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2002 Virginia Bowhunter Survey



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2002 VIRGINIA BOWHUNTER SURVEY

by

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Abstract: The Virginia Bowhunter Survey provides key information that is used by the Department of Game and Inland Fisheries to annually monitor the status and relative abundance of wildlife resources within the Commonwealth. The survey, initiated by the Department in 1997, establishes population indices based on the number of animals observed per hour hunting during the early special archery season. Survey instruments were mailed one week prior to the 2002 early archery season to a sample of bowhunters. The survey sample included randomly selected bowhunters from counties reporting 30 or fewer hunts during the 2001 survey period and 529 cooperative hunters who participated in the previous years survey. Useable responses were received from 560 hunters who received survey forms. Hunts were reported in 100% of the 98 counties and cities surveyed. Archery hunters participating in the survey recorded over 27,232 hours of hunting observations during the survey period. Annual, weekly, and regional index ratios were calculated based on animal observations per 100 hours of hunting effort. The frequency of hunts was greatest during the first week of the survey period and generally decreased weekly throughout the six-week season. The reported average length of a hunt was greatest on the first day and the last two weeks of the early archery season. Most archery hunts occurred on private versus public lands. Cooperating hunters observed most species of animals more frequently on private lands compared to public lands. Based on public land availability across the state (i.e. 9% public), over 50% more hunts (16.4%) were reported on public land than expected. Cooperative hunters also reported longer hunts (4.79 hours) on public lands than on private lands (4.04 hours). Data reflecting animal observations per 100 hours hunting effort reported from 1997 through 2002 is presented. The time-series data suggests some species populations (e.g. coyote) have generally increased since 1997 when the survey was initiated. In order to achieve the full potential of the bowhunter survey, a continued effort is needed to increase cooperator participation and improve the statewide distribution of survey respondents.

The 2002 Virginia Bowhunter Survey reflects a dedicated effort by cooperative hunters and the Department of Game and Inland Fisheries to annually monitor the status and relative abundance of wildlife resources within the Commonwealth. The annual survey of early season archery hunter observations was established in 1997 to provide harvest independent data for evaluating the status of wildlife populations. The observations of wildlife reported by hunters with respect to their hunting effort provides crucial information for monitoring increasing or decreasing trends in the abundance of wildlife populations over selected intervals of time.

Monitoring wildlife populations by requesting archery hunters to record observations of wildlife during each hunting trip is not a technique that is unique to Virginia. Archery hunters have been enlisted to report observations of wildlife with respect to hunting effort in other eastern and midwestern states (Lehman and Weaver 1998, Dwyer 1997, Glasscock et al. 1997, Hamilton and Fantz 1997, Ver Steeg and Warner 1997). Surveys of archery hunter observations have proven successful in detecting wildlife population changes and are a preferred technique because of its potential broad coverage, cost-effectiveness, and simplicity.

Public participation in archery hunting has been relatively stable during recent years and continues to be popular across all regions of the Commonwealth (Rodgers et al. 2003). The early archery season, generally held from the first weekend in October through the Saturday proceeding the deer firearms season, provides sportsmen the opportunity to observe animals with relatively few disturbances. Virginia archery license sales totaled 59,114 resident hunters and 2,630 non-resident hunters during the 2001-2002 hunting season. Rodgers et al. (2003) estimated that 55,365 bowhunters spent approximately 501,995 days afield during the 2000-2001 deer archery season.

The bowhunter survey provides a means to validate other techniques used to monitor the populations of many wildlife species (Lehman and Weaver 1998). In general, population abundance indices that are derived from chance observations of wildlife per unit of observational effort (e.g., bowhunter surveys) are considered to provide a more accurate assessment of population abundance statuses versus population assessments derived strictly from indices reflecting total harvest. For example, furbearer population indices derived from fur-buyer surveys or pelt tagging may not reflect the true status of a population because fur pelt values may influence year-to-year harvest efforts (Obbard et al. 1987).

Unfortunately, monitoring furbearer populations using methods independent of harvest such as scent station surveys (Hamilton et al. 1990), mark-recapture studies (Otis et al. 1978), road mortality indices (Clark

and Andrews 1981), and aerial surveys (Sargeant et al. 1975) are expensive and problematic for many reasons. Difficulties using these methods have led Virginia and other states to adopt and prefer the bowhunter survey for assessing the status of some fur-bearing species (Hamilton et al. 1990, Ver Steeg and Warner 1997).

We wish to express our appreciation to all cooperating bowhunters. In addition, we are grateful to Frances Boswell and Jim Sparks for assistance in collecting archery hunter license data, and Joan Bowers and Carole Martin for organizing and coding data forms. We appreciate the review and comments provided by Bob Ellis. This publication was funded in part by Pittman-Robertson Federal Aid to Wildlife Restoration Project - WE99R.

METHODS

Survey forms (Appendix 1) were mailed one week prior to the 2002 early archery season to a undetermined number of randomly selected bowhunters that purchased archery licenses in Virginia counties reporting 30 or fewer hunts during the 2001 survey period, and to 645 archery hunters who participated in the 2001 Virginia Bowhunter Survey.

The survey instrument provided an opportunity for hunters to record incidental observations of wildlife species, domestic animals of management interest, and other hunters during hunts in the early archery season (October 4 through November 14, 2002). For each date hunted, a cooperator was asked to record the county, hours hunted, whether the land hunted was privately or publicly owned, and three weather parameters (Appendix 1). Data were analyzed statewide, east and west of the Blue Ridge Mountains, by physiographic region (Figure 1), by week of the survey period, by land ownership, and by land ownership east and west of the Blue Ridge Mountains. The Tidewater, Southern Piedmont, and Northern Piedmont Regions were considered "east of the Blue Ridge Mountains", while the Southern and Northern Mountain Regions were considered "west of the Blue Ridge Mountains". Daily records were excluded if "county" or "hours hunted" were not specified.

Doe-buck ratios were calculated by dividing number of doe deer observed by the number of antlered deer observed; fawn-doe ratios were calculated by dividing the number of deer fawn seen by the number of doe deer seen.

Standard errors (SE) for all observations expressed as per unit of time (i.e., 100 hours) were calculated using ratio-estimators (Cochran 1977).

RESULTS

Participation and Hunter Effort

A total of 560 survey forms distributed to early archery hunters had been returned to the Department by January 31, 2002. The 560 cooperating archery hunters reported 6,523 total hunts averaging 4.17 hours per hunt for a total of 27,232 hours of observation (Table 1). Hunts were reported in 100% of the 98 counties or cities included in the analysis. However, the counties of Buchanan, Richmond, Spotsylvania, and Stafford and the city of Chesapeake had fewer than 20 hunts reported (Appendix 2). Hunts in Shenandoah County accounted for 5.4% (n = 352) of all hunts reported.

The number of hunts reported was greater east (n = 4,304) than west (n = 2,219) of the Blue Ridge Mountains, and the average length of hunts reported was essentially equal west (4.17 hours) and east (4.18 hours) of the Blue Ridge Mountains (Table 1). Slightly more than four of five hunts (83.8%) were reported on private lands versus public lands. Based on public land availability across the state (9%), over 50% more hunts (16.4%) were reported on public land than expected (Table 2). Cooperative hunters also reported longer hunts (4.79 hours) on public lands than on private lands (4.04 hours; Table 2). The proportion of hunters reporting hunts on private land (62.6%) was greater than the proportion of hunters reporting hunts on public lands west of the Blue Ridge Mountains (37.4%; Table 3). The average number of hunts reported by hunters per region influenced regional differences in the total number of hunts reported. Hunters in the South Mountain region averaged 11.0 hunts per hunter, whereas hunters in the North Mountain region averaged 8.7 hunts per hunter. The average number of hunts per hunter was slightly greater east of the Blue Ridge Mountains (10.8) versus west of the Blue Ridge Mountains (10.4) (Table 4). Cooperating archery hunters reported longer hunts in the South Piedmont (4.25 hours) region versus shorter average hunts reported in the Tidewater region (4.14 hours). Hunts lengths were similar for the North Mountain (4.18 hours), South Mountain (4.16 hours) and North Piedmont (4.17 hours) regions (Table 4).

The frequency of hunts was greatest during the first week of the survey period and generally decreased weekly throughout the six-week season (Table 5). The reported average length of a hunt was greatest on the first day and the last two weeks of the early archery season (Table 5).

Selected Animal Observations

The animal observation data collected by cooperative hunters during the 2002 early archery season are summarized for selected species in Tables 1-7. In addition, the observational data of selected species per 100 hours hunting effort reported in surveys conducted from 1997 through 2002 (Lafon et al. 1998, Farrar et al. 1999, 2000, 2001, 2002) are presented in Figures 2 - 35. While all tables are referenced in the text, some figures are not specifically mentioned.

East vs. West of Blue Ridge Mountains - The data presented in Table 1 indicates the frequency of animal observations statewide and east and west of the Blue Ridge Mountains. Cooperators observed more gray squirrels, red and gray foxes, river otter, and domestic dogs per hour of hunting east of the Blue Ridge Mountains. Deer does, fawns, fox squirrels, wild turkeys, ruffed grouse, black bears, coyotes, opossum, skunks and hunters were observed more frequently per hour of hunting west of the Blue Ridge Mountains. The rate of observations of antlered deer, bobcat, raccoon, mink, and house cats were similar east and west of the Blue Ridge Mountains.

Private vs. Public Land - The data presented in Table 2 and 3 indicates the frequency of animal observations on private versus public lands statewide, and on private and public lands east and west of the Blue Ridge Mountains, respectively. Most wildlife species, domestic dogs, and house cats were observed more frequently on private lands than on public lands. Exceptions were ruffed grouse, gray fox, coyote, and bobcat. Other hunters were seen more often on public lands than on private lands both east and west of the Blue Ridge Mountains.

Physiographic Regions - The data presented in Table 4 indicates the frequency of selected animal observations within the five physiographic regions illustrated in Figure 1. Archery hunters in the mountain regions reported more observations of deer fawns and deer of unknown age or sex per 100 hours hunting than other regions. Observations of fox squirrels and ruffed grouse were greater in the mountain regions. Black bear observation rates were least common in the Southern Piedmont and Tidewater regions. Red foxes were observed much more frequently in the Northern Piedmont, whereas gray foxes were observed most frequently in the Tidewater. Cooperators observed wild turkeys more frequently in the Southern Piedmont and Southern Mountain regions. Coyotes were observed more frequently in the Southern Mountain Region than in any other region. The population abundance of

coyotes appears to have increased then stabilized or decreased during 2001-2002 statewide (Figure 22). Bobcats were observed most frequently in the Southern Piedmont and Southern Mountain regions. Dogs were observed with much less frequency in the Northern Mountain region. The frequency with which cooperators saw other hunters was greatest in the Southern Mountain region and least in the Tidewater.

