Deer Hunter Observation Survey
2014-2017

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Abstract

An annual North Carolina Deer Hunter Observation Survey (DHOS) was conducted to provide an economical and statistically robust means of monitoring the relative observation rates of several game species. During the 4 deer hunting seasons from 2014-2017, volunteer deer hunters recorded wildlife observations on 105,683 hunting trips encompassing 364,238 observation hours. Gray squirrels, deer and turkeys were the most commonly observed animals. Statewide, hunters averaged seeing 0.7 deer per hunting hour. Results include annual observation rate estimates for deer recruitment (fawn per doe) and the effect of bait on various animal types. Trend estimates are more precise for commonly observed animal types, but estimates remain weak for most furbearers, bear, and feral swine.

The North Carolina Wildlife Resources Commission (NCWRC) initiated an annual volunteer deer hunter observation survey (DHOS) starting in 2014. Hunters were asked to record their daily observations of deer and other wildlife while still-hunting for deer during the fall hunting season. The primary objective of the DHOS was to provide an independent, non-harvest based supplement to other harvest data collected by the NCWRC. This project develops a long-term database for monitoring and evaluating an index of species activity (rate of species observation). Analyses provide insight into spatial differences and temporal changes within wildlife abundance and occurrences across North Carolina.

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 estimates at varying spatial scales for many species. Still-hunting from stand locations provides an ideal sampling scenario for detecting and counting most wildlife species within relatively comparable sized area (area located around a hunting stand). When combined with measure of time (hours hunted), observation records can provide a relatively standardized measure of sampling effort. Volunteer hunter observation projects continue to be 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 con-current 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 (Fig. 1).
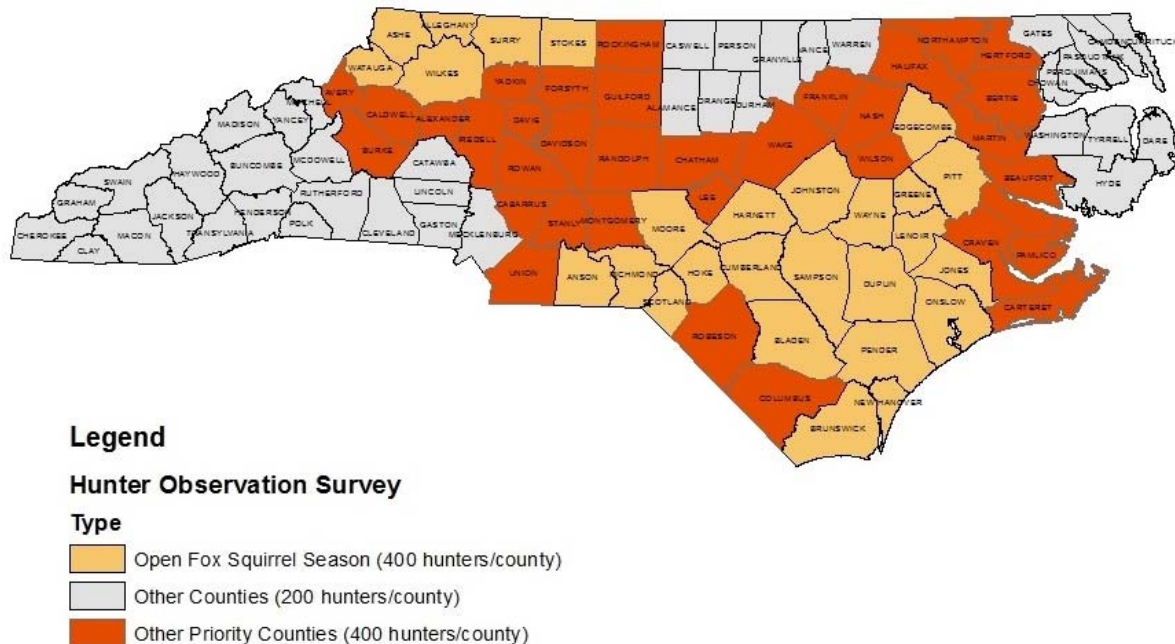

Figure 1. Survey participant recruitment efforts and sampling design, North Carolina Deer Hunter Observation Survey, 2014.

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 (i.e. deer fawn recruitment), all deer hunters across the state were invited to participate in following years. Annual survey mailings incorporated the previous season respondents and any additional volunteer signups. At the time of writing this report, 5,779 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 in early September, just before the start of the archery deer season, and the survey observation period was open until December 31. 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.

Hunters were asked to record the date they hunted, county, number of hours, location type, and use of bait, and the number of animal types on the survey table. Hunters were instructed to

separate morning and evening hunts when applicable. "Location type" was categorized into two options: 1) Game Lands – which included are 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, button buck & doe fawn deer, unknown deer, gray squirrel, fox squirrel, bearded turkey, no beard turkey, unknown turkey, 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.

Sampling Unit Refinement: Hunter observation records for each *hunter-county-location-bait* scenario were averaged into refined sampling units within each hunting season (Table 2). A sampling unit refinement process was necessary to reduce the effects of pseudoreplication within the submitted observation records. Pseudoreplication often occurs when some hunters remain in the same hunting stand for multiple days and often repeatedly count the same individual animals each day. Conversely, other hunters may move hunting stands more frequently and observe new areas with different animals. 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 to obtain a single independent sampling unit. If a different hunter also 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 combination decreases sample size and increases variance in some cases, but provides a conservative statistic based on truly independent samples.

Survey Data Access and Storage: 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 parameters (e.g. year, location type, date range within season, use of bait) and to produce basic survey summaries outputs at any desired scale (e.g. state, regional or county). For the purposes of this report, most results and analyses were limited to the statewide or management region scale.

Results

Approximately 105,683 hunting trips encompassing over 364,238 observation hours were reported by ~1,000 hunters each year during the 2014-2017 hunting seasons (Table 2). Most trips and observation hours occurred on private lands (100,005 trips, 336,449 hours hunted) compared to game lands (4,254 trips, 21,222 hours hunted). Use of bait by hunters was relatively consistent across years. Baiting was reported on approximately half the hunting trips on private lands, but was not reported on game lands where its use is prohibited.

Hunters reported an average of 20 hunts per year and hunted ~3.4 hours per hunt during the 114-day survey seasons.   Each hunter provided an average of ~2.3 sampling units per season. Total animal counts by year are presented below (Table 3). Other animals reported included (listed in descending order): rabbits, domestic cats, crows, hawks, doves, opossums, ducks, owls, skunks, groundhogs, chipmunks, and quail.

Table 2. Statewide total survey responses, North Carolina Deer Hunter Observation Survey, 2014-2017.

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	73	21	3.6	3,438
2015	1,385	26,498	92,206	67	19	3.5	3,136
2016	987	20,070	68,134	69	20	3.4	2,274
2017	1,699	31,567	106,053	62	19	3.4	3,610
			Average	**68**	**20**	**3.4**	

Table 3. Statewide total counts of animals observed, North Carolina Deer Hunter Observation Survey, 2014-2017. 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	34,123	47,956	15,751	5,587	69,294
2015	13,692	35,447	49,139	17,377	5,766	72,281
2016	9,901	22,388	32,288	10,581	3,809	46,679
2017	17,005	41,936	58,941	19,345	6,623	84,909

Year	Gray Squirrel	Fox Squirrel	Total Squirrels
2014	62,713	1,994	64,707
2015	69,225	1,549	70,774
2016	51,747	1,159	52,907
2017	89,997	2,071	92,068

Year	Bearded Turkey	No Beard 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	6,782	18,600	25,382	8,986	34,368

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	1,470	298	712	279	2,666

Year	Bear Adult	Bear Cub	Feral Swine
2014	791	468	410
2015	724	385	183
2016	401	184	86
2017	666	385	276

Based on 2017 sample counts, most sampling unit responses originated from counties within the central part of the state. (Figure 2). The unbalanced distribution between counties was likely a combination of the original 2014 participant recruitment mailings and regionally-specific distribution efforts by district biologists, and actual hunter distribution across the state. When calculating regional and statewide estimates, sampling units were weighted by county to balance for the effect of unequal sampling effort. Counties with less than 3 sampling units per year were excluded from regional and statewide analyses.
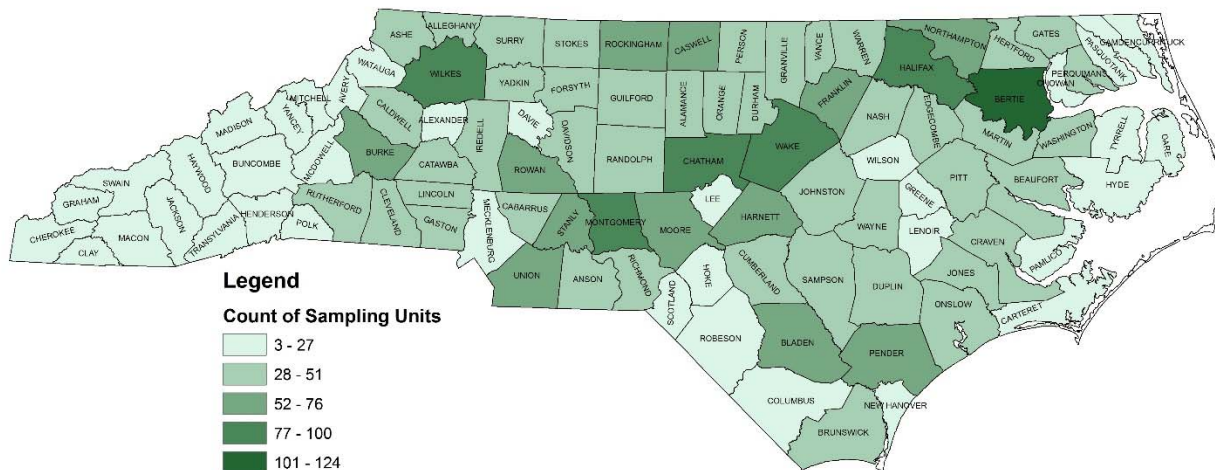

Figure 2. Total number of sampling unit responses, North Carolina Deer Hunter Observation Survey, 2017.

Data were analyzed to determine the effects by year, county, location type, and use of bait for each animal type category over the 4-year period. For mapping purposes in this report, figures are based on 4-year annual averages.

Observation rates were standardized for each of the 17 animal types to reflect the number of observations per 1,000 hours hunted in North Carolina (Table 4). 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, deer, and wild turkeys was high: confidence limits were generally within ±15% of the mean estimate 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 reduced scales.

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.

Table 4. Species observation rates, North Carolina Deer Hunter Observation Survey, 2014-2017. Statewide mean estimates derived from annual state averages. Parentheses indicate a 95% interval.

Animal Type	Animals seen per 1,000 hours	
Gray Squirrel	765.6	(±146.8)
All Deer *(including unknown age/sex)*	745.2	(±101.1)
Doe Deer	367.6	(±53.5)
All Turkey *(including unknown beard status)*	334.4	(±47.6)
Non-Bearded Turkey	169.0	(±33.4)
Fawn Deer	161.0	(±26.0)
Antlered Buck	147.4	(±11.3)
Bearded turkey	59.0	(±6.7)
Raccoon	27.2	(±2.9)
Fox Squirrel	17.7	(±2.8)
Coyote	14.1	(±2.3)
Adult Bear	11.7	(±1.9)
Gray Fox	8.3	(±3.0)
Cub Bear	5.7	(±0.9)
Red Fox	3.4	(±0.9)
Bobcat	3.4	(±0.8)
Swine	2.6	(±2.1)
Doe/Buck	2.45	(±0.22)
Fawn/Doe	0.58	(±0.04)
Bearded/Non-Bearded Turkey	0.36	(±0.07)
Fox Squirrel/Total Squirrel	0.04	(±0.01)

Since private land hunting trips comprised the majority of the sampling unit location types (91.9%, n=11,335), comparisons with game lands (8.1%, n=1,000) were not made. The use of bait was equally distributed within the data and remained fairly consistent across years (45%-51% hunts with bait per year). Baiting proved to be a significant factor within some animal types, after accounting for annual and county differences (Table 5).

Table 5. Species observation rates by use of bait, North Carolina Deer Hunter Observation Survey, 2014-2017. Statewide mean estimates derived from annual county averages. Parentheses indicate a 95% confidence interval.

