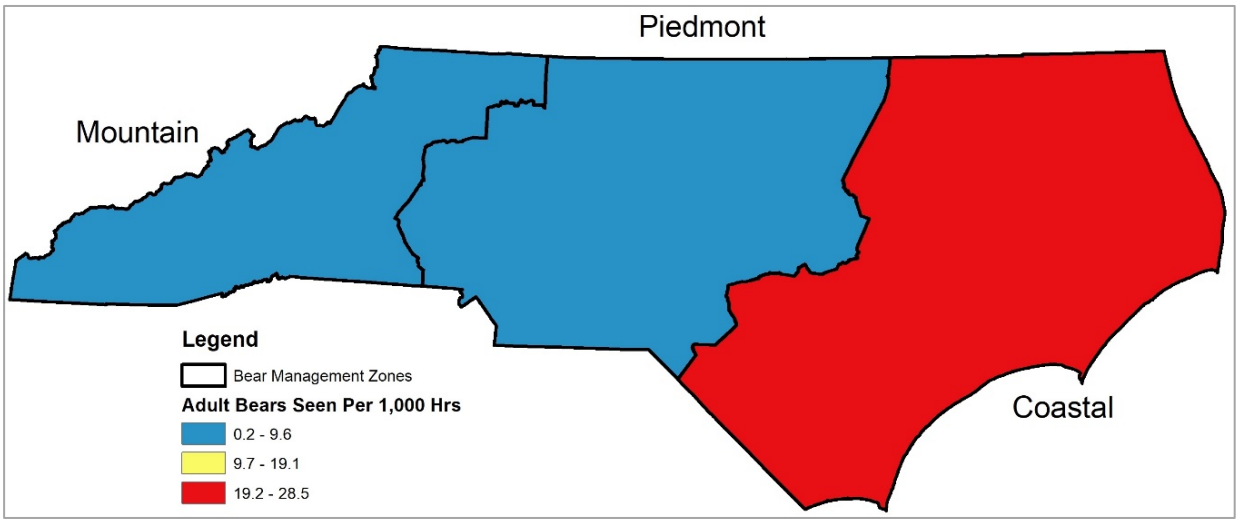

Figure 28. Adult bear observation rates by bear management unit based on 5-year averages, North Carolina Deer Hunter Observation Survey, 2016-2020.

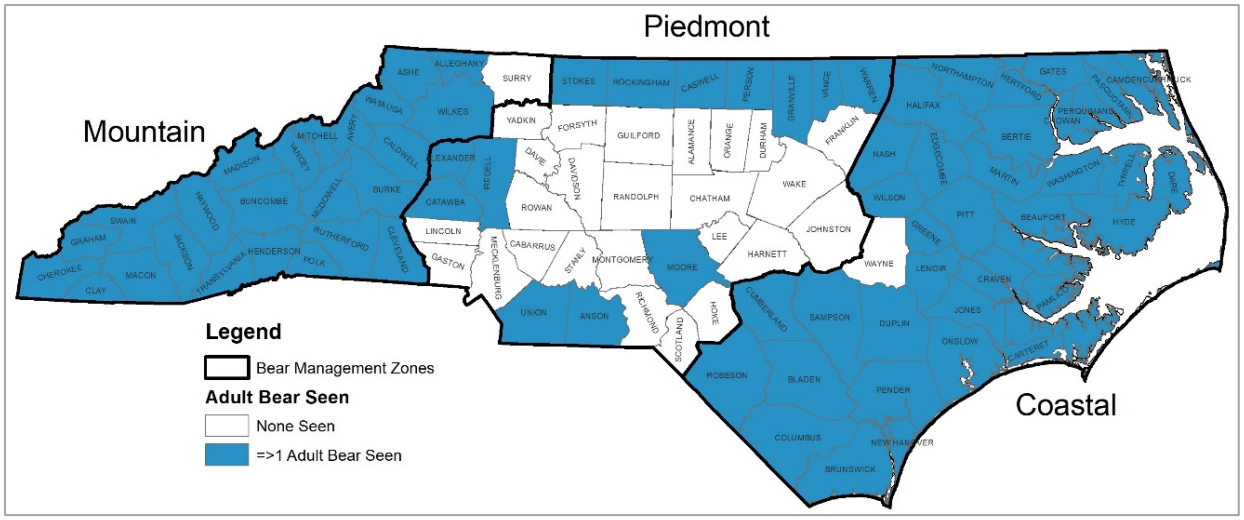

Figure 29. Adult bear presence (≥1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2016-2020.