Weeks – The data presented in Table 5 indicates the frequency of animal observations by cooperative hunters over the course of the six-week early archery deer season. Antlered deer were observed more frequently toward the end of the early archery season. In contrast, doe deer were generally observed with the same frequency throughout the season. Wild turkey observations peaked during the fourth week and then declined throughout the remainder of the early archery deer season. Observations of black bears, bobcats, and raccoons dramatically declined during the last two weeks of the season. Fox squirrel observations generally decreased throughout the season, whereas gray squirrel observations peaked during the middle of the season then declined. Observations of coyotes, red and gray foxes, skunks, and opossum fluctuated throughout the season. Other hunters were observed statewide by cooperators more frequently during the first day and last two weeks of the early archery deer season.

Deer – Doe-buck ratios estimated from survey data indicate higher ratios of doe deer to antlered deer observations east than west of the Blue Ridge Mountains (Table 6a). The doe to antlered deer observation on private lands indicates that more does are observed on public lands (Table 6b). The Northern Mountain region reported the highest ratio of does to antlered deer, where as the North Piedmont region reported the lowest observation of does to antlered deer (Table 6c). The number of antlered deer observed per doe deer seen increased over the first five weeks of the season before stabilizing or slightly decreasing over the last week of the six-week early archery deer season (Table 6d).

Domestic dogs and cats – Dogs, house cats, and furbearers constitute a majority of potential mammalian predators in Virginia. The combined statewide observations of dogs and cats (n = 821) represented approximately 42% of all mammalian predators observed. The combined dog and cat observations east and west of the Blue Ridge Mountains comprised 46.7% and 32.6% of the total number of mammalian predators observed, respectively. Combined dog and cat observations on private and public lands represented

44.4% and 31.2% of total mammalian predators observed, respectively.

Other Species Observations

Bowhunters were asked to record incidental observations of miscellaneous species ("Other Animals") not solicited on the survey instrument chart. (Appendix 1). Caution should be used when examining Table 7 because some hunters may have chosen to report animals that others would not report. Despite the potential issue of accuracy of these data, we have no reason to question the precision of these estimates and therefore consider them useful as trend indicators.

DISCUSSION AND SUMMARY

Observational data that is reported in this survey in combination with observational data collected in surveys conducted from 1997 through 2002 demonstrates the utility of using animal observations per unit of hunting effort to establish the status of wildlife populations. In general, the population abundance indices derived from cooperative early archery hunter observations over the six years is not of a sufficient time interval to detect population trends. However, the time-series data illustrated in Figures 2 through 35 suggests some species populations (e.g. coyote) have generally increased since 1997 when the Virginia Bowhunter Survey was initiated. Information collected from successive bowhunter surveys should provide sufficient time-series data for performing a detailed analysis for establishing population trends and status.

The high variability surrounding the expected value of observation per unit effort of some species may affect the accuracy of future analyses. The high variability may be a consequence of (1) small sample sizes (e.g., the 1997 Virginia Bowhunter Survey) and (2) a non-uniform sampling distribution across the Commonwealth (e.g., the 1997-99 Virginia Bowhunter Surveys). Variability in the frequency of animal observations during survey periods may also be attributed to abiotic (e.g., weather) and biotic influences (e.g., breeding seasons and mast availability) on animal activity and movement patterns. Despite these potential problems, future bowhunter surveys will provide much useful information on the relative abundance and population trends of those fur-bearing animals whose populations are difficult to monitor. In addition, doe-buck and fawn-doe ratios may help identify regions with productivity problems and areas that provide greater opportunities to harvest quality bucks. A more detailed analysis of animal observation data over several years may yield valuable information that will

facilitate the development of predictive models that estimate hunter success with respect to weather and food availability.

In order to achieve the full potential of the bowhunter survey, a continued effort is needed to improve the sample size and distribution of survey respondents. Increased bowhunter cooperator recruitment should be achieved by continuing to solicit hunter cooperation from a stratified sample of hunters purchasing an early archery license. A stratified sampling regime is necessary to establish a uniform distribution of cooperators across the Commonwealth in order to avoid collecting regionally biased animal observation data.

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Table 1. Observations of selected animals by cooperating archery hunters October 5 - November 16, 2002 statewide and east (EBR) and west (WBR) of the Blue Ridge Mountains in Virginia.

Animal	Total Seen	Animals Seen/100 hrs. \pm SE		
		State	EBR	WBR
<i>Deer (antlered)</i>	3,522	12.93 \pm 0.57	12.86 \pm 0.64	13.08 \pm 1.13
<i>Deer (doe)</i>	8,776	32.23 \pm 1.33	28.92 \pm 1.36	38.66 \pm 2.79
<i>Deer (fawn)</i>	4,282	15.72 \pm 1.11	12.30 \pm 1.29	22.38 \pm 1.91
<i>Deer (unknown)</i>	3,549	13.03 \pm 0.83	9.82 \pm 0.63	19.27 \pm 1.99
<i>Gray Squirrel</i>	26,556	97.52 \pm 3.46	102.15 \pm 4.12	88.51 \pm 6.23
<i>Fox Squirrel</i>	1,831	6.72 \pm 0.89	1.10 \pm 0.24	17.66 \pm 2.19
<i>Wild Turkey</i>	7,488	27.50 \pm 2.39	22.97 \pm 2.83	36.31 \pm 4.15
<i>Grouse</i>	354	1.30 \pm 0.17	0.28 \pm 0.08	3.28 \pm 0.41
<i>Bear</i>	105	0.39 \pm 0.08	0.15 \pm 0.06	0.84 \pm 0.20
<i>Red Fox</i>	248	0.91 \pm 0.09	1.06 \pm 0.13	0.62 \pm 0.12
<i>Gray Fox</i>	207	0.76 \pm 0.09	0.96 \pm 0.12	0.38 \pm 0.09
<i>Coyote</i>	78	0.29 \pm 0.06	0.16 \pm 0.04	0.54 \pm 0.16
<i>Bobcat</i>	52	0.19 \pm 0.03	0.18 \pm 0.04	0.21 \pm 0.06
<i>Raccoon</i>	316	1.16 \pm 0.12	1.16 \pm 0.14	1.16 \pm 0.19
<i>Opossum</i>	46	0.17 \pm 0.03	0.12 \pm 0.03	0.26 \pm 0.06
<i>Striped Skunk</i>	35	0.13 \pm 0.03	0.09 \pm 0.03	0.21 \pm 0.05
<i>River Otter</i>	19	0.07 \pm 0.03	0.10 \pm 0.04	0.01 \pm 0.01
<i>Mink</i>	6	0.02 \pm 0.01	0.02 \pm 0.01	0.02 \pm 0.02
<i>Dog</i>	659	2.42 \pm 0.30	2.95 \pm 0.43	1.40 \pm 0.28
<i>House Cat</i>	162	0.59 \pm 0.08	0.56 \pm 0.11	0.66 \pm 0.11
<i>Hunter</i>	1,965	7.22 \pm 0.73	6.87 \pm 0.91	7.89 \pm 1.17
<i>Number of hunters (n)</i>		560	399	214
<i>Number of hunts</i>		6,523	4,304	2,219
<i>Average hunt length (hrs.)</i>		4.17 \pm 0.03	4.18 \pm 0.04	4.17 \pm 0.05

Table 2. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters October 5 - November 16, 2002 on private and public lands in Virginia.

Animal	Animals Seen/100 hrs. \pm SE	
	Private Land	Public Land
<i>Deer (antlered)</i>	14.15 \pm 0.68	7.62 \pm 0.66
<i>Deer (doe)</i>	34.55 \pm 1.50	23.35 \pm 2.27
<i>Deer (fawn)</i>	16.80 \pm 1.28	10.84 \pm 1.73
<i>Deer (unknown)</i>	14.13 \pm 1.00	8.75 \pm 0.86
<i>Gray Squirrel</i>	102.16 \pm 3.83	80.64 \pm 7.26
<i>Fox Squirrel</i>	7.27 \pm 1.06	4.84 \pm 1.40
<i>Wild Turkey</i>	29.16 \pm 2.86	21.16 \pm 3.26
<i>Grouse</i>	1.06 \pm 0.17	2.46 \pm 0.45
<i>Bear</i>	0.40 \pm 0.10	0.36 \pm 0.10
<i>Red Fox</i>	1.02 \pm 0.11	0.52 \pm 0.15
<i>Gray Fox</i>	0.72 \pm 0.09	0.99 \pm 0.26
<i>Coyote</i>	0.26 \pm 0.06	0.40 \pm 0.15
<i>Bobcat</i>	0.17 \pm 0.03	0.30 \pm 0.09
<i>Raccoon</i>	1.21 \pm 0.13	1.01 \pm 0.30
<i>Opossum</i>	0.18 \pm 0.03	0.14 \pm 0.05
<i>Striped Skunk</i>	0.14 \pm 0.03	0.10 \pm 0.04
<i>Otter</i>	0.07 \pm 0.03	0.06 \pm 0.06
<i>Mink</i>	0.02 \pm 0.01	0.02 \pm 0.02
<i>Dog</i>	2.67 \pm 0.35	1.45 \pm 0.56
<i>House Cat</i>	0.67 \pm 0.10	0.32 \pm 0.12
<i>Hunter</i>	6.06 \pm 0.79	12.47 \pm 1.76
<i>Number of hunters (n)</i>	504	177
<i>Number of hunts</i>	5,347	1,035
<i>Average hunt length (hrs.)</i>	4.04 \pm 0.03	4.79 \pm 0.08

Table 3. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters October 5 - November 16, 2002 on private and public lands east and west of the Blue Ridge Mountains in Virginia.