Animal Type	Animals seen per 1,000 hours				P
	Bait		No Bait		
Gray Squirrel	**845.8**	**(+51.8)**	**682.8**	**(+38.3)**	**0.00**
All Deer *(including unknown age/sex)*	**759.8**	**(+40.2)**	**702.8**	**(+36.6)**	**0.04**
Doe Deer	369.6	*(+22.8)*	354.7	*(+20.4)*	0.34
All Turkey *(including unknown beard status)*	322.6	*(+32.2)*	331.4	*(+43.9)*	0.75
Non-Bearded Turkey	179.1	*(+22.6)*	150.6	*(+19.5)*	0.06
Fawn Deer	**179.4**	**(+11.6)**	**139.9**	**(+10.9)**	**0.00**
Antlered Buck	**149.5**	**(+8.9)**	**137.4**	**(+8.1)**	**0.05**
Bearded turkey	62.5	*(+7.4)*	55.2	*(+8.5)*	0.21
Raccoon	**34.4**	**(+7.4)**	**18.3**	**(+3.2)**	**0.00**
Fox Squirrel	16.2	*(+3.5)*	17.3	*(+3.6)*	0.65
Coyote	**11.5**	**(+1.5)**	**17.1**	**(+3.8)**	**0.01**
Adult Bear	12.3	*(+4.6)*	11.2	*(+3.1)*	0.70
Gray Fox	**9.3**	**(+1.6)**	**7.0**	**(+1.2)**	**0.02**
Cub Bear	6.2	*(+2.8)*	5.4	*(+1.9)*	0.63
Red Fox	3.3	*(+0.9)*	3.6	*(+0.9)*	0.72
Bobcat	2.9	*(+0.7)*	3.6	*(+1.0)*	0.29
Swine	**1.5**	**(+0.6)**	**3.1**	**(+1.4)**	**0.04**
Doe/Buck	**2.47**	**(+0.16)**	**2.72**	**(+0.15)**	**0.03**
Fawn/Doe	**0.62**	**(+0.03)**	**0.49**	**(+0.03)**	**0.00**
Bearded/Non-Bearded Turkey	0.48	*(+0.08)*	0.61	*(+0.13)*	0.10
Fox Squirrel/Total Squirrel	**0.03**	**(+0.01)**	**0.04**	**(+0.01)**	**0.01**

*significant differences indicated in bold (P<0.05).

Species Specific Results and Comments:

When looking at each of the following sections and charts, we caution against making direct comparisons between regional estimates for any species. Observation rates between regions can be biased by differences in many factors such as habitat, topography, land use, or any other factor affecting the sightability of animals. For each of the selected species, any differences between regions may NOT be entirely related to regional differences in population size.

Deer

Hunters were asked to report deer they saw according to four categories: Antlered Buck, Adult Doe, Doe Fawn/Button Buck, or Unknown. These observations provide a solid 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. Observation data complement other annual deer data sets (reported harvest, hunter harvest survey, biological data collections) that biologists rely on to manage the herd.

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 over time of year, and time of observations should be critically considered before assuming observations are an accurate depiction of population demographics (Figure 3). 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.
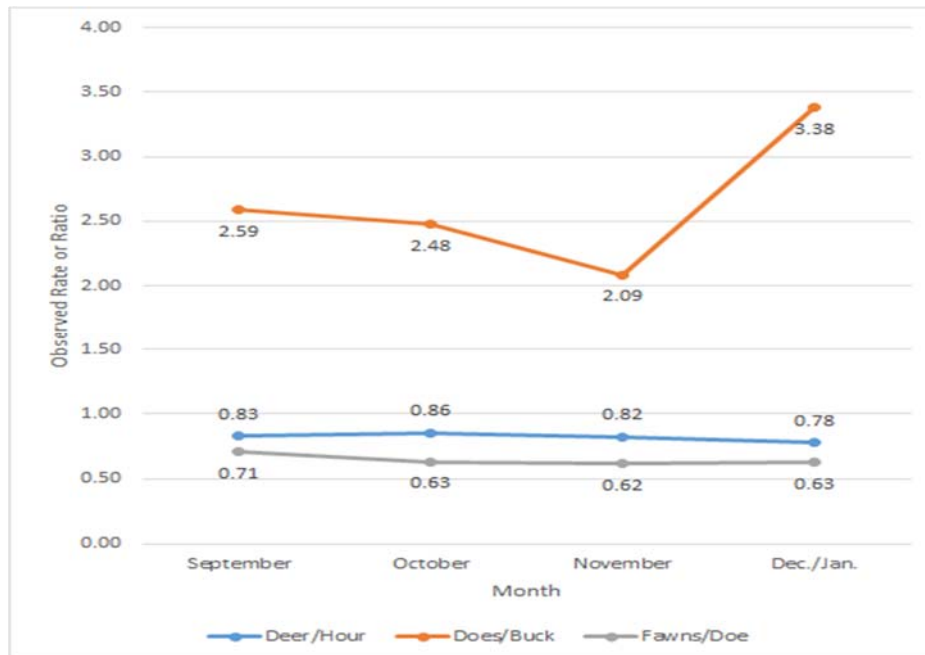
Figure 3. Deer observation rates and ratios by month, North Carolina Deer Hunter Observation Survey, 2014-2017. Deer observations vary over time of year due to changes in deer movements, hunter ability to detect and correctly identify types of deer, and deer harvest.

Observation Rates of Deer

Deer were the second most commonly observed animal type (745.2 deer per 1,000 hours) and were seen in all 100 counties (Figure 4). Adult does were seen at a higher rate (367.6 does per 1,000 hours), than either fawns (161.0 fawns per 1,000 hours), or antlered bucks (147.4 bucks per 1,000 hours). Significantly more deer were observed on stand locations with bait (759.8 per 1,000 hours, than without bait (702.8 deer per 1,000 hours) (Table X). Baited sites likely attract deer since they provide a direct food source.

The highest observation rates for deer occurred in the northeastern season zone (935.2 deer per 1,000 hours) and were lowest in the western season zone (461.9 deer per 1,000 hours). Statewide trends appear to be stable in all 4 deer season zones, but annual estimates remain imprecise. County estimates maintained relatively consistent observation rates across years, reliable enough to estimate recruitment for most counties (Figure 5). However, counties on far coast and far mountains exhibited a high amount of annual variation due to small sample sizes.

Deer observed per hour is slightly lower near the end of the deer hunting season when day length is short, and many deer have been harvested or exposed to hunting pressure. 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.
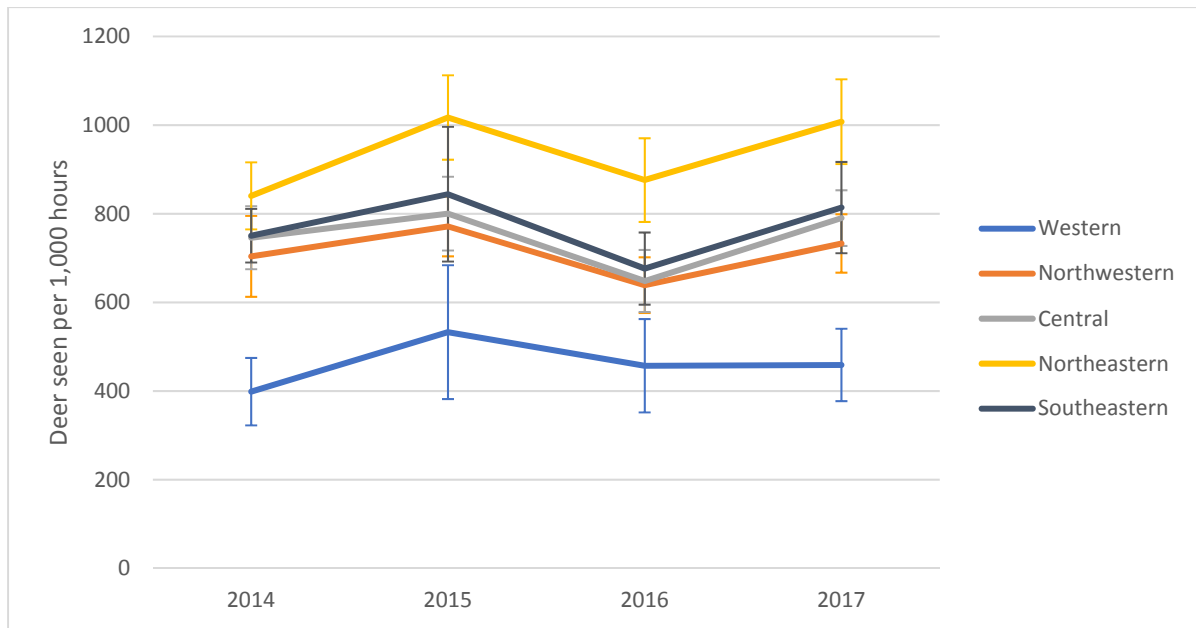
Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	398.6	76.1	703.8	91.3	745.9	71.0	840.2	75.6	750.4	60.4	707.8	33.4
2015	532.8	150.9	771.4	67.5	800.2	83.1	1,017.0	95.1	844.1	151.9	817.0	54.5
2016	457.1	105.3	638.8	62.9	648.2	70.0	875.9	94.4	676.3	81.3	678.1	38.4
2017	458.9	81.7	732.9	65.8	790.1	62.8	1,007.5	95.6	813.9	102.9	777.9	39.7
Avg.	461.9	53.9	711.7	54.8	746.1	68.0	935.2	88.5	771.2	72.8	745.2	62.3

Figure 4. North Carolina deer observation rates by deer season zone (# of deer seen per 1,000 hours), Deer Hunter Observation Survey, 2014-2017.
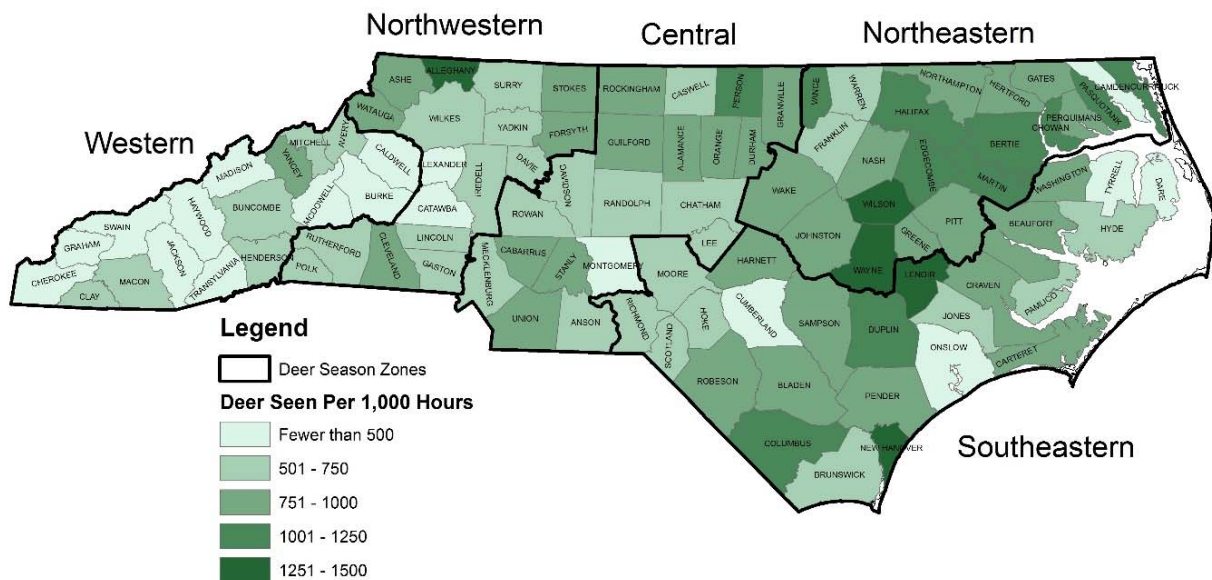

Figure 5. Deer observation rates by county, North Carolina Deer Hunter Observation Survey, 2014-2017.

Ratio of Fawns Per Doe

This ratio offers insight into deer population recruitment. The two main influences on this ratio are doe 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 into deer population dynamics.

Statewide, hunters observed 0.58 fawns for every adult (1.5+ years) doe on average. The observed fawn/doe ratio were highest in the Central and Northwestern zones (Figure 6). Statewide rates appeared to relatively stable across years and within most season zones. However considerable annual variation existed in the western season zone, with a notable decline noted over the past 4 years.

Baiting analyses suggest that the use of bait significantly increases the fawn per doe ratio by ~25% (0.62 fawns per doe with bait, 0.49 fawns per doe without bait). This appears to be influenced by fawns having a higher tendency to visit baited sites compared to adult does.