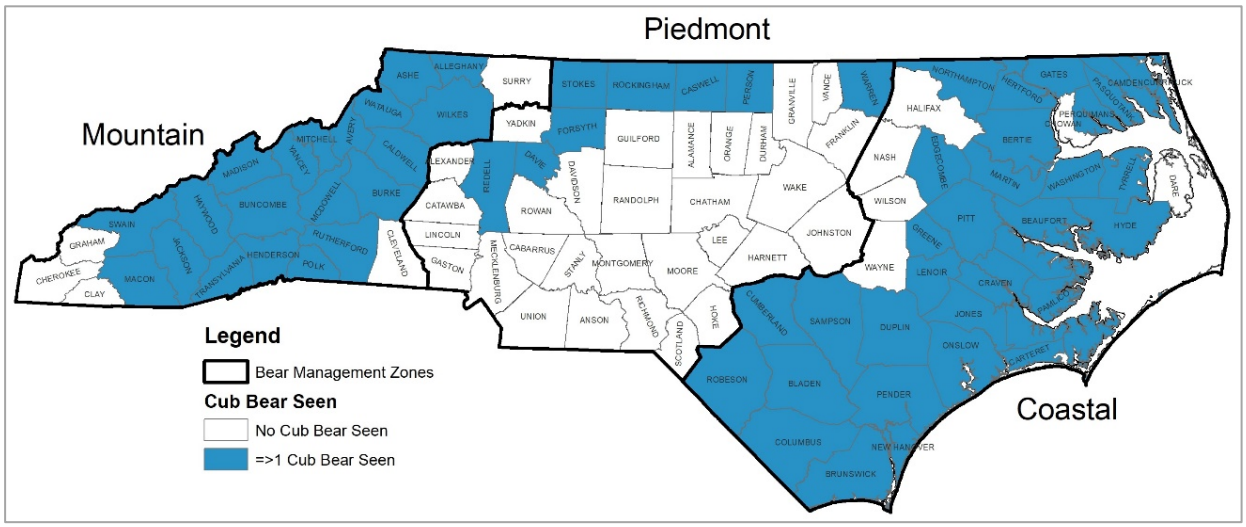

Figure 30. Cub bear presence (≥1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2016-2020.

Feral Swine

Swine were observed in 54 of the 100 counties and statewide observation rates were relatively low (2.7 feral swine per 1,000 hours). Confident observation rate estimates could not be derived due the relatively low observation count and high variability due to swine's herding behavior. There was no significant evidence that the use of bait or location type had any influence on swine observation rates (Table 5). However, a majority of observations occurred on game lands where baiting is prohibited (Table 6).

For the purposes of this section, analyses were limited to the occurrence of the species (≥1 feral swine seen per hunting trip, Figure 31). Within the past 5 years, there has been no evidence that statewide occurrence rates have changed over time. Occurrences of feral swine generally followed their known presence within most counties across the state (Figure 32).