Animal	Animals Seen/100 hrs. \pm SE			
	EBR		WBR	
	Private Land	Public Land	Private Land	Public Land
<i>Deer (antlered)</i>	13.40 \pm 0.72	9.02 \pm 1.04	15.87 \pm 1.45	6.39 \pm 0.86
<i>Deer (doe)</i>	29.85 \pm 1.46	24.22 \pm 3.68	45.35 \pm 3.39	22.59 \pm 2.80
<i>Deer (fawn)</i>	12.54 \pm 1.43	9.37 \pm 2.33	26.56 \pm 2.32	12.13 \pm 2.39
<i>Deer (unknown)</i>	10.37 \pm 0.71	6.48 \pm 1.01	22.75 \pm 2.68	10.73 \pm 1.23
<i>Gray Squirrel</i>	106.24 \pm 4.62	83.16 \pm 8.52	92.79 \pm 6.89	78.44 \pm 11.31
<i>Fox Squirrel</i>	1.02 \pm 0.26	1.38 \pm 0.70	21.61 \pm 2.84	7.86 \pm 2.29
<i>Wild Turkey</i>	24.38 \pm 3.32	15.76 \pm 3.70	40.15 \pm 5.28	25.88 \pm 4.92
<i>Grouse</i>	0.23 \pm 0.08	0.69 \pm 0.31	2.96 \pm 0.49	4.00 \pm 0.72
<i>Bear</i>	0.16 \pm 0.07	0.13 \pm 0.09	0.92 \pm 0.27	0.57 \pm 0.16
<i>Red Fox</i>	1.12 \pm 0.14	0.95 \pm 0.30	0.79 \pm 0.16	0.15 \pm 0.09
<i>Gray Fox</i>	0.86 \pm 0.12	1.77 \pm 0.53	0.41 \pm 0.12	0.30 \pm 0.10
<i>Coyote</i>	0.14 \pm 0.04	0.30 \pm 0.20	0.55 \pm 0.15	0.49 \pm 0.22
<i>Bobcat</i>	0.17 \pm 0.04	0.30 \pm 0.14	0.17 \pm 0.06	0.30 \pm 0.13
<i>Raccoon</i>	1.16 \pm 0.14	1.34 \pm 0.59	1.34 \pm 0.25	0.72 \pm 0.22
<i>Opossum</i>	0.14 \pm 0.03	0.04 \pm 0.04	0.27 \pm 0.07	0.23 \pm 0.09
<i>Striped Skunk</i>	0.10 \pm 0.04	0.04 \pm 0.04	0.23 \pm 0.06	0.15 \pm 0.08
<i>River Otter</i>	0.10 \pm 0.05	0.13 \pm 0.13	0.02 \pm 0.02	0.00 \pm 0.00
<i>Mink</i>	0.02 \pm 0.01	0.04 \pm 0.04	0.03 \pm 0.02	0.00 \pm 0.00
<i>Dog</i>	3.17 \pm 0.48	1.90 \pm 1.10	1.54 \pm 0.30	1.06 \pm 0.44
<i>House Cat</i>	0.60 \pm 0.13	0.39 \pm 0.19	0.82 \pm 0.14	0.26 \pm 0.16
<i>Hunter</i>	5.89 \pm 0.96	13.56 \pm 2.83	6.44 \pm 1.37	11.52 \pm 2.16
<i>Number of hunters (n)</i>	363	79	174	104

Table 4. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters October 5 - November 16, 2002 within physiographic regions of Virginia.

Animal	Animals Seen/ 100 hrs. \pm SE				
	Tidewater	S. Piedmont	S. Mountain	N. Mountain	N. Piedmont
<i>Deer (antlered)</i>	11.54 \pm 0.96	12.30 \pm 1.11	14.04 \pm 1.67	11.72 \pm 1.35	15.08 \pm 1.24
<i>Deer (doe)</i>	26.28 \pm 2.03	28.14 \pm 2.06	39.11 \pm 3.10	38.04 \pm 5.08	33.02 \pm 2.89
<i>Deer (fawn)</i>	11.69 \pm 1.55	12.96 \pm 3.46	21.43 \pm 2.65	23.70 \pm 2.72	12.43 \pm 1.38
<i>Deer (unknown)</i>	9.13 \pm 0.85	9.15 \pm 1.09	19.37 \pm 3.04	19.14 \pm 2.21	11.36 \pm 1.35
<i>Gray Squirrel</i>	76.09 \pm 4.66	108.10 \pm 7.43	74.75 \pm 7.44	107.74 \pm 10.15	129.16 \pm 8.47
<i>Fox Squirrel</i>	0.39 \pm 0.22	1.07 \pm 0.39	15.70 \pm 2.96	20.41 \pm 3.23	2.03 \pm 0.61
<i>Wild Turkey</i>	16.56 \pm 2.10	38.07 \pm 7.94	45.21 \pm 6.28	23.86 \pm 3.76	16.02 \pm 2.74
<i>Grouse</i>	0.16 \pm 0.12	0.55 \pm 0.20	4.14 \pm 0.62	2.07 \pm 0.42	0.18 \pm 0.09
<i>Bear</i>	0.01 \pm 0.01	0.04 \pm 0.03	0.95 \pm 0.32	0.70 \pm 0.17	0.43 \pm 0.20
<i>Red Fox</i>	0.56 \pm 0.11	0.47 \pm 0.14	0.54 \pm 0.15	0.73 \pm 0.21	2.28 \pm 0.33
<i>Gray Fox</i>	1.42 \pm 0.23	0.71 \pm 0.19	0.30 \pm 0.11	0.49 \pm 0.16	0.62 \pm 0.18
<i>Coyote</i>	0.10 \pm 0.05	0.27 \pm 0.11	0.87 \pm 0.26	0.08 \pm 0.04	0.11 \pm 0.06
<i>Bobcat</i>	0.09 \pm 0.04	0.35 \pm 0.10	0.30 \pm 0.09	0.08 \pm 0.04	0.14 \pm 0.06
<i>Raccoon</i>	1.69 \pm 0.28	0.91 \pm 0.21	1.39 \pm 0.28	0.83 \pm 0.25	0.74 \pm 0.20
<i>Opossum</i>	0.14 \pm 0.04	0.15 \pm 0.05	0.26 \pm 0.09	0.26 \pm 0.08	0.07 \pm 0.04
<i>Striped Skunk</i>	0.06 \pm 0.03	0.13 \pm 0.08	0.20 \pm 0.07	0.21 \pm 0.07	0.09 \pm 0.04
<i>River Otter</i>	0.11 \pm 0.05	0.13 \pm 0.11	0.02 \pm 0.02	0.00 \pm 0.00	0.05 \pm 0.05
<i>Mink</i>	0.03 \pm 0.02	0.00 \pm 0.00	0.02 \pm 0.02	0.03 \pm 0.03	0.04 \pm 0.03
<i>Dog</i>	3.04 \pm 0.74	3.37 \pm 0.95	2.15 \pm 0.45	0.34 \pm 0.11	2.41 \pm 0.43
<i>House Cat</i>	0.54 \pm 0.19	0.60 \pm 0.22	0.78 \pm 0.16	0.49 \pm 0.14	0.54 \pm 0.15
<i>Hunter</i>	6.11 \pm 1.20	7.06 \pm 2.09	8.66 \pm 1.67	6.82 \pm 1.54	7.63 \pm 1.34
<i>Number of hunters (n)</i>	177	132	118	106	134
<i>Number of hunts</i>	1,686	1,294	1,296	923	1,324
<i>Average hunt length (hrs.)</i>	4.14 \pm 0.05	4.25 \pm 0.07	4.16 \pm 0.07	4.18 \pm 0.08	4.17 \pm 0.06

Table 5. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters by week during October 5 - November 16, 2002 in Virginia.

Animal	Animals Seen/100 hrs. + SE						
	Day 1 (10/5)	Week 1 (10/7-12)	Week 2 (10/14-19)	Week 3 (10/21-26)	Week 4 (10/28-11/2)	Week 5 (11/4-9)	Week 6 (11/11-16)
<i>Deer (antlered)</i>	9.53 ± 1.00	11.15 ± 0.81	12.30 ± 0.89	13.16 ± 0.90	16.09 ± 1.08	15.00 ± 1.18	12.86 ± 1.22
<i>Deer (doe)</i>	26.57 ± 2.02	33.31 ± 2.16	34.92 ± 2.11	32.50 ± 2.09	32.81 ± 2.31	28.93 ± 1.90	32.96 ± 3.68
<i>Deer (fawn)</i>	14.06 ± 1.35	16.87 ± 1.58	17.46 ± 1.55	15.13 ± 1.56	14.92 ± 1.50	13.83 ± 1.52	16.24 ± 2.24
<i>Deer (unknown)</i>	10.79 ± 1.46	14.77 ± 1.64	13.46 ± 1.17	14.35 ± 1.20	14.23 ± 1.24	9.70 ± 0.94	11.68 ± 1.73
<i>Gray Squirrel</i>	98.45 ± 4.86	103.92 ± 5.36	102.86 ± 4.87	105.97 ± 4.74	95.19 ± 4.87	84.53 ± 5.00	83.03 ± 6.64
<i>Fox Squirrel</i>	9.67 ± 1.49	9.74 ± 1.98	6.24 ± 0.89	6.03 ± 0.92	4.86 ± 0.92	4.46 ± 0.77	6.15 ± 1.53
<i>Wild Turkey</i>	26.25 ± 3.59	29.02 ± 3.80	27.67 ± 3.74	28.47 ± 4.02	35.32 ± 4.87	20.89 ± 2.38	22.88 ± 3.47
<i>Grouse</i>	1.54 ± 0.61	1.32 ± 0.23	1.38 ± 0.33	1.05 ± 0.21	1.39 ± 0.37	1.35 ± 0.38	1.15 ± 0.30
<i>Bear</i>	0.47 ± 0.29	0.46 ± 0.14	0.62 ± 0.19	0.30 ± 0.10	0.50 ± 0.17	0.16 ± 0.06	0.07 ± 0.05
<i>Red Fox</i>	0.93 ± 0.23	0.85 ± 0.15	0.96 ± 0.18	0.85 ± 0.16	1.08 ± 0.18	1.04 ± 0.23	0.63 ± 0.16
<i>Gray Fox</i>	0.65 ± 0.19	0.95 ± 0.19	1.02 ± 0.18	0.50 ± 0.15	0.53 ± 0.14	0.91 ± 0.22	0.52 ± 0.21
<i>Coyote</i>	0.33 ± 0.17	0.30 ± 0.10	0.22 ± 0.10	0.25 ± 0.09	0.31 ± 0.13	0.23 ± 0.09	0.45 ± 0.26
<i>Bobcat</i>	0.33 ± 0.14	0.17 ± 0.06	0.22 ± 0.07	0.21 ± 0.07	0.33 ± 0.11	0.08 ± 0.04	0.03 ± 0.03

Table 5 (continued). Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters by week during October 5 - November 16, 2002 in Virginia.