Annual county estimates maintained relatively consistent observation rates, reliable enough to estimate recruitment for most counties (Figure 7). However, several counties in the mountains and coast exhibited the highest amount of annual variation due to small sample sizes.
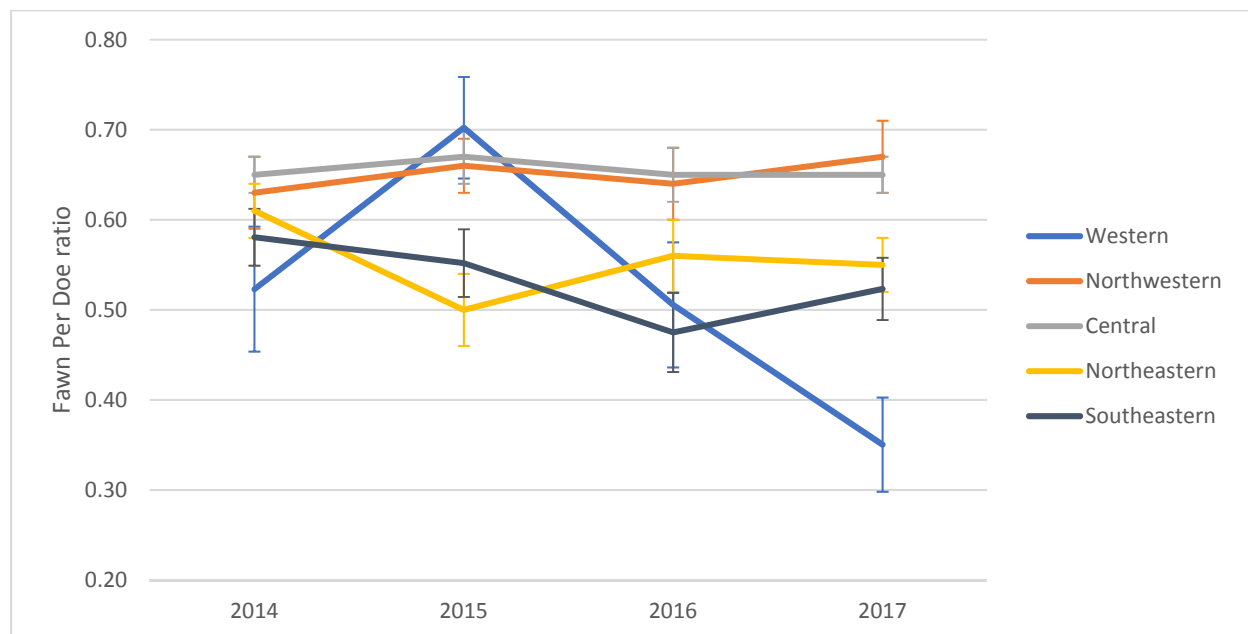
Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	0.52	0.07	0.63	0.04	0.65	0.03	0.61	0.03	0.58	0.03	0.59	0.02
2015	0.70	0.06	0.66	0.03	0.67	0.03	0.50	0.04	0.55	0.04	0.60	0.02
2016	0.51	0.07	0.64	0.04	0.65	0.04	0.56	0.04	0.47	0.04	0.56	0.02
2017	0.35	0.05	0.67	0.04	0.65	0.03	0.55	0.03	0.52	0.03	0.55	0.02
Avg.	0.52	0.14	0.65	0.02	0.66	0.01	0.56	0.04	0.53	0.04	0.58	0.02

Figure 6. Annual fawn per doe observation rates by deer season zone with 95% confidence intervals), Deer Hunter Observation Survey, 2014-2017.
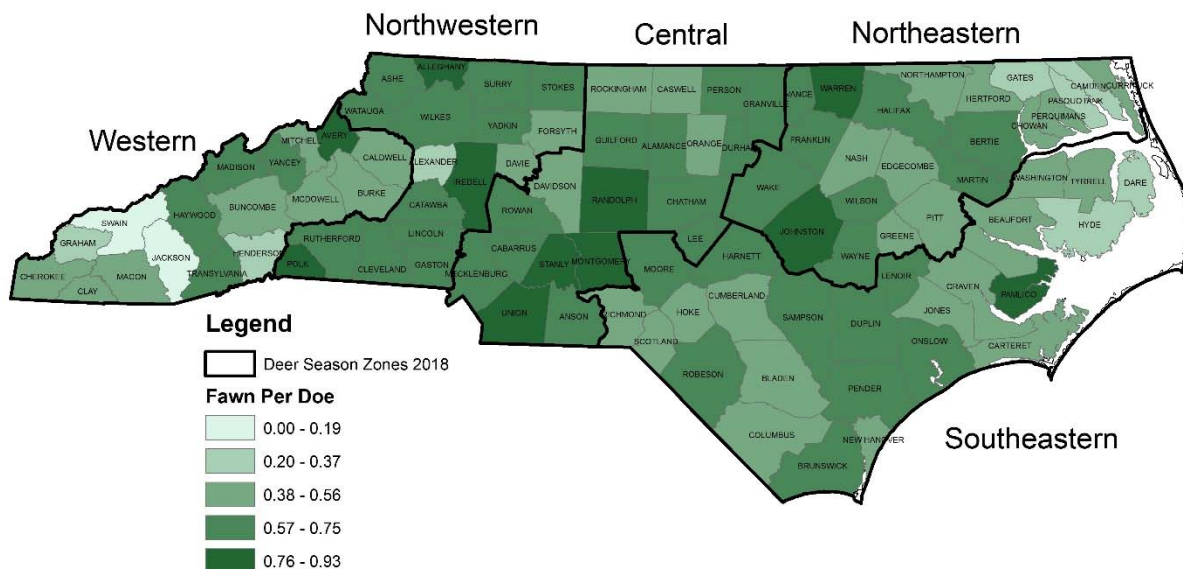
Figure 7. Fawn per doe observation rates by county, North Carolina Deer Hunter Observation Survey, 2014-2017.

Ratio of Adult Does Per Antlered Buck

This ratio offers insight into the sex ratio of the deer herd. The two main influences on this ratio are the harvest rates of males and the harvest rates of females. When changes in the ratio are observed over time, harvest management strategies are likely responsible, since birth rates and survival for male and female fawns are relatively equal. This data is extremely valuable and is used in combination with information from our reported annual harvest numbers to provide a more comprehensive assessment of the deer management strategies.

Statewide, hunters observed 2.45 adult does for every antlered buck on average (Figure 8). The observed doe per buck ratio were highest in the southeastern zone (2.71 does per buck), and lowest in the central (2.10 does per buck). Rates appeared to relatively stable across years within most season zones.

Baiting analyses suggest that the use of bait significantly reduces the doe per buck ratio by ~9% (2.47 does per buck with bait, 2.72 does per buck without bait). This appears to be influenced by bucks having a slightly higher tendency to visit baited sites compared to adult does.

Annual county estimates maintained relatively consistent observation rates, reliable enough to estimate recruitment for most counties (Figure 9). However, several counties in the mountains and coast exhibited the highest amount of annual variation due to small sample sizes.
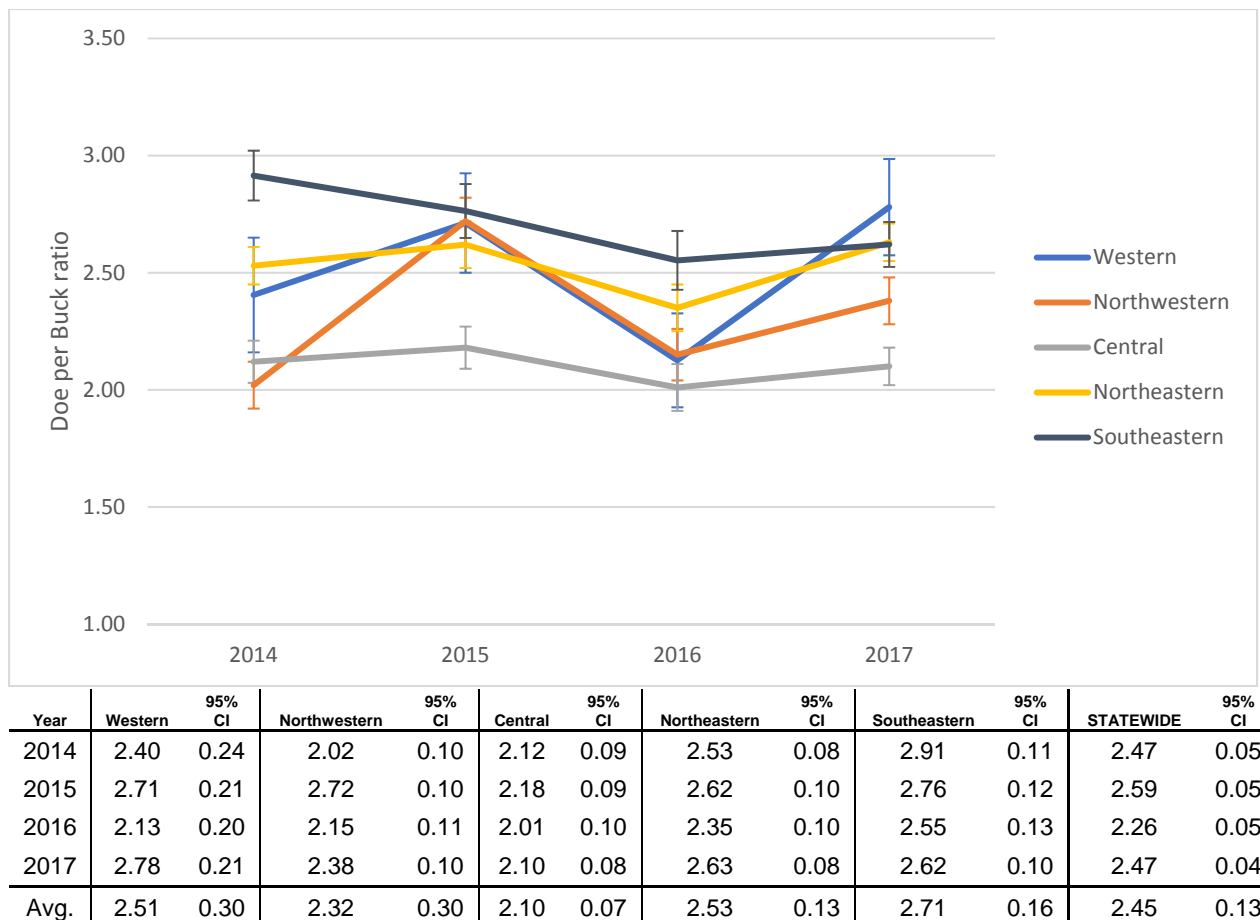
Year	Western	95% CI	Northwestern	95% CI	Central	95% CI	Northeastern	95% CI	Southeastern	95% CI	STATEWIDE	95% CI
2014	2.40	0.24	2.02	0.10	2.12	0.09	2.53	0.08	2.91	0.11	2.47	0.05
2015	2.71	0.21	2.72	0.10	2.18	0.09	2.62	0.10	2.76	0.12	2.59	0.05
2016	2.13	0.20	2.15	0.11	2.01	0.10	2.35	0.10	2.55	0.13	2.26	0.05
2017	2.78	0.21	2.38	0.10	2.10	0.08	2.63	0.08	2.62	0.10	2.47	0.04
Avg.	2.51	0.30	2.32	0.30	2.10	0.07	2.53	0.13	2.71	0.16	2.45	0.13

Figure 8. Adult doe per antlered buck observation rates by deer season zone with 95% confidence intervals), Deer Hunter Observation Survey, 2014-2017.
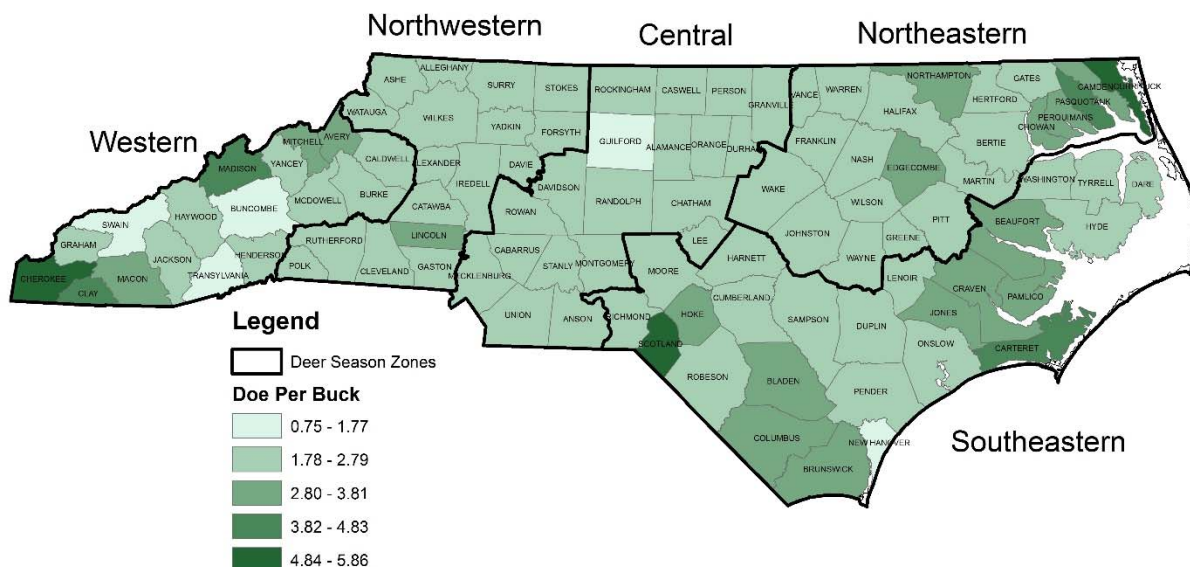

Figure 9. Adult does per antlered buck observation rates by county, North Carolina Deer Hunter Observation Survey, 2014-2017.

Gray Squirrel

Gray squirrels were the most commonly observed animal type (765.6 squirrels per 1,000 hours) and were seen in all 100 counties (Figure 10). Highest observations rates occurred in the central piedmont of the state (Figure 11). Significantly more gray squirrels were observed on stand locations with bait (8.5 squirrels per hour), than without bait (6.8 squirrels per hour), since squirrels appear to utilize bait as a direct food source (Table 5).

Annual statewide observation rates generally had low annual variation and increased across the state. Annual county estimates maintained relatively consistent observation rates, reliable enough to estimate observation rates for most counties. However, counties on far coast and far mountains exhibited a high amount of annual variation due to small sample sizes.