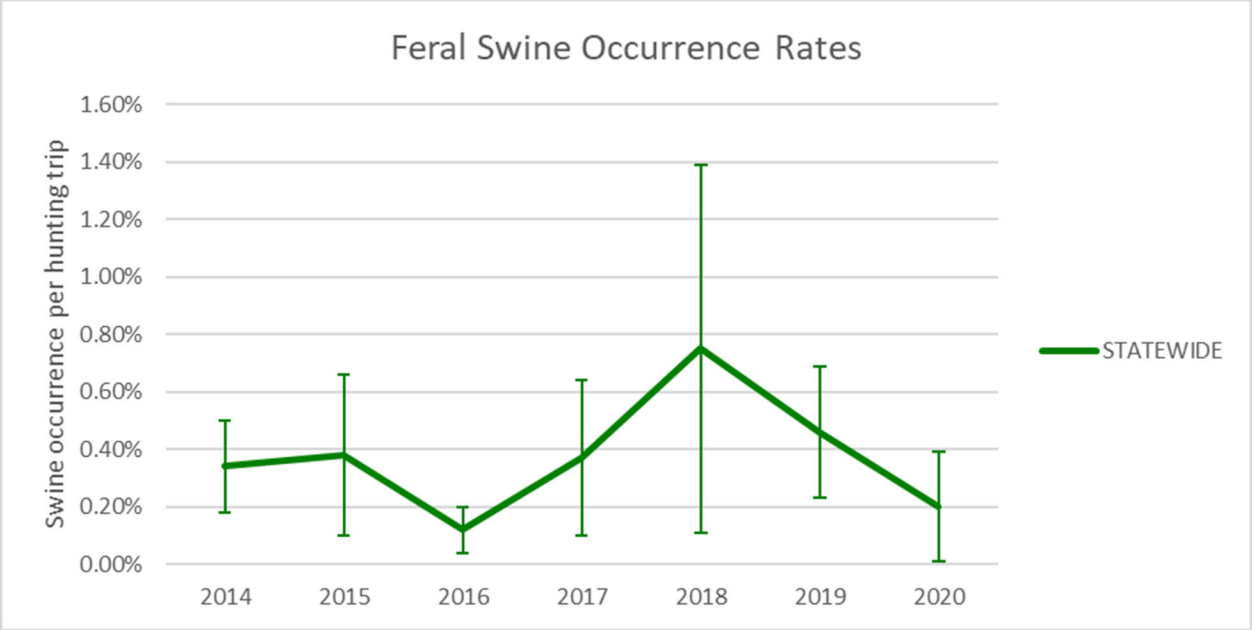

Figure 31. Feral swine occurrence rates (≥ 1 animal seen per hunting trip) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020. For the raw data used for this chart, see Appendix B15.

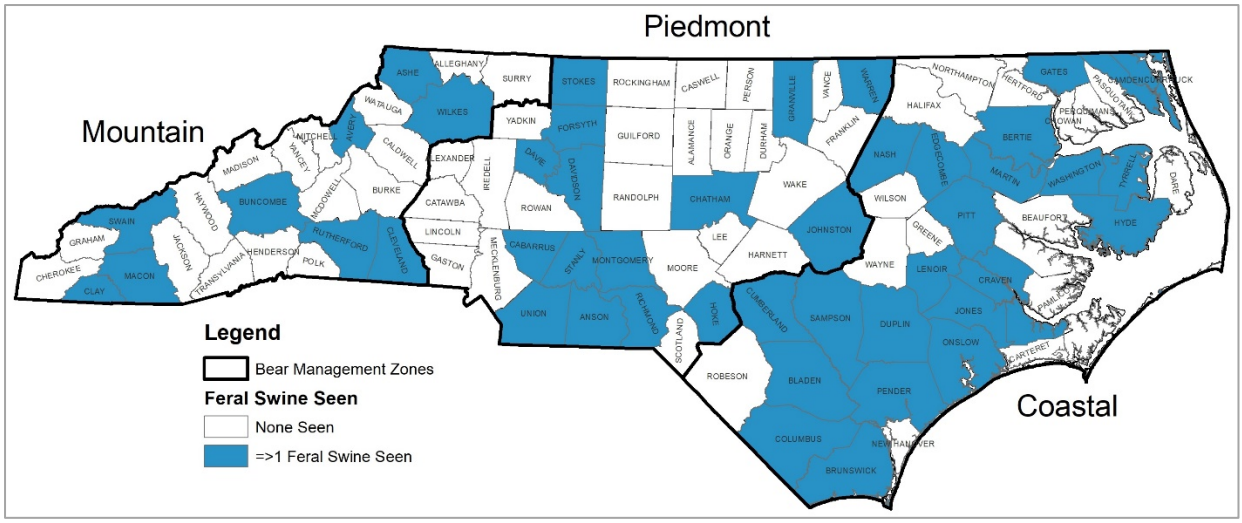

Figure 32. Feral swine presence (≥1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2016-2020.