Animal	Animals Seen/100 hrs. + SE						
	Day 1 (10/6)	Week 1 (10/8-13)	Week 2 (10/15-20)	Week 3 (10/22-27)	Week 4 (10/29-11/4)	Week 5 (11/5-10)	Week 6 (11/12-17)
<i>Raccoon</i>	1.63 ± 0.47	1.36 ± 0.25	1.38 ± 0.25	1.44 ± 0.25	0.94 ± 0.24	0.67 ± 0.19	0.56 ± 0.17
<i>Opossum</i>	0.14 ± 0.06	0.19 ± 0.06	0.14 ± 0.06	0.18 ± 0.06	0.25 ± 0.09	0.10 ± 0.05	0.17 ± 0.08
<i>Striped Skunk</i>	0.09 ± 0.07	0.17 ± 0.06	0.14 ± 0.06	0.11 ± 0.05	0.14 ± 0.06	0.13 ± 0.06	0.07 ± 0.05
<i>River Otter</i>	0.00 ± 0.00	0.06 ± 0.06	0.16 ± 0.09	0.14 ± 0.07	0.00 ± 0.00	0.03 ± 0.03	0.04 ± 0.04
<i>Mink</i>	0.00 ± 0.00	0.02 ± 0.02	0.02 ± 0.02	0.07 ± 0.04	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00
<i>Dog</i>	2.20 ± 0.53	2.27 ± 0.51	2.17 ± 0.51	2.09 ± 0.36	2.50 ± 0.48	2.98 ± 0.63	2.96 ± 0.69
<i>House Cat</i>	0.33 ± 0.12	0.69 ± 0.17	0.70 ± 0.13	0.60 ± 0.12	0.69 ± 0.19	0.57 ± 0.20	0.35 ± 0.13
<i>Hunter</i>	10.70 ± 1.18	7.45 ± 1.02	6.12 ± 0.78	5.32 ± 0.80	5.97 ± 0.94	9.00 ± 1.43	8.14 ± 1.45
<i>Number of hunters (n)</i>	382	471	461	437	397	309	215
<i>Number of hunts</i>	418	1,301	1,257	1,153	923	855	616
<i>Average hunt length (hrs.)</i>	5.12 ± 0.12	4.14 ± 0.06	3.99 ± 0.06	3.78 ± 0.06	3.90 ± 0.07	4.51 ± 0.09	4.67 ± 0.11

Table 6. Doe-buck and fawn-doe ratio estimates (a) east and west of the Blue Ridge Mountains, (b) by land ownership, (c) by region, and (d) by week of survey season based on cooperating archery hunter observations in Virginia during October 5 - November 16, 2002.

(a)

Ratio	East of BR	West of BR	Statewide
<i>Doe: Buck</i>	2.25	2.96	2.49
<i>Fawn: Doe</i>	0.43	0.58	0.49

(b)

Ratio	Private	Public
<i>Doe: Buck</i>	2.44	3.06
<i>Fawn: Doe</i>	0.49	0.46

(c)

Ratio	Tidewater	S. Piedmont	S. Mountain	N. Mountain	N. Piedmont
<i>Doe: Buck</i>	2.28	2.29	2.79	3.25	2.19
<i>Fawn: Doe</i>	0.44	0.46	0.55	0.62	0.38

(d)

Ratio	Day 1	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
<i>Doe: Buck</i>	2.79	2.99	2.84	2.47	2.04	1.93	2.56
<i>Fawn: Doe</i>	0.53	0.51	0.50	0.47	0.45	0.48	0.49

Table 7. Statewide observations (per 100 Hunts) of miscellaneous animals reported by cooperating archery hunters during October 5 - November 16, 2002 in Virginia.

Animal	Total Observations	Observations / 100 Hunts
Bats	2	0.03
Beaver	7	0.11
Buzzard	3	0.05
Chipmunk	90	1.38
Crow	65	1.00
Doves	9	0.14
Ducks	33	0.51
Eagle	29	0.44
Falcon	1	0.02
Flying Squirrels	1	0.02
Geese	68	1.04
Groundhog	133	2.04
Hawk	157	2.41
Hérons	0	0.00
Miscellaneous Birds	74	1.13
Mouse	4	0.06
Muskrat	0	0.00
Nutria	2	0.03
Owl	57	0.87
Pheasant	0	0.00
Quail	23	0.35
Rabbit	92	1.41
Red Squirrel	7	0.11
Shrew	0	0.00
Sika & Other Deer	1	0.02
Snake	6	0.09
Snipe	2	0.03
Turtles	9	0.14
Weasel	0	0.00
Woodcock	7	0.11