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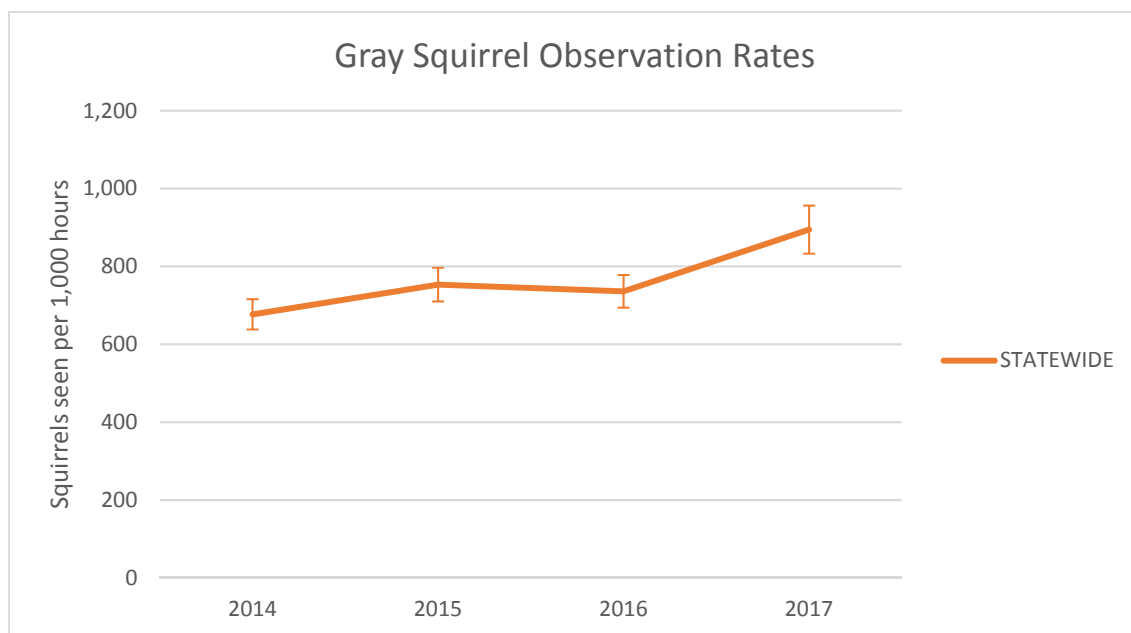
Year	STATEWIDE	95% CI
2014	676.95	38.94
2015	753.50	43.26
2016	736.05	41.88
2017	894.64	61.71
Avg.	765.3	90.4

Figure 10. Annual statewide gray squirrel observation rates with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.
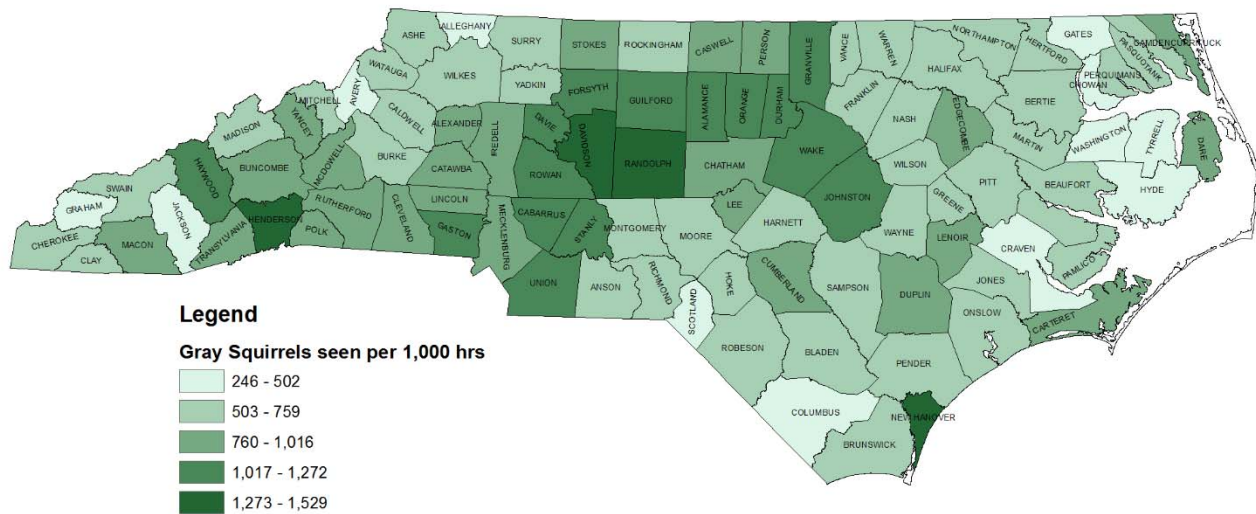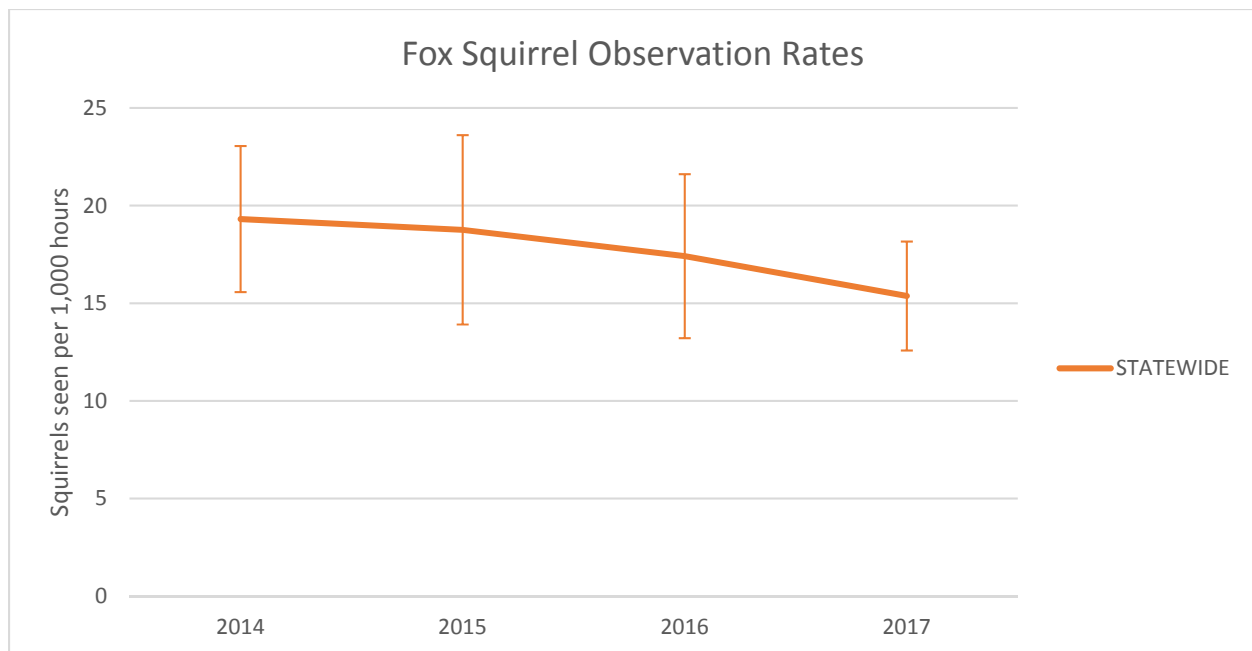
Figure 11. North Carolina gray squirrel observation rates by county (# of gray squirrels seen per 1,000 hours), Deer Hunter Observation Survey 2014-2017.

Fox Squirrel

Fox squirrels were a relatively uncommon animal type (17.7 squirrels per 1,000 hours) and were seen in 65 counties (Figure 12). Highest observations rates occurred in the Sandhills region and the central coastal area of the state (Figure 13). Observations included records in counties outside of the previous known range of the species and have been used to update the known range distribution of fox squirrels throughout the state. As opposed to gray squirrels, the use of bait does not appear to have a significant influence on observation rates. Since observations are relatively rare within years, annual estimates are relatively imprecise. Trends indicate a notable decline in observation rates over the past 4 years.

Fox Squirrel Observation Rates

Year	STATEWIDE	95% CI
2014	19.3	3.7
2015	18.8	4.9
2016	17.4	4.2
2017	15.4	2.8
Avg.	17.7	1.7

Figure 12. Annual statewide fox squirrel observation rates (# of fox squirrels seen per 1,000 hours) with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.
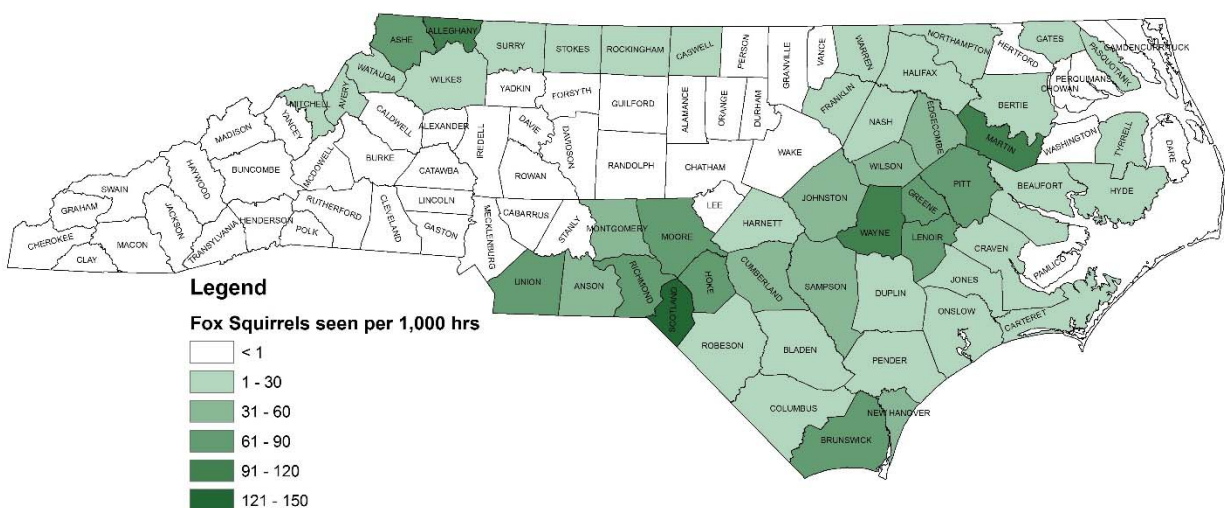

Figure 13. North Carolina fox squirrel observation rates by county (# of fox squirrels seen per 1,000 hours), Deer Hunter Observation Survey 2014-2017.

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/1,000 hours) and a ratio of bearded (adult males) to non- bearded (females and young of the year).

Observation Rates of Turkeys

Turkey were a relatively commonly observed animal type (322.6 turkeys per 1,000 hours) and were seen in all 100 counties (Figure 14). Non-bearded turkeys were seen at a higher rate (169.0 turkeys per 1,000 hours), than bearded turkeys (59.0 turkeys per 1,000 hours). There was no evidence that the use of bait influenced turkey observation rates (Table 5). Turkey observations often contained a relatively high degree of variance due to the flocking characteristic of turkeys making estimates less precise.

The highest observation rates for turkeys occurred in the coastal region (450.6 turkeys per 1,000 hours) and were lowest in the piedmont (216.3 turkeys per 1,000 hours) (Figure 15). Trends appear to be stable in all 3 regions.
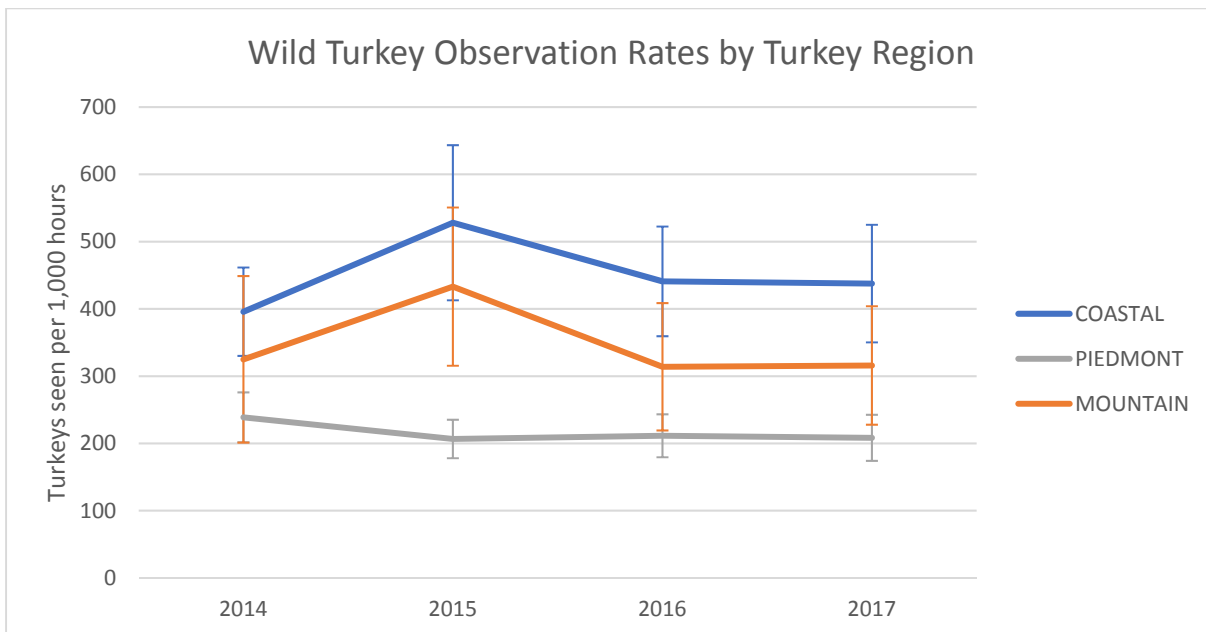
Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	395.8	65.7	325.0	123.8	238.8	37.1	318.2	39.8
2015	528.1	115.3	433.1	117.6	206.6	28.7	379.3	53.1
2016	440.9	81.5	313.9	94.6	211.3	31.9	320.0	39.4
2017	437.6	87.4	315.9	88.1	208.3	34.3	320.2	41.4
Avg.	450.6	54.5	347.0	56.4	216.3	14.9	334.4	29.3