Appendix A: Deer Hunter Observation Survey Form

Thank you for taking an active part in the conservation of North Carolina's wildlife resources!

Do you know of other deer hunters who would like to participate in the Deer Hunter Observation Survey?
If so, please enter their information in the block below.

(name)
(address)
(city/state/zip)
(WRC Customer #)

«CustomerID»
«First_Name» «Middle_Name» «Last_Name» «Suffix»
«Address_1_»
«Address_2_»
«City» «State_» «Zip» «Zip_4»

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RALEIGH NC 27690-4620

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INSTRUCTIONS

The NC Wildlife Resources Commission is seeking volunteers to report wildlife observations this deer season to help biologists improve management decisions. These observations help track long-term wildlife population and distribution changes. Deer observations also provide information on fawn survival and buck to doe ratios.

Observations should only be recorded while *still/stand hunting* for deer. Please attempt to provide an accurate count for the animals listed in the table on the front of this form. Record observations from each hunt (morning, evening, or daily) on a single row on the table. Separate morning and evening hunts on different rows for the same day, when applicable. Record all the animals you observe on each hunt, even if you suspect you have seen some of them on previous hunts. Record hours spent hunting even if no animals were observed. Do not record observations of others with whom you hunted.

Please return this form immediately after the deer season (no later than January 15). To return, *fold* this form along the lines above so that the Business Reply Mail address shows and *tape* on the areas indicated. If you have any questions about this survey, please call Ryan Myers at (919)218-3376, or email at ryan.myers@ncwildlife.org.

Tape here *Tape here*

Deer Hunter Observation Survey

North Carolina Wildlife Resources Commission

Please see instructions on the back of this form. Return this form immediately after your last hunt of the deer season.

					Deer				Squirrels		Turkey								Bear			
Date	Hours Hunted	County	Location*	Hunt with Bait	Antlered Buck	Adult Doe	Button Buck/ Doe Fawn	Unknown	Gray Squirrel	Fox Squirrel	Bearded	No Beard	Unknown	Coyote	Bobcat	Gray Fox	Red Fox	Raccoon	Adult	Cub	Feral Swine	Other Animals & Number Seen**
10/8/17	2.5	Example	GL / (PVT)	Yes / (No)		1	2		10						1							Armadillo : 1
			GL / PVT	Yes / No																		
			GL / PVT	Yes / No																		
			GL / PVT	Yes / No																		
			GL / PVT	Yes / No																		
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			GL / PVT	Yes / No																		

*Location types: GL=Game Lands, PVT = Private Land or other property not in the NC Game Lands Program

**Other animals of survey interest include: *armadillo, domestic cat, elk, mink, red squirrel, spotted skunk, and weasel*

Appendix B: Raw data tables

Table B1. Statewide deer observation rates and ratios by month, North Carolina Deer Hunter Observation Survey, 2016-2020.