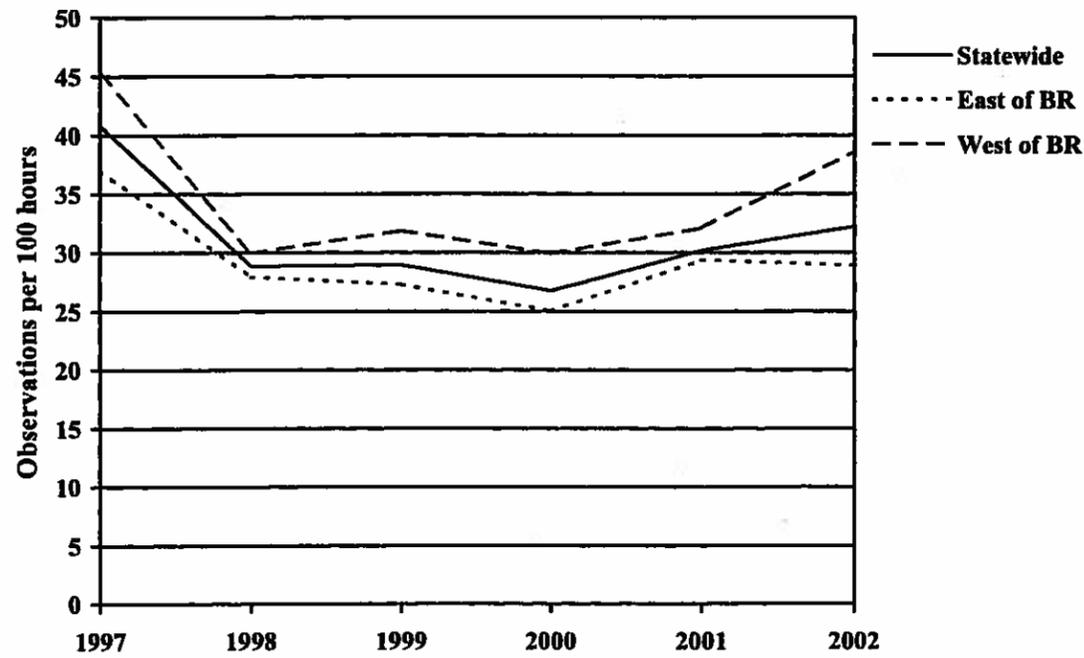


Figure 4. Doe deer observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

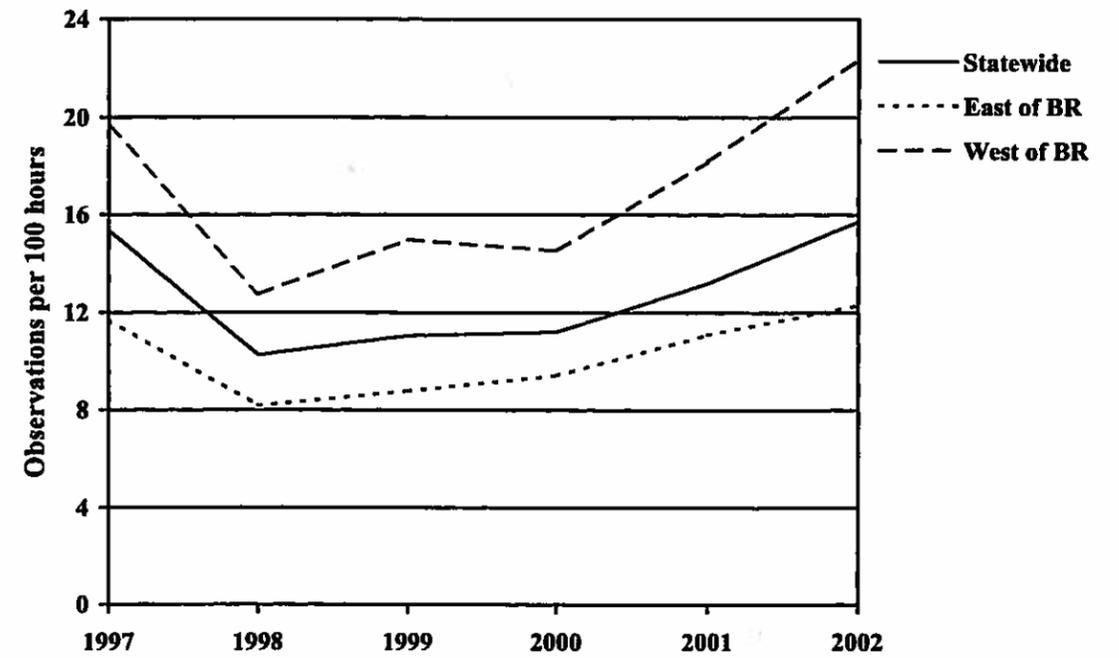


Figure 6. Fawns observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

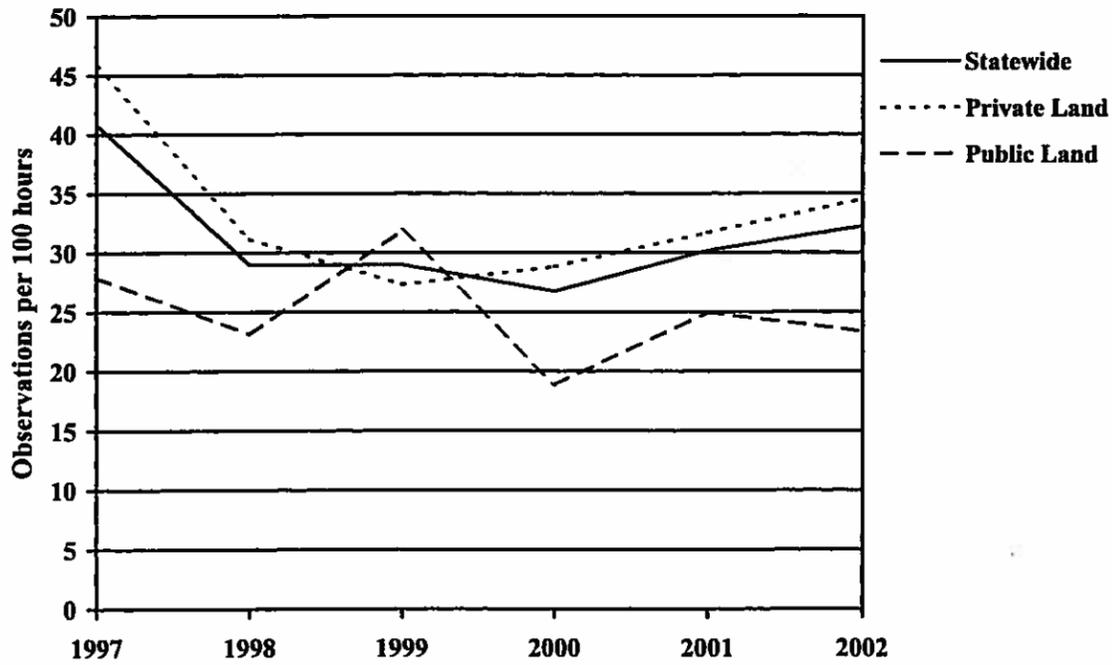


Figure 5. Doe deer observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

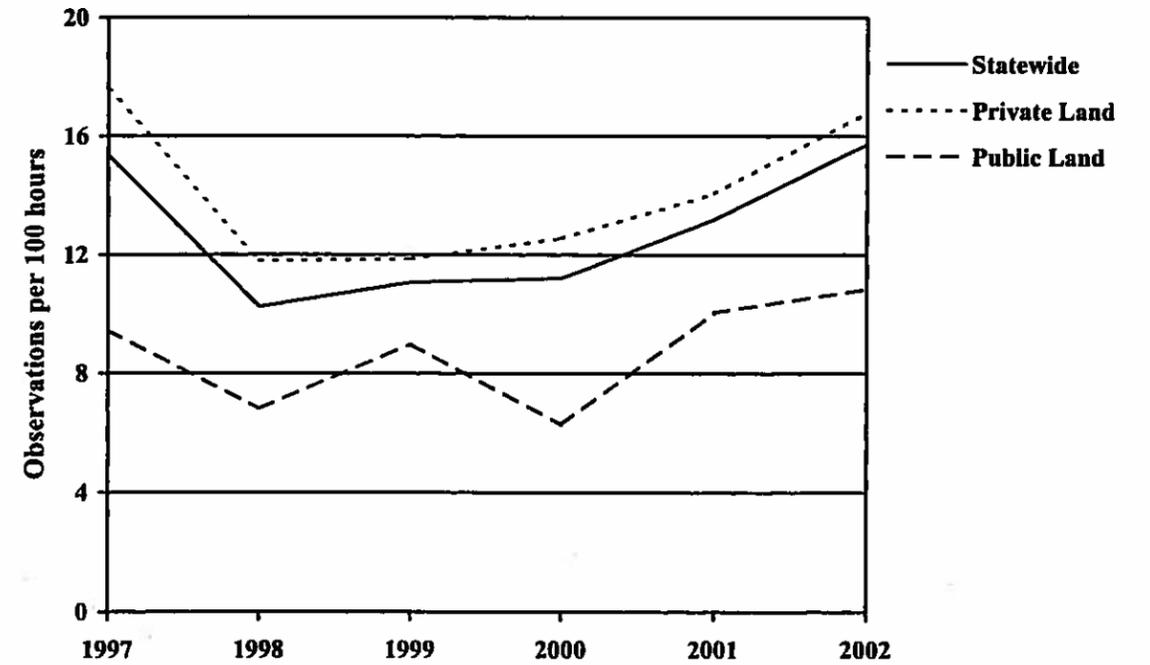


Figure 7. Fawns observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

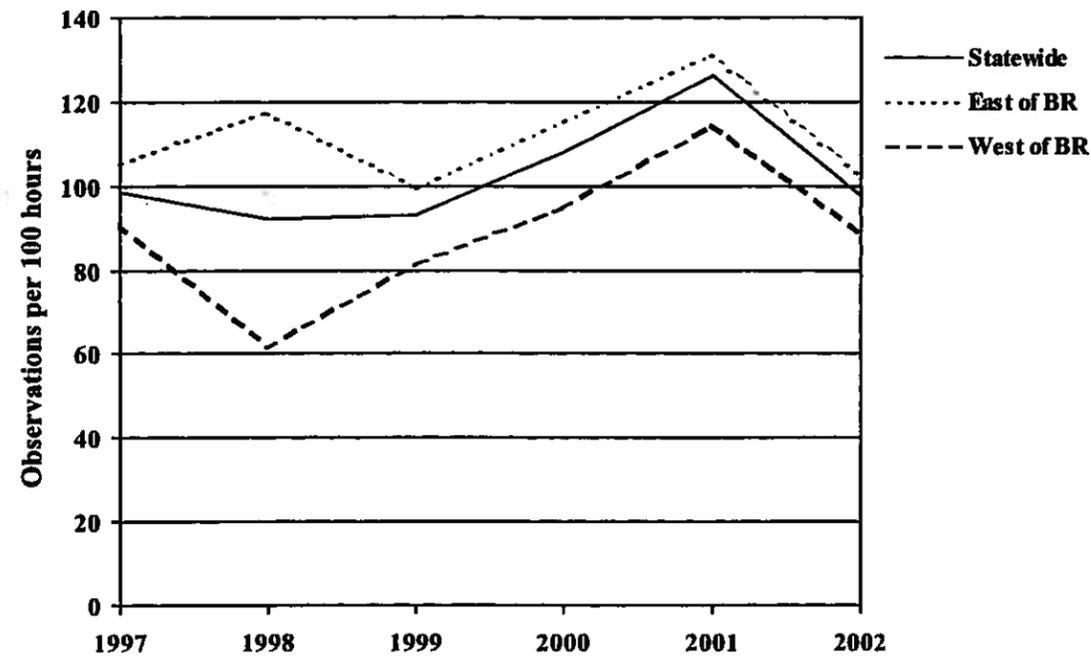


Figure 8. Gray squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

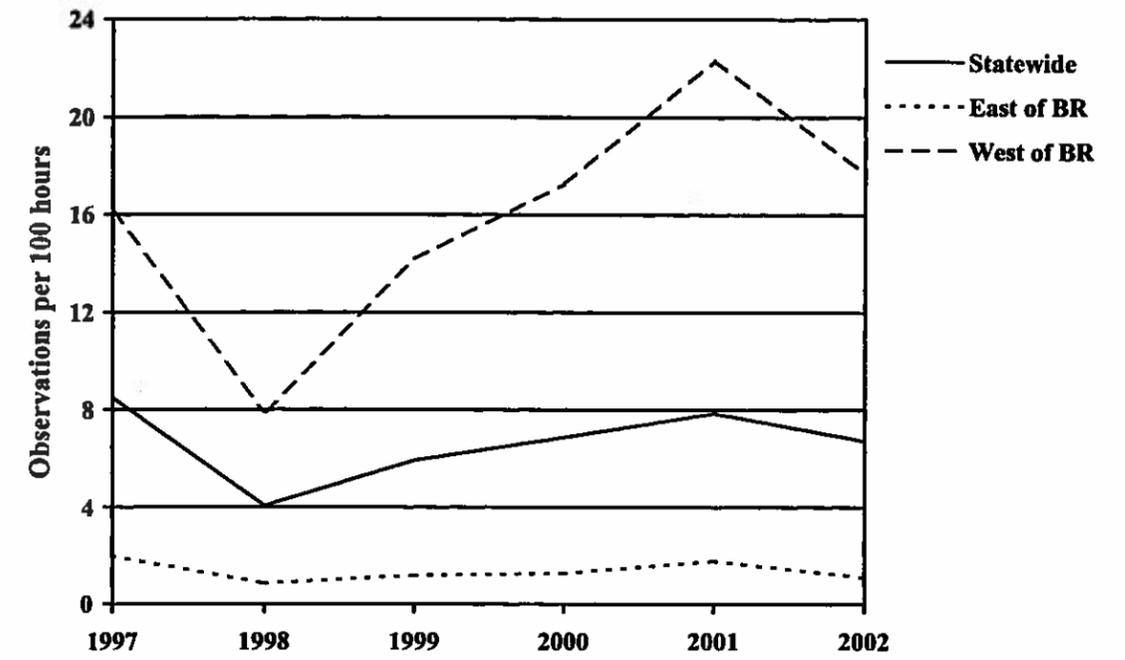