Figure 14. Turkey observation rates by turkey management region and year, North Carolina Deer Hunter Observation Survey, 2014-2017. Brackets indicate a 95% confidence interval.
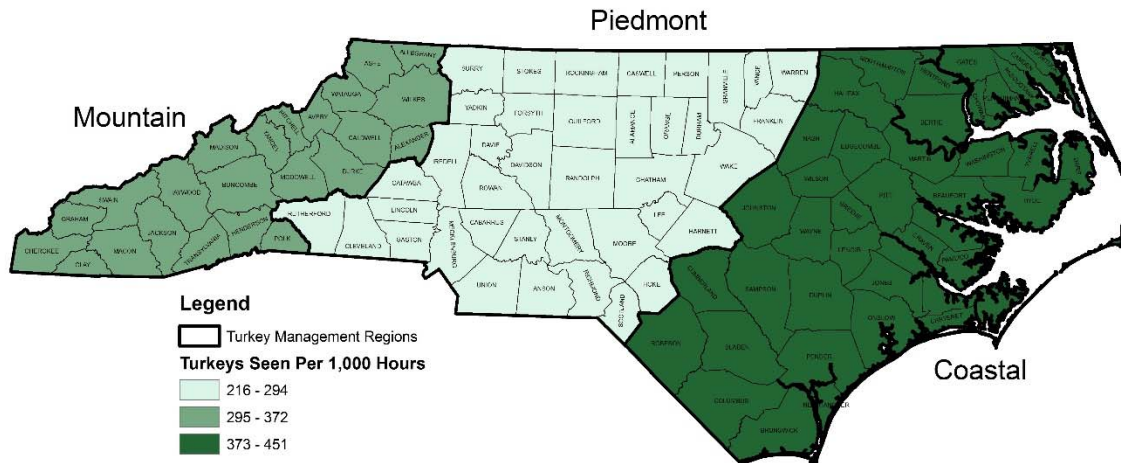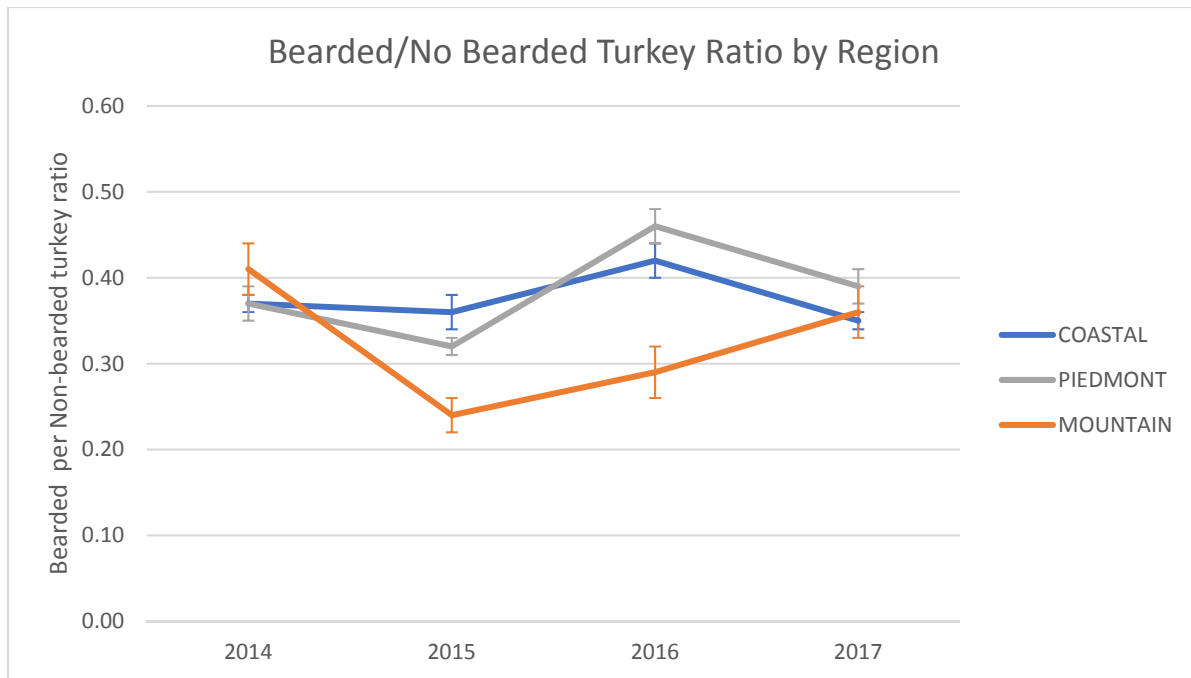
Figure 15. Turkey observation rates by turkey management unit, North Carolina Deer Hunter Observation Survey, 2014-2016. Observation rates for turkeys were relatively stable from 2014 through 2016, but differed somewhat across the three regions. Observation rates were highest in the Coastal Region and lowest in the Piedmont Region.

Ratio of Bearded/No Beard Turkeys

This ratio offers insight into turkey population dynamics. The two main influences on this ratio are the survival/harvest rates of males and survival of females. 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 observed ratio of Bearded/No Beard Turkeys was comparable in all regions (Figure 16). In 2015 and 2016 the ratio was somewhat lower in the Mountain Region. Sample sizes in the DHOS are capable of providing very precise estimates of the ratio of Bearded/No Beard turkeys at regional levels. However, in some cases, the differences in ratios across regions or through time may be statistically significant, but not very biologically meaningful (Figure 17).

Figure 16. Bearded per non-bearded turkey observation rates by turkey management region and year, North Carolina Deer Hunter Observation Survey, 2014-2017. Brackets indicate a 95% confidence interval.

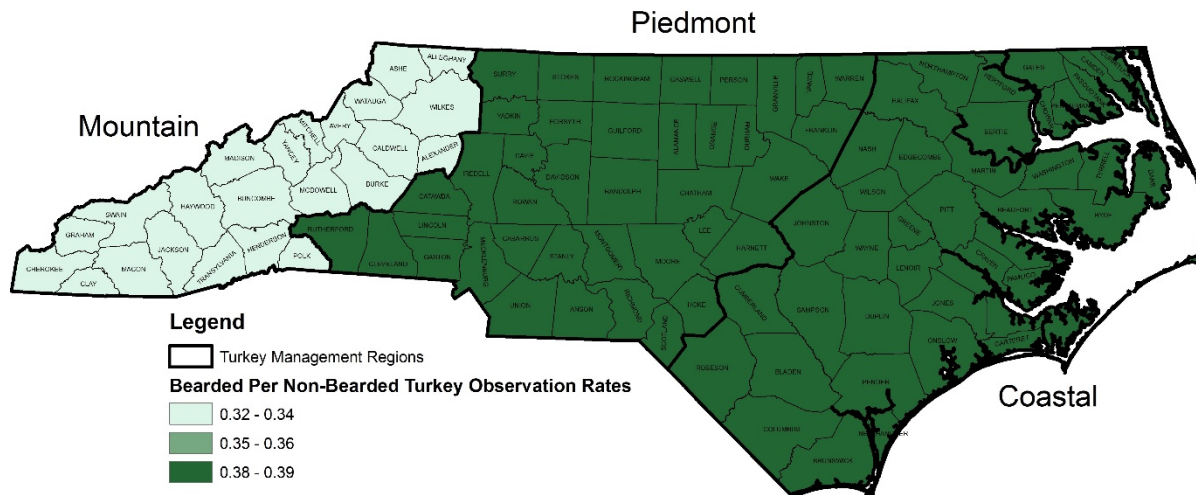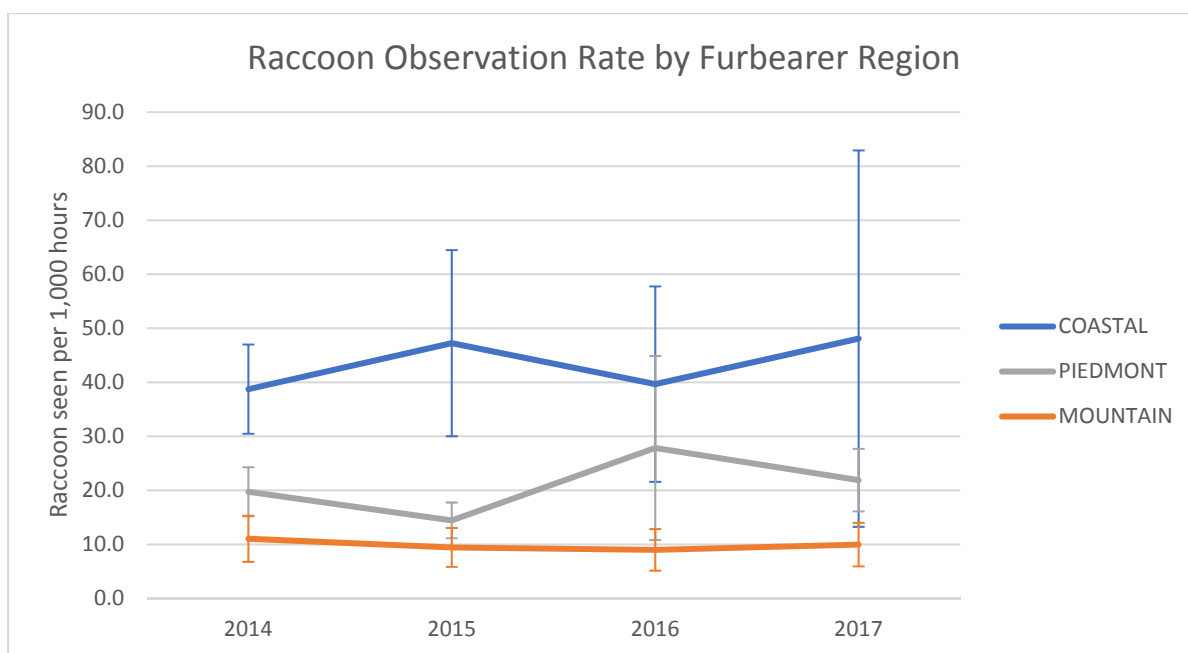| Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	0.37	0.01	0.41	0.03	0.37	0.02	0.37	0.01
2015	0.36	0.02	0.24	0.02	0.32	0.01	0.31	0.01
2016	0.42	0.02	0.29	0.03	0.46	0.02	0.41	0.01
2017	0.35	0.01	0.36	0.03	0.39	0.02	0.36	0.01
Avg.	0.38	0.03	0.33	0.07	0.39	0.06	0.36	0.04

Figure 17. Bearded turkey per non-bearded turkey observation ratio by turkey management unit, North Carolina Deer Hunter Observation Survey, 2014-2016.

Raccoon

Observations of raccoon have generally followed their perceived statewide range and were recorded in 97 of the 100 counties. Statewide raccoon observation rates were the highest for any furbearer species, but were still relatively rare (27.2 raccoons per 1,000 hours) (Figure 18). Highest reporting rates were recorded in the coastal plain furbearer management region (43.4 raccoons per 1,000 hours), and lowest in the mountain region (9.8 raccoons per 1,000 hours) (Figure 19). Statewide trends appear to be stable across all 3 management regions, but annual estimates in the coastal plain region remain imprecise.

Significantly more raccoon were observed on stand locations with bait (34.4 raccoon per 1,000 hours, than without bait (18.3 raccoons per 1,000 hours) (Table 5). Baited sites likely attract raccoons since they provide a direct food source.

Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	38.7	8.3	11.0	4.3	19.7	4.6	25.1	3.8
2015	47.2	17.2	9.4	3.6	14.4	3.3	26.2	7.0
2016	39.7	18.1	9.0	3.9	27.9	17.0	28.4	9.8
2017	48.1	34.8	10.0	4.0	21.9	5.8	29.0	13.5
Avg.	43.4	4.8	9.8	0.9	21.0	5.4	27.2	1.8

Figure 18. Annual raccoon observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.

Figure 19. Raccoon observation rates by furbearer management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.

Coyote

Observations for coyote have generally followed their perceived statewide range and were observed in 99 of the 100 counties. Statewide coyote observation rates were generally rare (14.1 coyotes per 1,000 hours) (Figure 20). Observation rates have been highly variable between years and within counties, making estimates very imprecise. There is no evidence that observation rates are different between furbearer management regions, partly due to the imprecision of the data (Figure 21).

Significantly less coyotes were observed on stand locations with bait (11.5 coyotes per 1,000 hours, than without bait (17.1 coyotes per 1,000 hours) (Table 5). As baited sites likely have higher human activity, this negative relationship may the likely result of coyote's human avoidance behavior.