Month	Deer/Hour	95% CI	Does/Buck	95% CI	Fawn/Doe	95% CI
September	0.78	±0.06	2.52	±0.14	0.61	±0.05
October	0.84	±0.08	2.44	±0.08	0.55	±0.01
November	0.82	±0.07	1.97	±0.10	0.49	±0.01
Dec./Jan.	0.74	±0.06	3.11	±0.21	0.51	±0.02

Table B2. Annual deer observation rates (# of deer seen per 1,000 hours) by deer season zone, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	403.5	±84.5	702.1	±91.3	693.7	±55.5	826.6	±80.1	754.0	±65.9	695.9	±34.1
2015	534.0	±150.5	737.2	±58.5	781.6	±79.7	986.3	±101.3	790.2	±90.0	786.7	±44.5
2016	481.7	±122.5	623.3	±61.4	624.0	±71.1	866.4	±87.8	684.1	±87.2	675.7	±39.4
2017	456.2	±83.7	724.8	±65.1	781.7	±63.9	995.1	±100.4	753.9	±82.8	756.7	±37.4
2018	526.6	±106.9	831.8	±85.8	888.4	±71.3	1,002.1	±109.1	939.8	±148.9	854.3	±51.9
2019	540.4	±79.2	858.3	±72.9	967.4	±89.5	1,021.4	±107.9	951.0	±100.9	883.4	±43.0
2020	540.9	±86.7	856.0	±82.6	805.4	±63.7	1,054.5	±124.2	844.0	±96.0	833.3	±44.0
Avg.	497.6	±39.1	761.9	±66.1	791.7	±84.7	964.6	±62.6	816.7	±74.1	783.7	±58.5

Table B3. Annual fawn per doe observation rates by deer season zone with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	0.52	±0.07	0.57	±0.05	0.58	±0.04	0.53	±0.03	0.48	±0.03	0.53	±0.02
2015	0.58	±0.06	0.60	±0.03	0.59	±0.04	0.46	±0.04	0.49	±0.04	0.53	±0.02
2016	0.50	±0.07	0.56	±0.04	0.58	±0.04	0.55	±0.05	0.44	±0.05	0.52	±0.02
2017	0.35	±0.05	0.59	±0.04	0.56	±0.03	0.51	±0.03	0.44	±0.04	0.49	±0.02
2018	0.44	±0.06	0.57	±0.04	0.60	±0.03	0.47	±0.04	0.43	±0.04	0.49	±0.02
2019	0.41	±0.05	0.57	±0.04	0.56	±0.03	0.47	±0.04	0.51	±0.04	0.50	±0.02
2020	0.47	±0.06	0.56	±0.04	0.62	±0.03	0.48	±0.04	0.43	±0.04	0.50	±0.02
Avg.	0.47	±0.06	0.57	±0.01	0.59	±0.02	0.50	±0.03	0.46	±0.00	0.51	±0.01

Table B4. Annual adult doe per antlered buck observation rates by deer season zone with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	2.41	±0.25	2.00	±0.10	2.11	±0.09	2.45	±0.08	2.84	±0.11	2.41	±0.05
2015	2.65	±0.21	2.54	±0.10	2.14	±0.09	2.53	±0.10	2.68	±0.11	2.49	±0.05
2016	2.11	±0.20	2.07	±0.10	1.96	±0.10	2.22	±0.09	2.47	±0.12	2.18	±0.05
2017	2.76	±0.20	2.28	±0.10	2.05	±0.07	2.52	±0.08	2.46	±0.09	2.36	±0.04
2018	2.54	±0.18	2.24	±0.09	2.21	±0.08	2.14	±0.07	2.25	±0.09	2.22	±0.04
2019	2.61	±0.18	2.04	±0.08	1.96	±0.07	2.47	±0.09	2.61	±0.10	2.27	±0.04
2020	2.29	±0.15	2.01	±0.08	2.17	±0.08	2.43	±0.09	2.53	±0.10	2.28	±0.04
Avg.	2.48	±0.17	2.17	±0.15	2.09	±0.07	2.39	±0.11	2.55	±0.00	2.32	±0.08

Table B5. Annual statewide gray squirrel observation rates (# of gray squirrels seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	STATEWIDE	95% CI
2014	665.2	±36.9
2015	742.0	±40.7
2016	755.2	±44.1
2017	868.4	±45.3
2018	777.6	±41.1
2019	734.8	±38.4
2020	780.1	±43.5
Avg.	760.5	±45.3