Figure 10. Fox squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

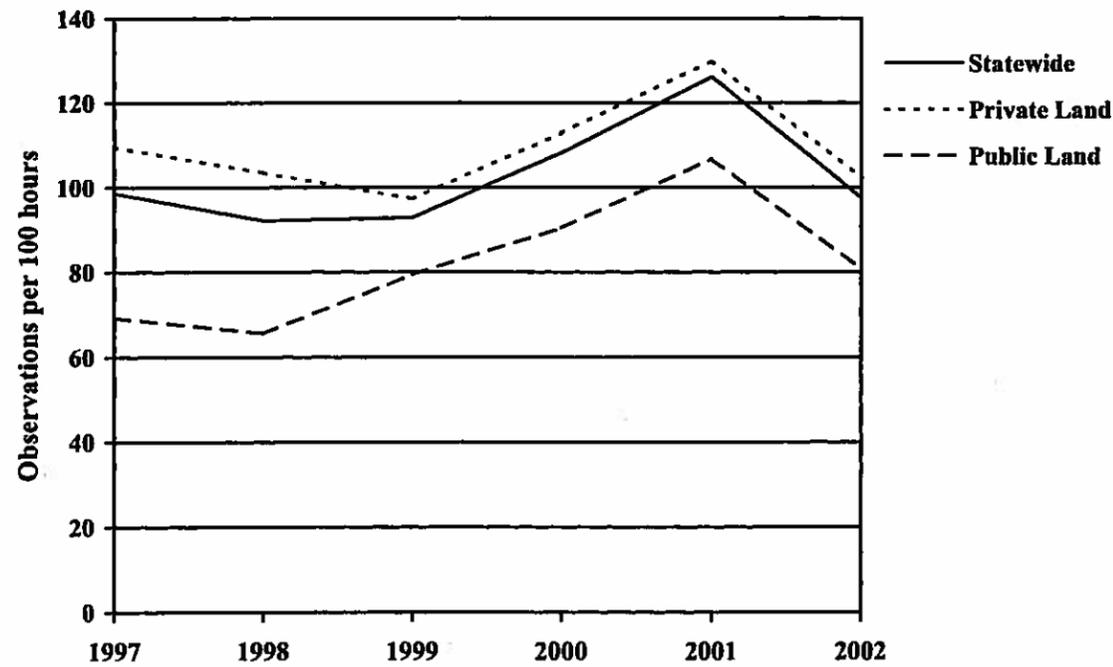


Figure 9. Gray squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

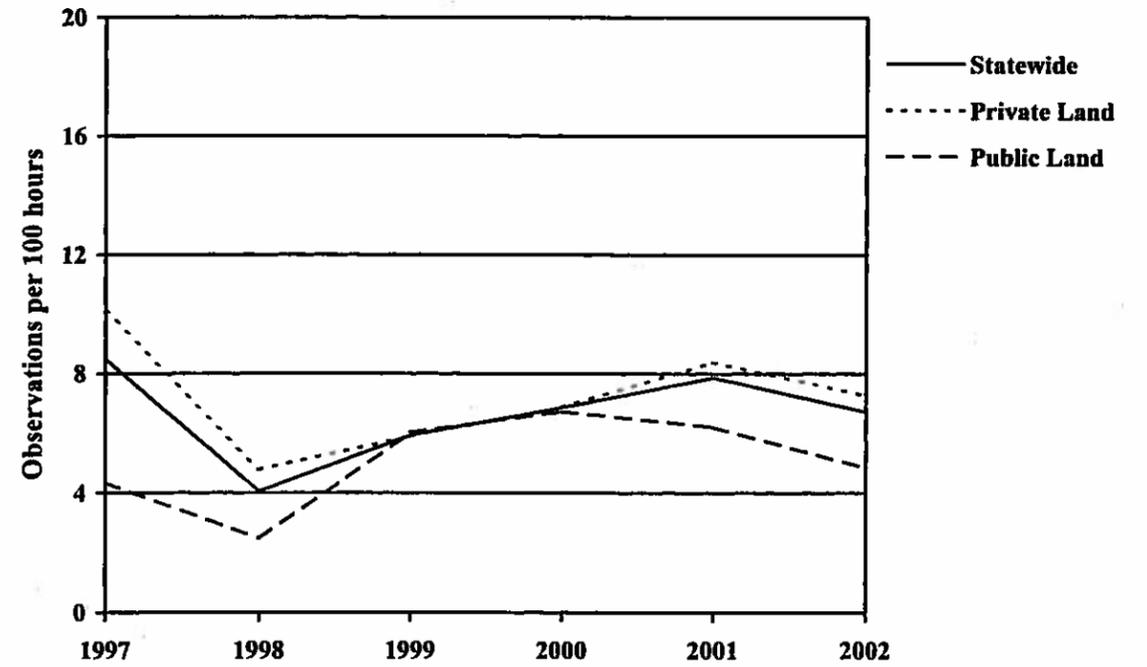


Figure 11. Fox squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

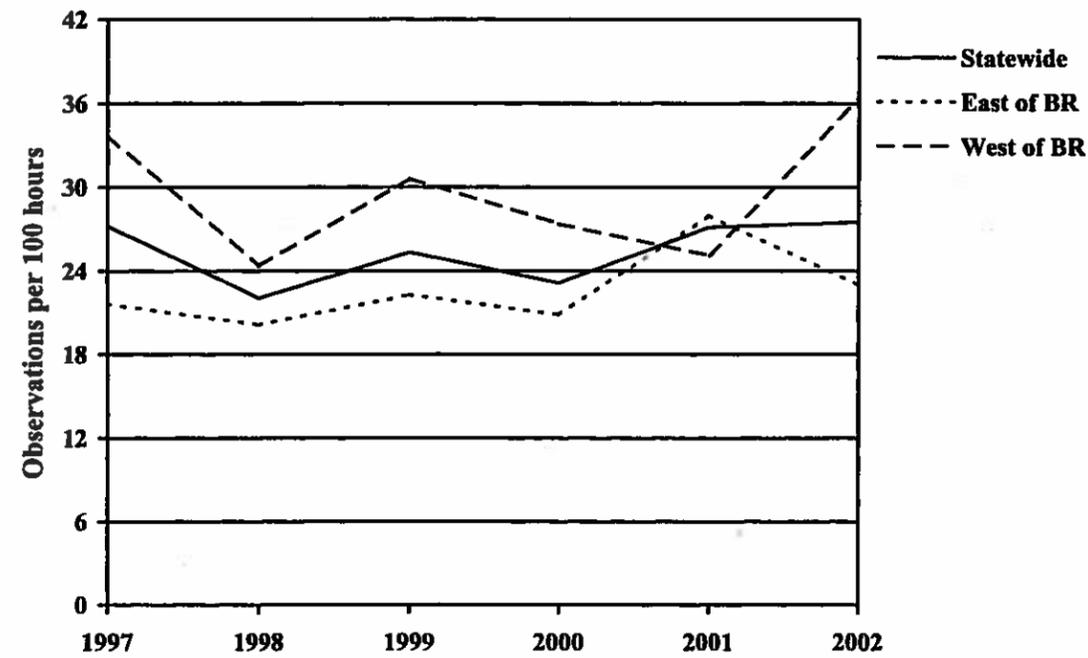


Figure 12. Wild turkeys observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

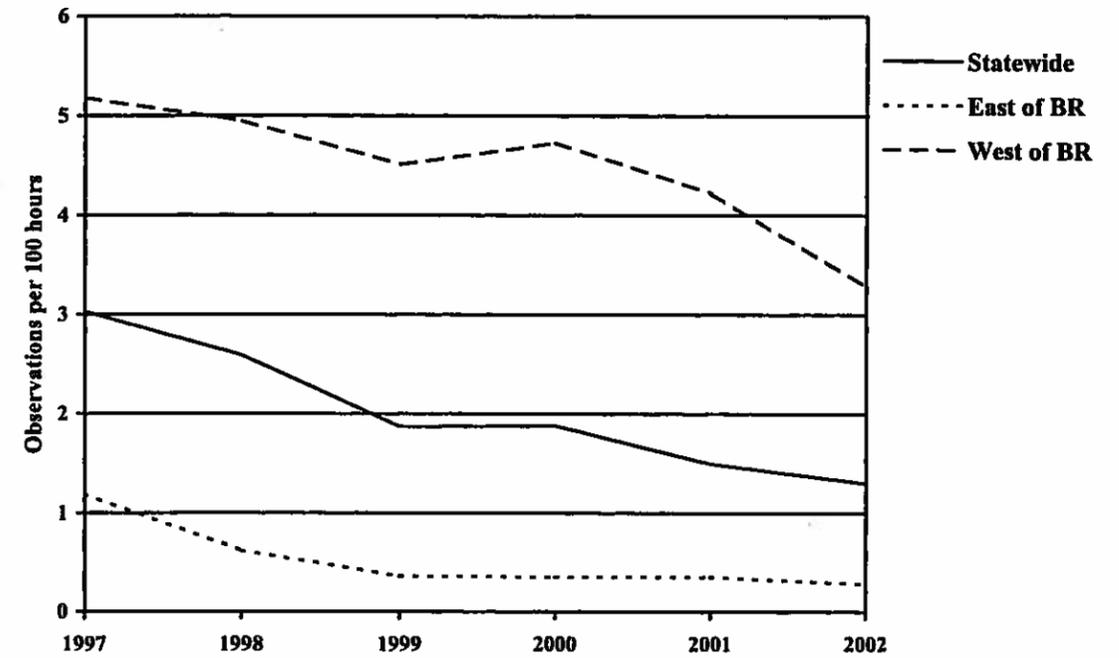


Figure 14. Ruffed grouse observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

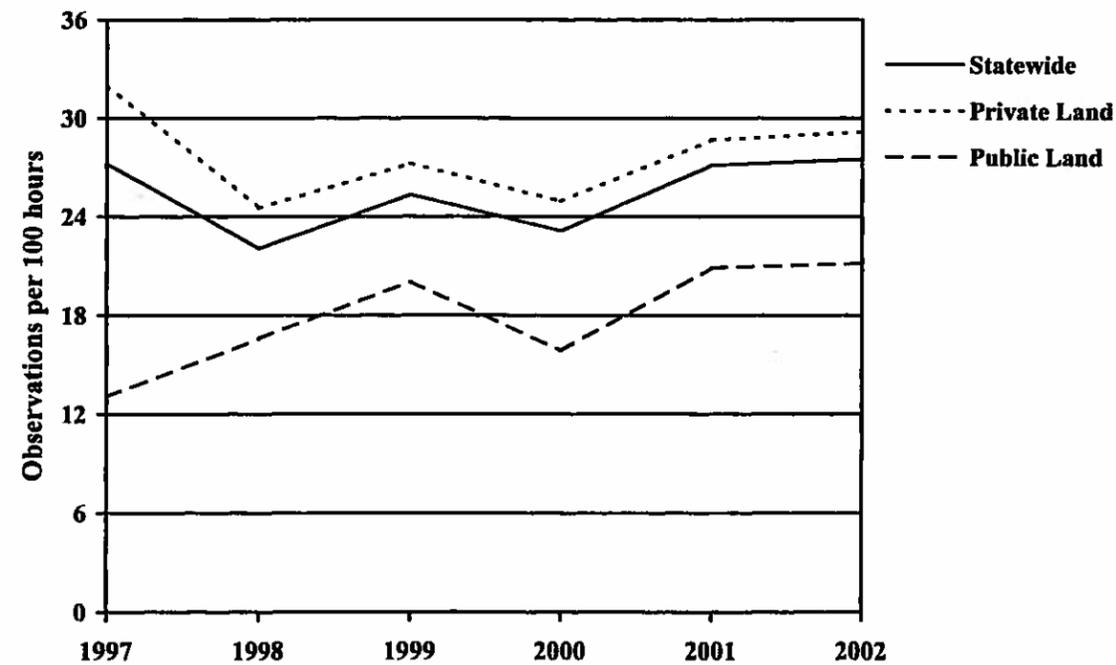


Figure 13. Wild turkeys observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