Coyote Observation Rates by Furbearer Region
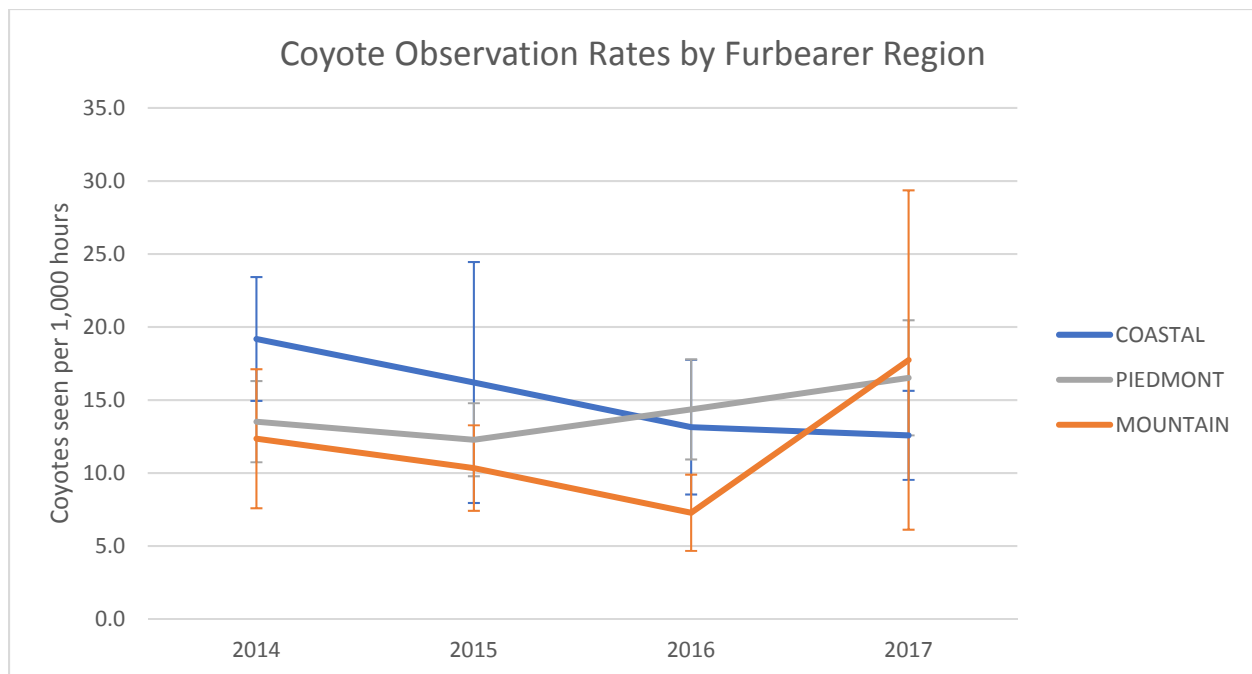
Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	19.2	4.2	12.4	4.8	13.5	2.8	15.5	2.2
2015	16.2	8.3	10.3	2.9	12.3	2.5	13.4	3.4
2016	13.1	4.6	7.3	2.6	14.4	3.4	12.4	2.3
2017	12.6	3.1	17.7	11.6	16.5	3.9	15.3	3.4
Avg.	15.3	3.0	11.9	4.3	14.2	1.7	14.1	1.5

Figure 20. Annual coyote observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.
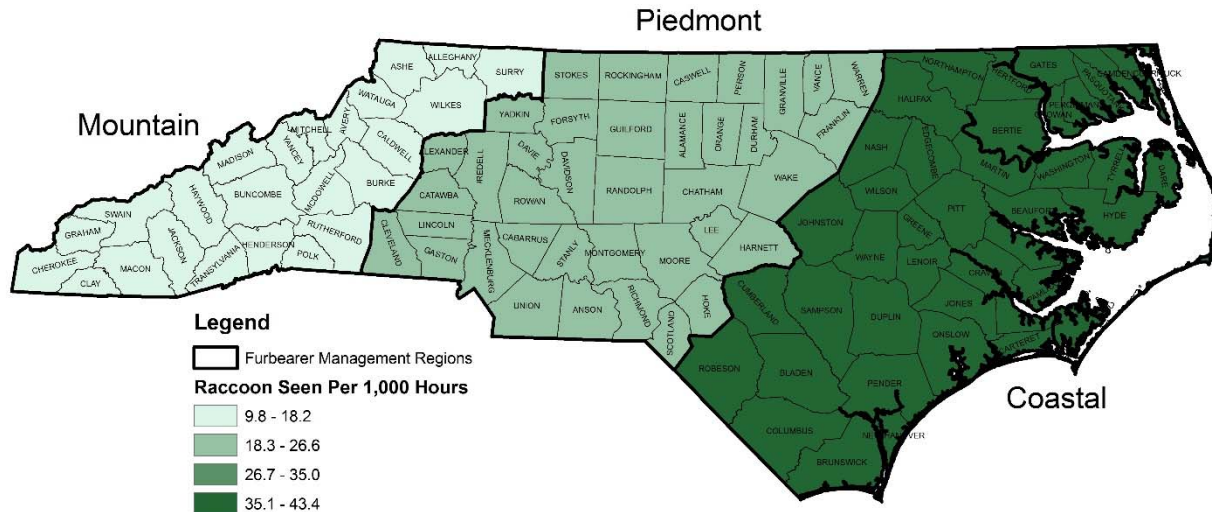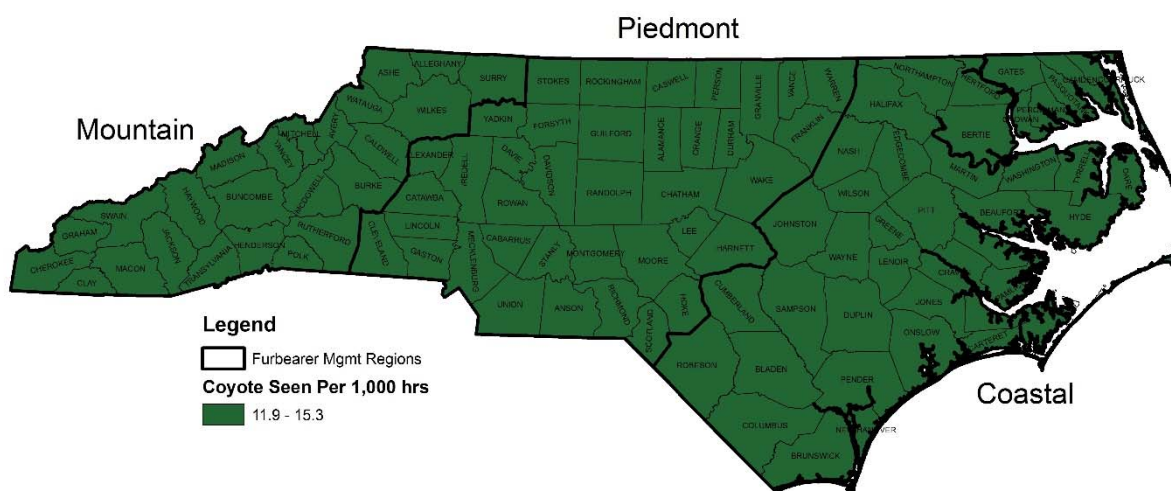

Figure 21. Coyote observation rates by furbearer management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.

Gray Fox

Observations of gray fox have generally followed their perceived statewide range and were seen in 94 of the 100 counties. Statewide gray fox observation rates were relatively rare (8.3 gray fox per 1,000 hours, Figure 22). Trends indicate an overall statewide decline in observation rates over the past 4 years, though due to the high degree of imprecision, this may not be the case. Gray fox observation rates in the mountain and piedmont furbearer management region appear stable, while there may be a decline in the coastal plain region. After accounting for yearly effects, highest observation rates were recorded in the coastal plain and piedmont furbearer management regions, and lowest in the mountain region (Figure 23).

Significantly more gray fox were observed on stand locations with bait (9.3 gray fox per 1,000 hours, than without bait (7.0 gray fox per 1,000 hours) (Table 5). As baited sites likely more bird and small mammal activity, gray fox may be attracted both indirectly and directly to these food resources.

Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	14.0	3.3	2.6	2.3	11.4	3.1	10.4	1.8
2015	14.0	4.2	1.5	1.0	8.8	4.2	9.3	2.4
2016	9.8	2.8	0.4	0.3	7.3	2.2	6.8	1.4
2017	8.1	2.2	1.4	0.7	8.4	4.3	6.6	1.8
Avg.	11.5	2.9	1.5	0.9	9.0	1.7	8.3	1.8

Figure 22. Annual gray fox observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.

Figure 23. Gray fox observation rates by furbearer management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.

Red Fox

Observations for red fox have generally followed their perceived statewide range and were seen in 92 of the 100 counties. Red fox were a relatively rare observation for deer hunters (3.4 red fox per 1,000 hours, Figure 24). Over the past 4 years, there has been no evidence that observation rates are different between furbearer management regions (Figure 25). There is no significant evidence that baited sites has any influence on red fox observation rates, as compared to coyotes or gray fox (Table 5). Since statewide observation rates were very rare, trends at all scales are imprecise and cannot be determined at this time.

Red Fox Observation Rate by Furbearer Region

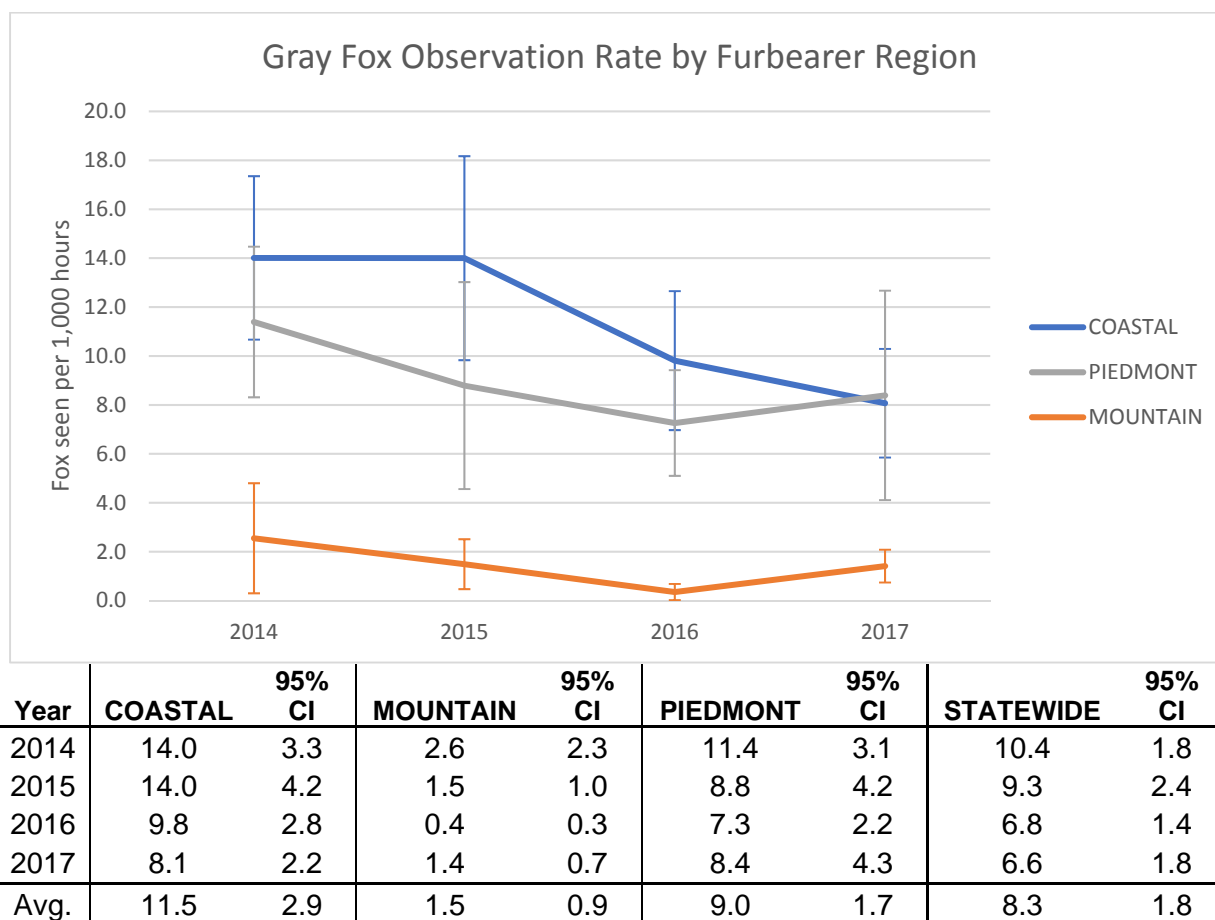| Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	4.0	2.4	1.8	1.6	4.4	1.7	3.7	1.2
2015	2.9	1.4	4.4	3.1	5.2	2.4	4.1	1.3
2016	3.7	2.0	2.1	2.1	2.5	0.8	2.9	1.0
2017	2.4	1.4	2.3	1.3	4.3	1.8	3.1	0.9
Avg.	3.2	0.7	2.7	1.2	4.1	1.1	3.4	0.6