Table B6. Annual statewide fox squirrel observation rates (# of fox squirrels seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	STATEWIDE	95% CI
2014	20.4	±4.5
2015	18.5	±4.8
2016	18.5	±4.4
2017	15.8	±3.2
2018	15.8	±3.1
2019	16.4	±3.5
2020	19.9	±3.8
Avg.	17.9	±1.4

Table B7. Annual turkey observation rates by turkey management region intervals (# of turkeys seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	326.2	±127.7	243.6	±39.4	384.2	±61.1	315.9	±39.6
2015	413.6	±111.4	211.8	±27.6	504.3	±129.0	368.1	±57.1
2016	341.2	±101.8	210.9	±31.7	427.0	±76.7	319.8	±38.5
2017	309.8	±81.1	210.4	±33.4	414.6	±77.9	310.9	±37.6
2018	344.8	±79.1	246.1	±32.3	474.6	±88.6	354.4	±40.4
2019	278.2	±52.9	231.4	±33.6	603.9	±101.2	381.4	±42.6
2020	249.0	±79.7	214.0	±31.8	521.0	±92.5	337.0	±41.8
Avg.	323.2	±39.1	224.0	±11.8	475.7	±55.6	341.1	±20.4

Table B8. Bearded per non-bearded turkey observation rates by turkey management region and year with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	0.42	±0.04	0.38	±0.02	0.37	±0.01	0.38	±0.01
2015	0.24	±0.02	0.32	±0.01	0.36	±0.02	0.31	±0.01
2016	0.29	±0.03	0.46	±0.02	0.43	±0.02	0.41	±0.01
2017	0.35	±0.02	0.40	±0.02	0.35	±0.01	0.37	±0.01
2018	0.27	±0.02	0.35	±0.02	0.40	±0.02	0.35	±0.01
2019	0.26	±0.02	0.28	±0.01	0.33	±0.01	0.30	±0.01
2020	0.28	±0.02	0.47	±0.02	0.53	±0.02	0.47	±0.01
Avg.	0.30	±0.05	0.38	±0.05	0.40	±0.05	0.37	±0.04

Table B9. Annual raccoon observation rates (# of raccoons seen per 1,000 hours) by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	13.8	±6.0	21.3	±4.9	41.5	±9.3	26.0	±4.1
2015	9.6	±3.7	15.3	±3.4	44.9	±15.4	26.5	±7.0
2016	10.2	±4.7	19.2	±5.3	39.9	±18.1	29.1	±10.0
2017	9.4	±4.0	21.9	±5.8	31.9	±6.2	28.9	±13.5
2018	20.1	±8.9	21.4	±4.7	51.0	±13.3	30.9	±5.8
2019	12.1	±4.0	20.2	±4.9	35.5	±8.1	26.2	±4.8
2020	10.1	±3.7	14.2	±3.7	44.8	±13.7	24.6	±5.4
Avg.	12.2	±2.8	19.1	±2.3	41.3	±4.7	27.5	±1.6

Table B10. Annual coyote observation rates (# of coyotes seen per 1,000 hours) by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	12.0	±5.0	14.6	±3.0	18.0	±3.7	15.3	±2.2
2015	10.2	±2.9	12.2	±2.2	15.9	±7.8	13.2	±3.2
2016	7.7	±2.7	14.6	±3.2	11.9	±3.7	12.1	±2.0
2017	18.4	±11.8	15.7	±3.0	13.0	±3.1	15.3	±3.3
2018	13.8	±10.3	13.1	±2.7	13.1	±4.0	13.2	±3.1
2019	12.9	±9.9	13.1	±3.3	11.9	±3.4	12.6	±3.0
2020	10.9	±5.3	13.9	±3.5	9.5	±2.6	11.5	±2.1
Avg.	12.3	±2.5	13.9	±0.9	13.3	±2.1	13.3	±1.1