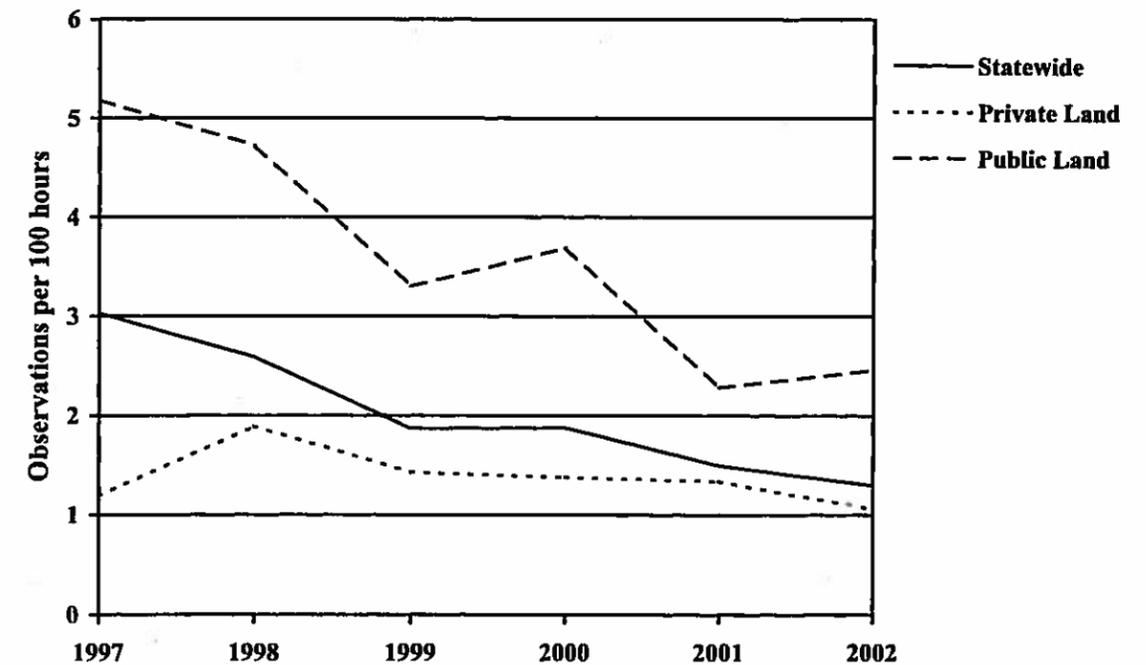


Figure 15. Ruffed grouse observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

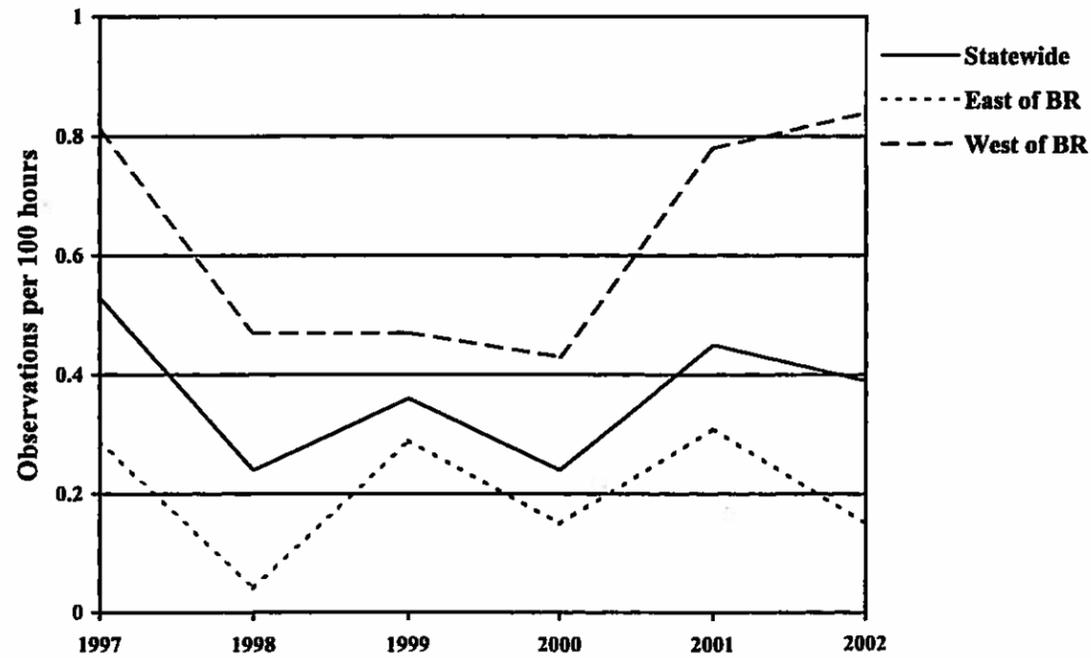


Figure 16. Black bears observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

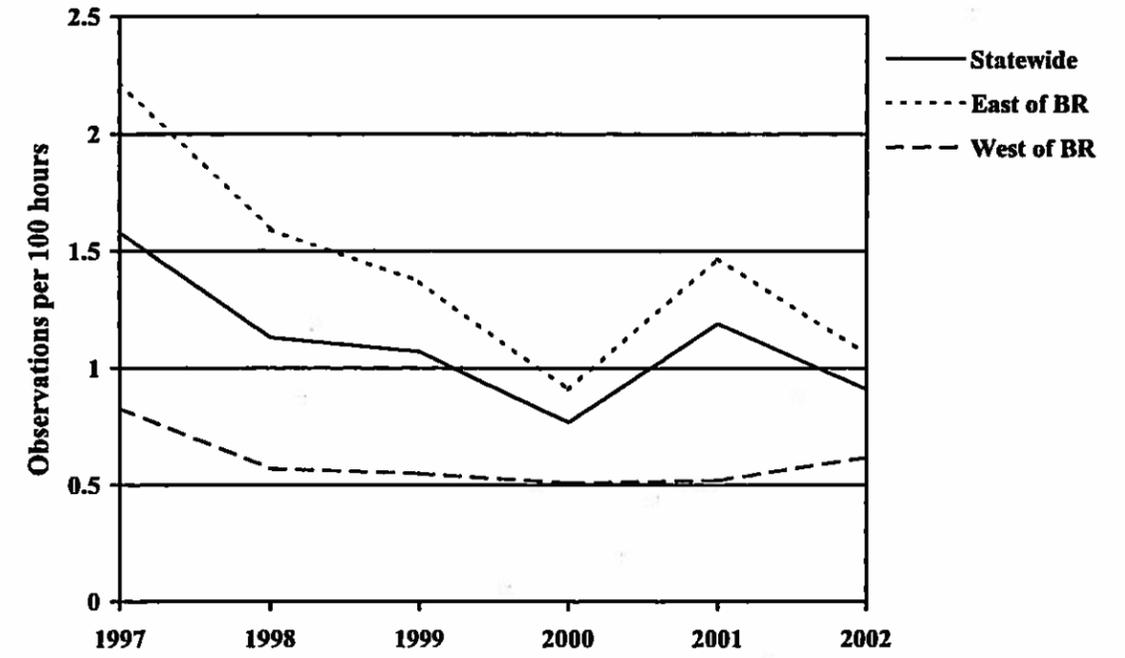


Figure 18. Red foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

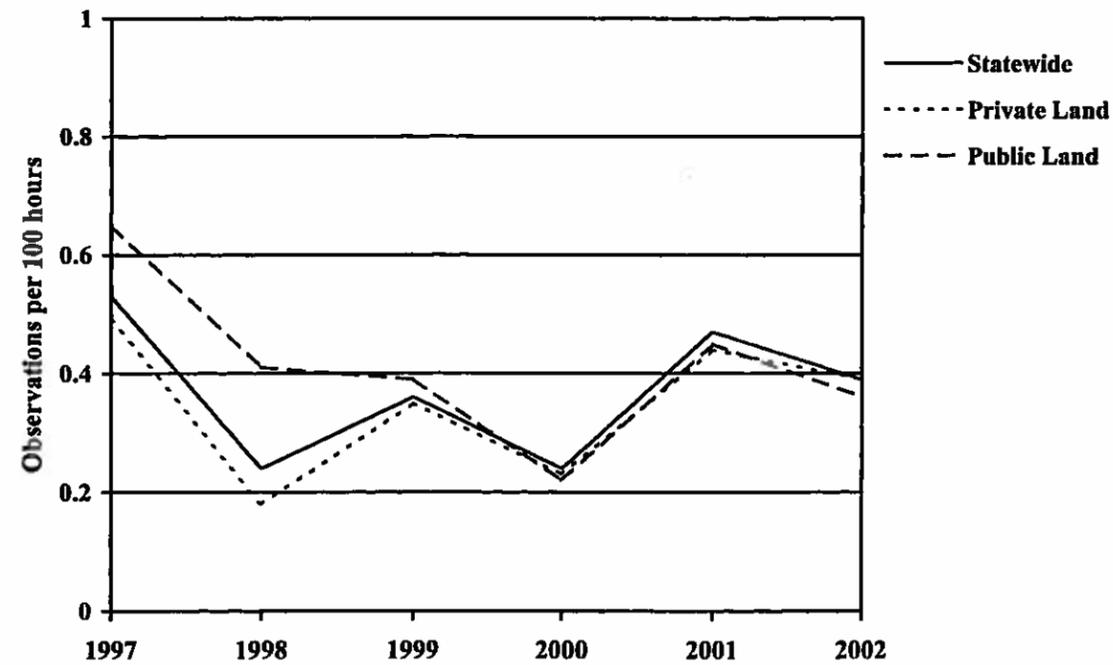


Figure 17. Black bears observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