Figure 24. Annual red fox observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.
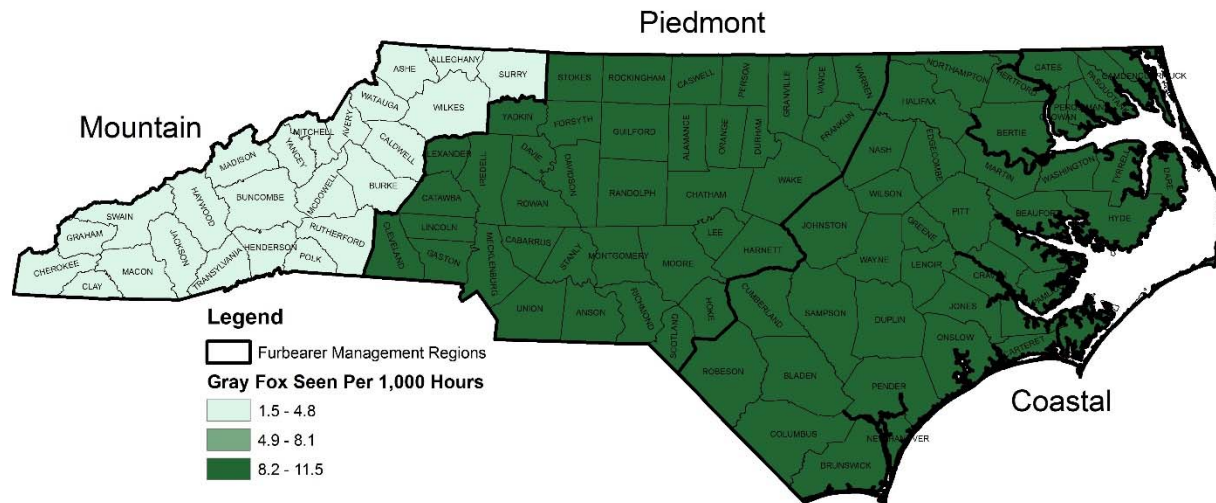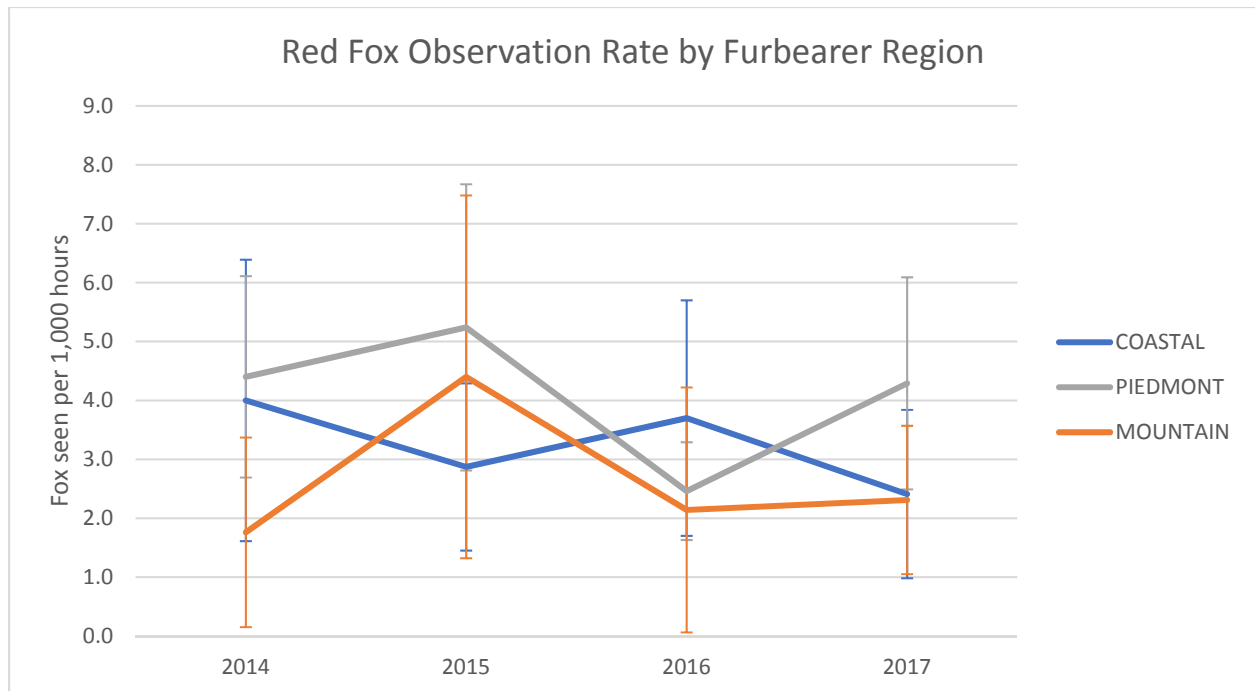

Figure 25. Red fox observation rates by furbearer management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.

Bobcat

Observations of bobcat have generally followed their perceived statewide range and were seen in 92 of the 100 counties.   Bobcat observations were relatively rare (3.4 bobcat per 1,000 hours, Figure 26). Since statewide observation rates were very low, trends at all scales are imprecise and cannot be determined at this time. Highest reporting rates were recorded in the coastal plain furbearer management region (4.7 bobcat per 1,000 hours), but regional observation rate estimates were very imprecise (Figure 27).

There is no significant evidence that baited sites has any influence on bobcat observation rates, as compared to coyotes or gray fox (Table 5).

Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	4.5	1.1	2.9	1.6	2.4	1.2	3.3	0.7
2015	4.6	2.1	3.5	1.7	3.9	5.2	4.1	2.2
2016	5.1	2.6	1.6	0.9	1.3	0.6	2.8	1.0
2017	4.6	1.4	4.6	2.9	1.5	0.7	3.4	0.9
Avg.	4.7	0.2	3.1	1.2	2.3	1.2	3.4	0.5

Figure 26. Annual bobcat observation rates by furbearer management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.
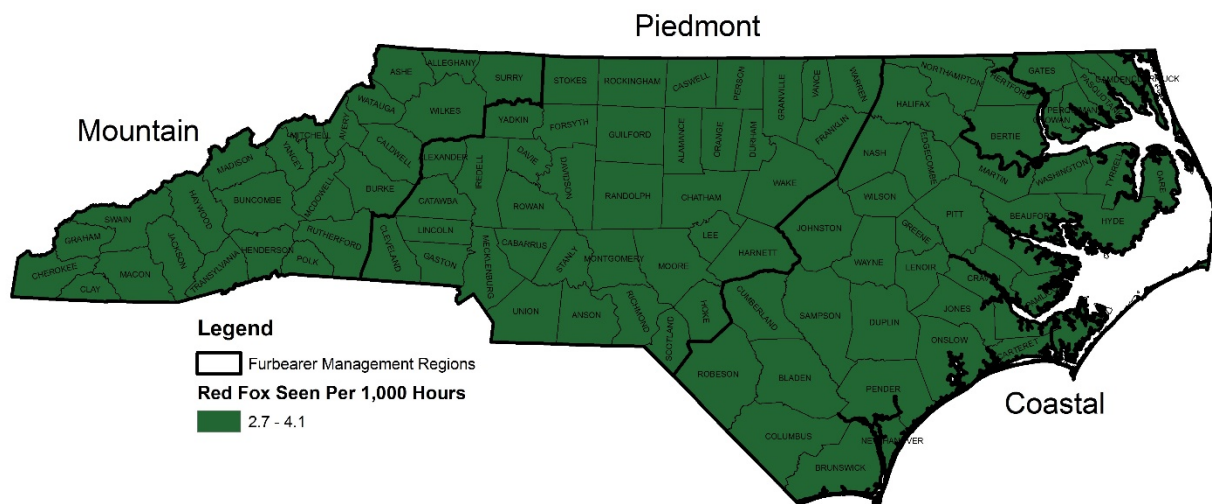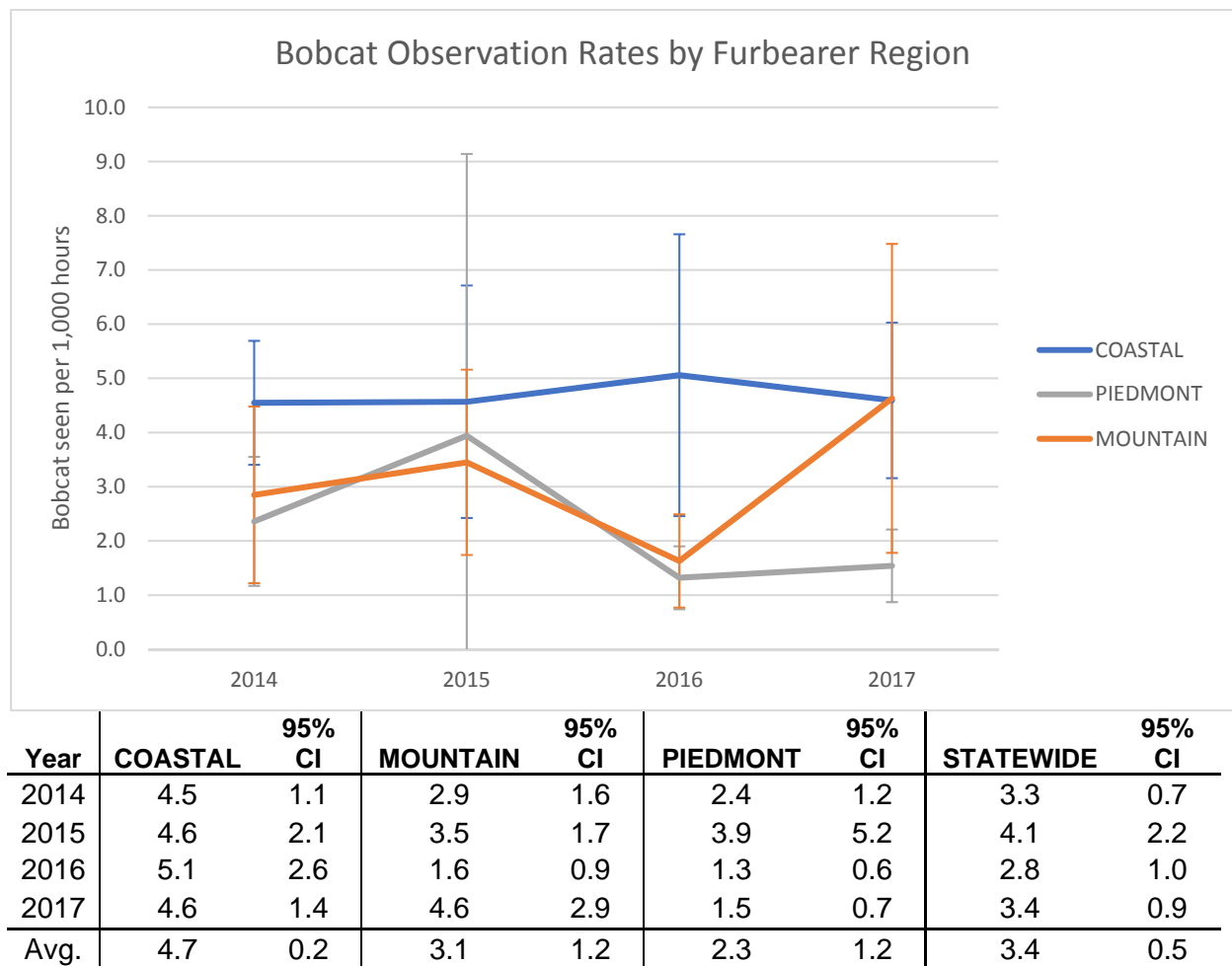
Figure 27. Bobcat observation rates by furbearer management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.

Bear

Adult bears were observed in 71 of the 100 counties. Bear observations were relatively rare (11.7 adult bears and per 1,000 hours, Figure 28). The bulk of the bear observations occurred in the coastal bear management unit (CBMU) and observation rates were substantially her in the CBMU versus the other two bear management units (Figure 29). While there is a well-established bear population in the Mountain Bear Management Unit (MBMU), the MBMU bear population is lower than the CBMU and has fewer bears per square mile, resulting in fewer observations when compared to the CBMU. 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.

Observations of adult bears generally followed their known presence within counties across the state, except for a few notable exceptions in 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 30). Cubs of the year were observed in 46 of the 100 counties (Figure 31). 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.

Adult Bear Observation Rates by Bear Management Region

Year	COASTAL	95% CI	MOUNTAIN	95% CI	PIEDMONT	95% CI	STATEWIDE	95% CI
2014	24.6	5.7	1.5	1.0	0.4	0.6	10.0	2.3
2015	27.7	8.9	3.3	1.7	0.4	0.4	11.7	3.6
2016	30.0	12.1	2.4	1.5	0.4	0.4	12.2	4.7
2017	29.7	11.4	6.4	3.3	0.2	0.2	12.9	4.4
Avg.	28.0	2.5	3.4	2.1	0.3	0.1	11.7	1.2

Figure 28. Adult bear observation rates by bear management unit with 95% confidence intervals, North Carolina Deer Hunter Observation Survey, 2014-2017.