Table B11. Annual gray fox observation rates (# of gray fox seen per 1,000 hours) by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	2.7	±2.5	11.5	±3.4	14.7	±3.5	10.8	±2.0
2015	1.4	±1.0	7.3	±2.0	12.1	±3.5	7.9	±1.6
2016	0.4	±0.4	7.4	±2.0	10.6	±3.1	7.2	±1.5
2017	1.5	±0.7	8.0	±4.2	8.0	±2.2	6.5	±1.8
2018	2.8	±2.6	9.7	±2.5	10.0	±3.7	8.2	±1.8
2019	1.7	±1.0	6.6	±2.1	7.4	±2.5	5.7	±1.3
2020	1.4	±1.1	8.7	±2.5	6.4	±2.6	6.1	±1.4
Avg.	1.7	±0.6	8.5	±1.2	9.9	±2.1	7.5	±1.3

Table B12. Annual red fox observation rates (# of red fox seen per 1,000 hours) by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	2.0	±1.9	3.5	±1.2	4.7	±3.4	3.6	±1.5
2015	4.4	±3.1	4.2	±1.5	3.0	±1.6	3.8	±1.1
2016	1.5	±1.4	2.7	±0.9	3.3	±1.6	2.7	±0.8
2017	2.5	±1.3	3.8	±1.3	2.5	±1.4	3.0	±0.8
2018	1.3	±0.8	2.9	±1.3	2.7	±1.5	2.5	±0.8
2019	0.7	±0.5	4.6	±1.7	4.7	±3.1	3.7	±1.3
2020	1.7	±0.8	3.5	±1.3	2.6	±1.4	2.7	±0.7
Avg.	2.0	±0.9	3.6	±0.5	3.4	±0.7	3.1	±0.4

Table B13. Annual bobcat observation rates (# of bobcat seen per 1,000 hours) by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	3.1	±1.7	1.8	±0.7	5.0	±1.3	3.4	±0.7
2015	3.5	±1.8	4.0	±5.2	3.8	±1.4	3.8	±2.2
2016	1.9	±1.1	1.4	±0.6	3.6	±1.3	2.4	±0.6
2017	4.8	±3.0	1.7	±0.8	5.2	±1.7	3.8	±1.0
2018	3.2	±1.9	2.1	±1.1	5.1	±2.2	3.5	±1.0
2019	2.7	±1.7	2.7	±1.3	3.5	±1.2	3.0	±0.8
2020	3.9	±3.3	1.8	±0.6	5.6	±1.8	3.7	±1.1
Avg.	3.3	±0.7	2.2	±0.7	4.5	±0.7	3.4	±0.4

Table B14. Adult bear observation rates (# of bear seen per 1,000 hours) by bear management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	MOUNTAIN	95% CI	PIEDMONT	95% CI	COASTAL	95% CI	STATEWIDE	95% CI
2014	1.5	±1.1	0.6	±0.7	26.3	±7.0	10.5	±2.7
2015	2.9	±1.4	0.3	±0.4	29.1	±9.5	11.9	±3.7
2016	2.6	±1.6	0.4	±0.5	26.9	±11.4	10.8	±4.4
2017	5.9	±3.1	0.2	±0.2	29.6	±11.2	12.5	±4.3
2018	8.1	±4.8	0.2	±0.1	30.3	±13.2	13.1	±5.0
2019	7.5	±7.0	0.1	±0.1	22.2	±6.8	10.0	±3.1
2020	6.4	±7.0	0.1	+0.1	33.4	±15.4	13.8	±5.7
Avg.	5.0	±1.9	0.3	±0.1	28.3	±2.6	11.6	±1.1

Table B15. Feral swine occurrence rates (≥ 1 swine seen per hunting trip) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2020.

Year	STATEWIDE	95% CI
2014	0.33%	±0.16%
2015	0.37%	±0.28%
2016	0.12%	±0.08%
2017	0.36%	±0.26%
2018	0.70%	±0.57%
2019	0.41%	+0.20%
2020	0.20%	±0.19%
Avg.	0.37%	±0.15%