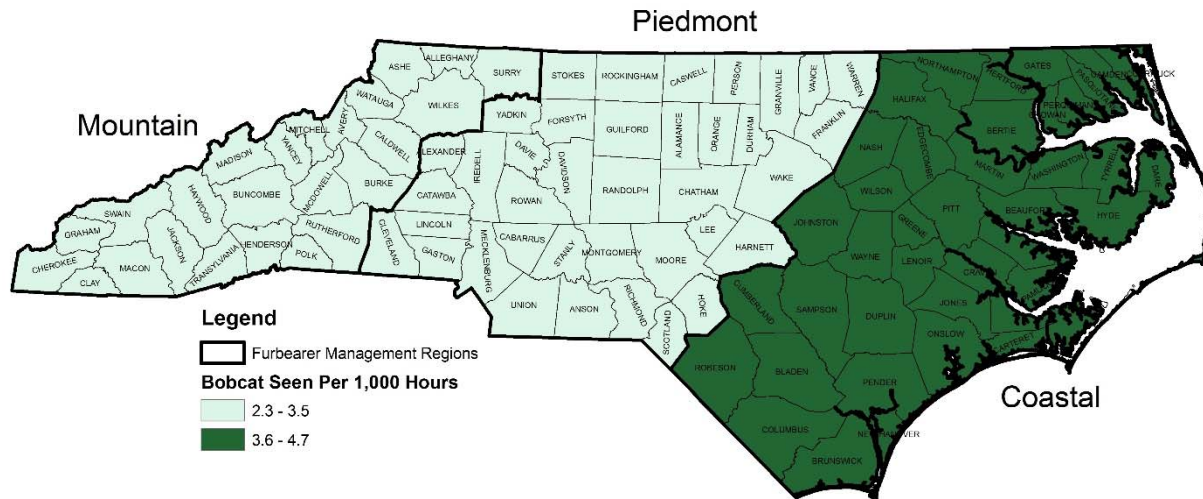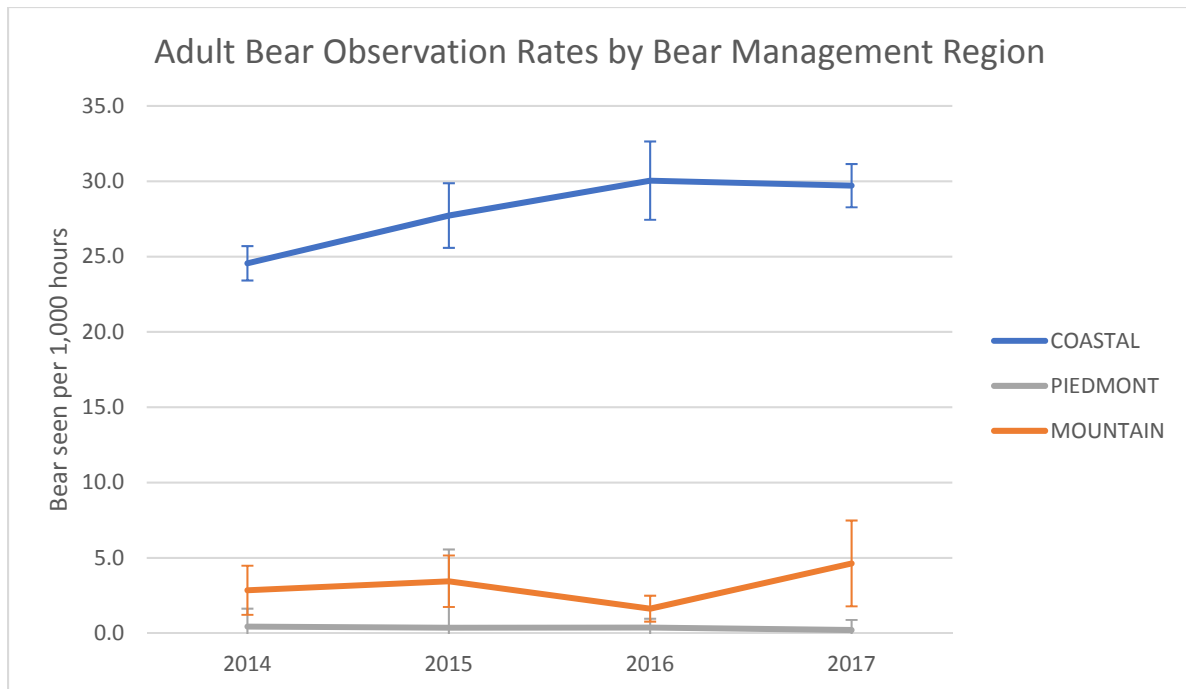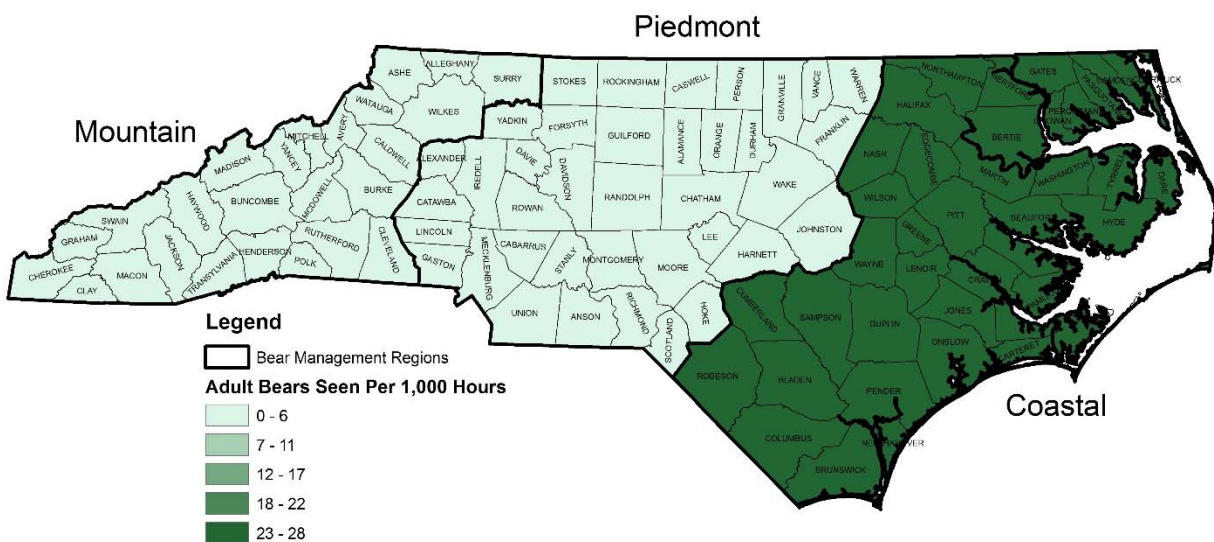Figure 29. Adult bear observation rates by bear management unit, North Carolina Deer Hunter Observation Survey, 2014-2017.
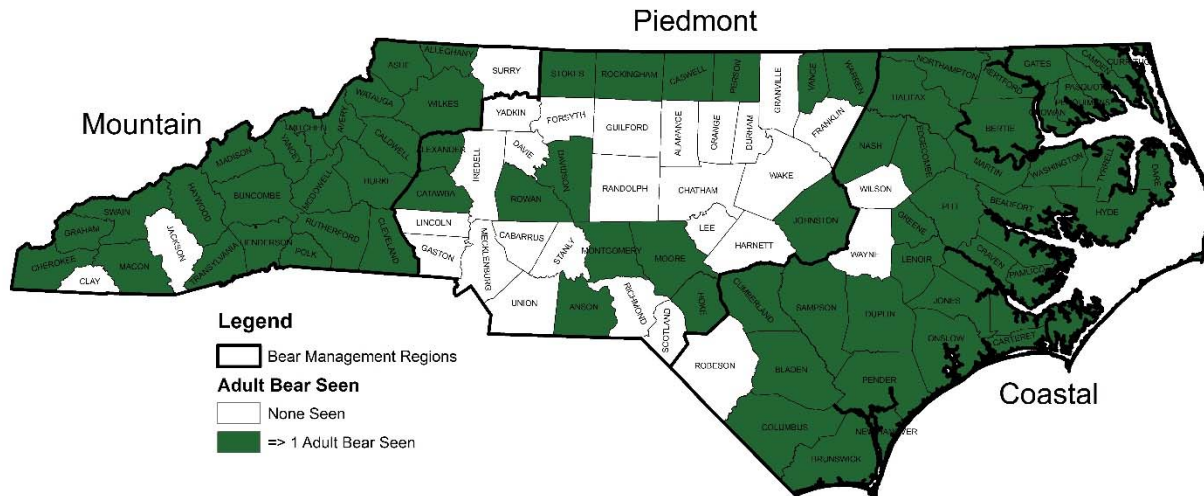
Figure 30. Adult bear presence (≥1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2014-2017.
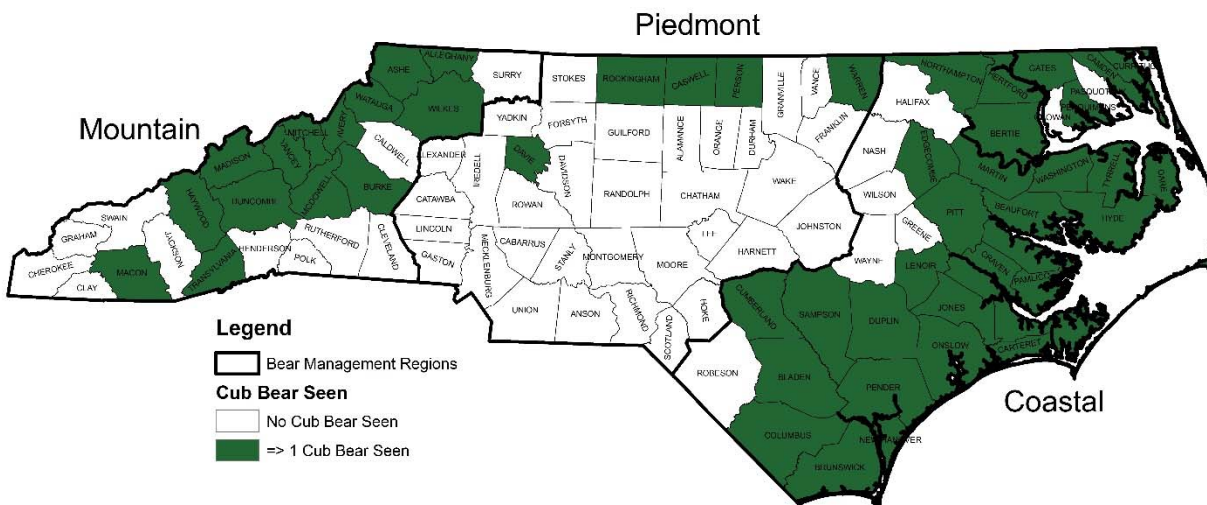
Figure 31. Cub bear presence (≥1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2014-2017.

Feral Swine

Observations of feral swine generally followed their known presence within most counties across the state. Feral swine were observed in 43 of the 100 counties (Figure 32). Confident observation rate estimates could not be derived due the relatively low number of observations. For the purposes of this section, analyses were limited to the presence of the species ($\geq$1 feral swine seen per county).
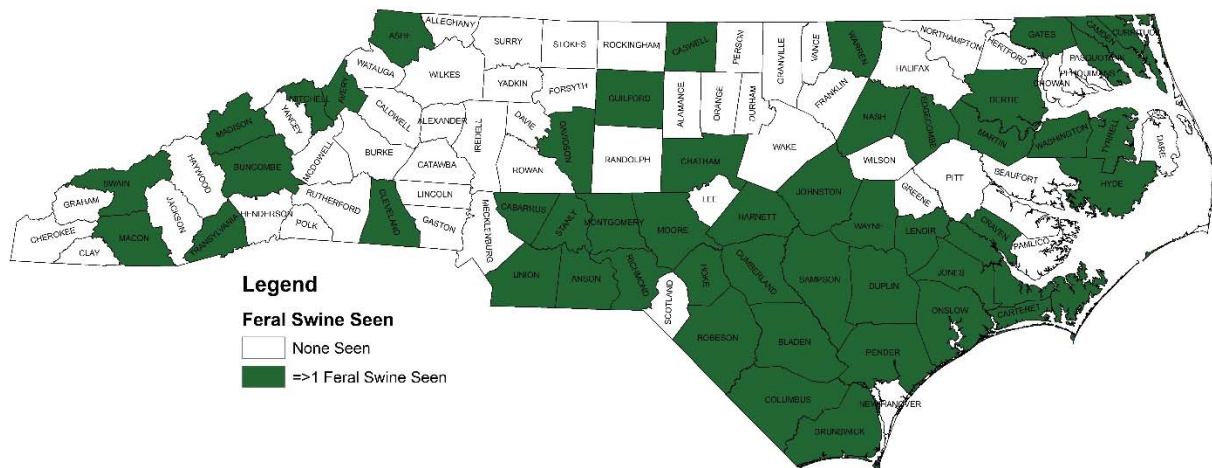
Figure 32. Feral swine presence ($\geq$1 animal observed) by county, North Carolina Deer Hunter Observation Survey, 2014-2017.

Thank you to all the volunteer deer hunters from across the state that took the time and interest in North Carolina's wildlife to fill out the observation survey!

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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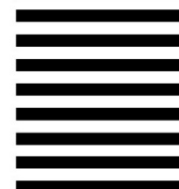
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INSTRUCTIONS

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.

Date	Hours Hunted	County	Location*	Hunt with Bait	Deer				Squirrels		Turkey			Coyote	Bobcat	Gray Fox	Red Fox	Raccoon	Bear		Feral Swine	Other Animals & Number Seen**
					Antlered Buck	Adult Doe	Button Buck/ Doe Fawn	Unknown	Gray Squirrel	Fox Squirrel	Bearded	No Beard	Unknown						Adult	Cub		
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																		
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*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*