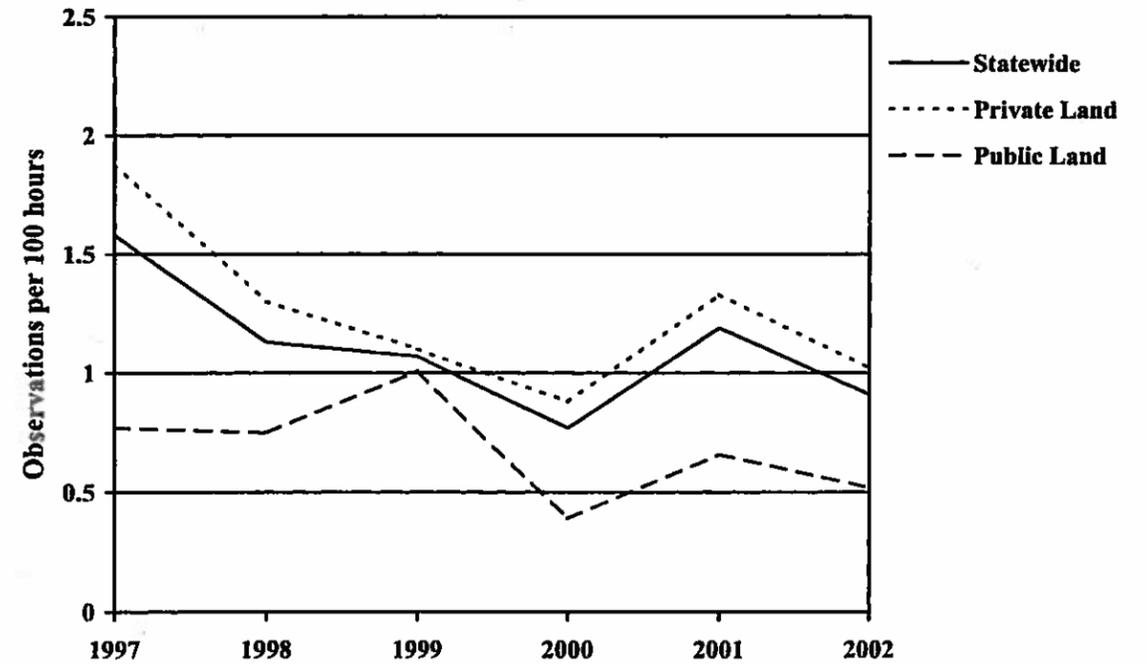


Figure 19. Red foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

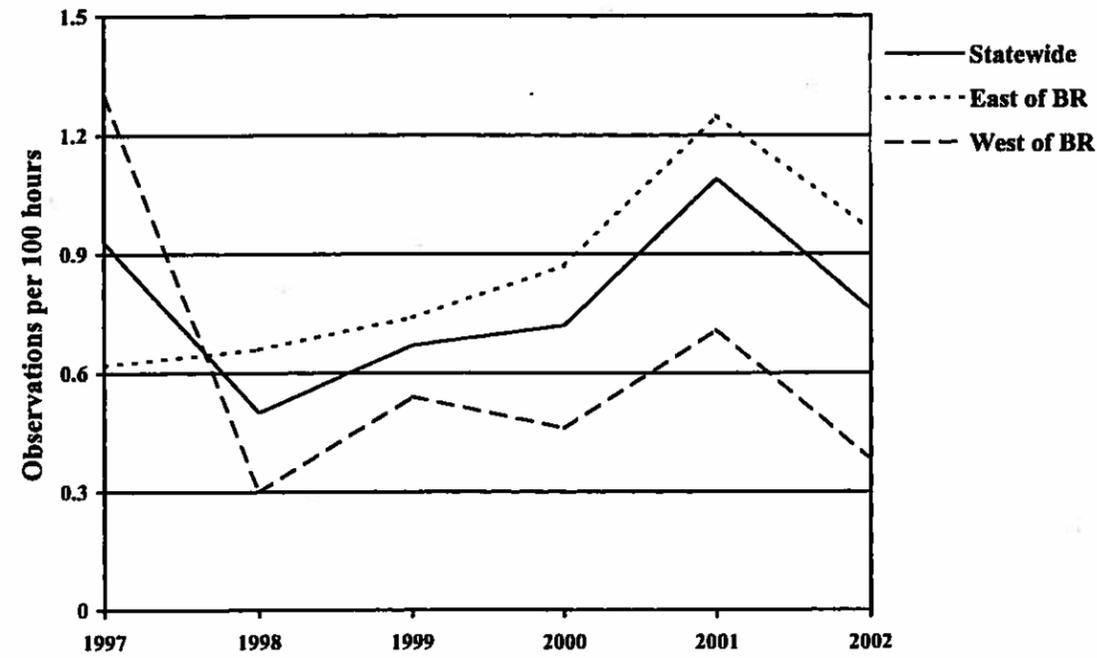


Figure 20. Gray foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

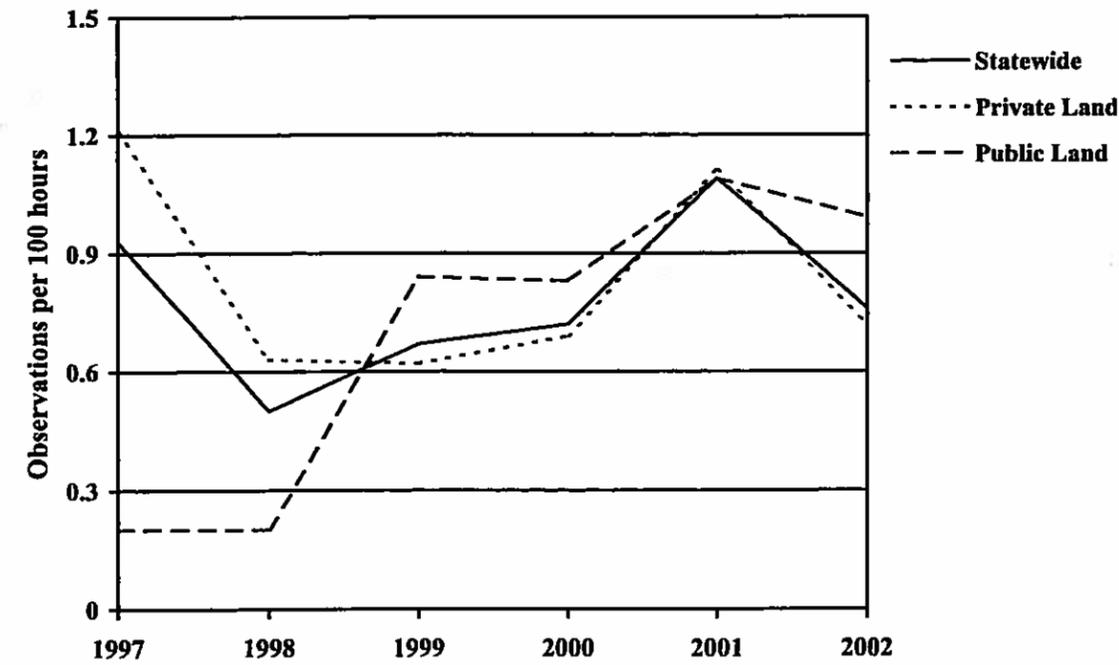


Figure 21. Gray foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

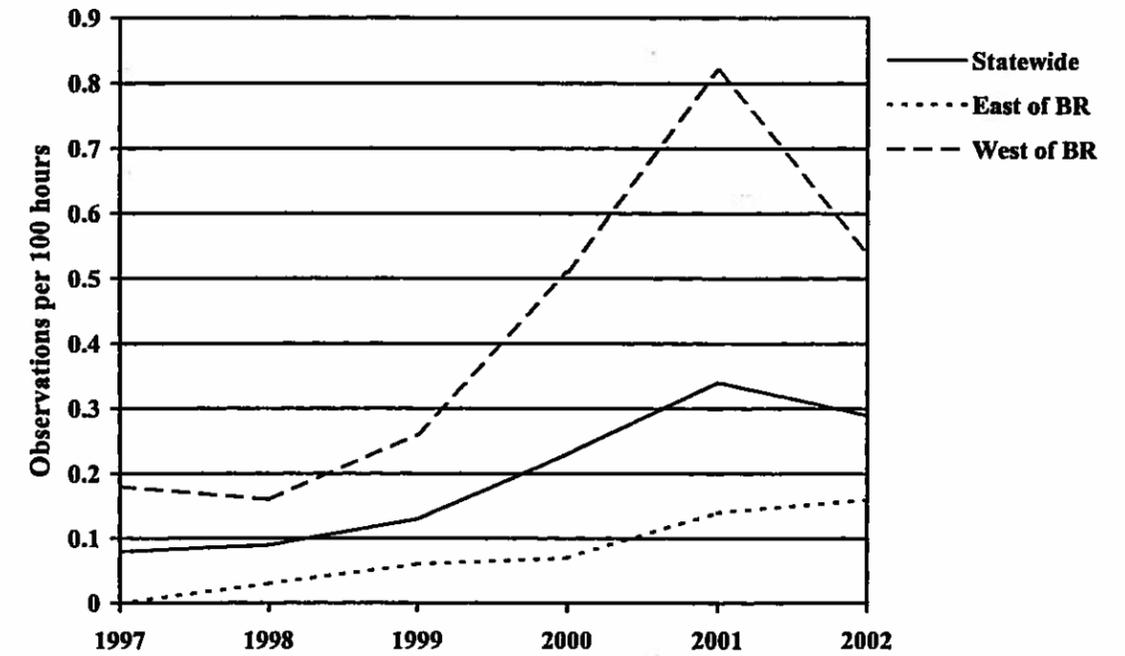


Figure 22. Coyotes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

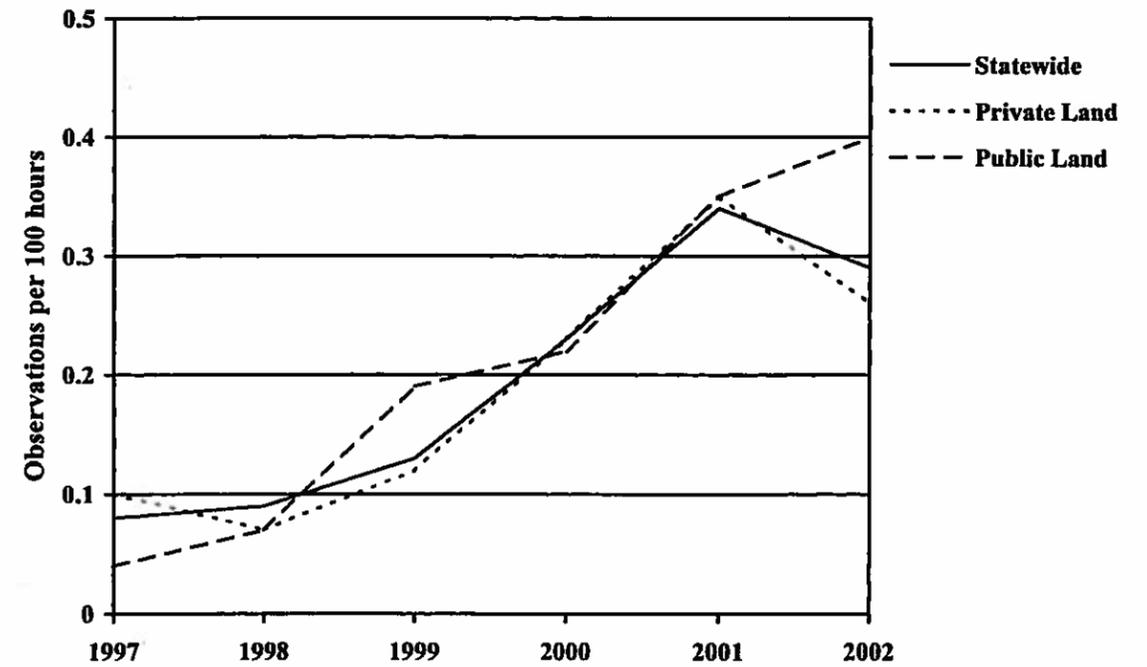


Figure 23. Coyotes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

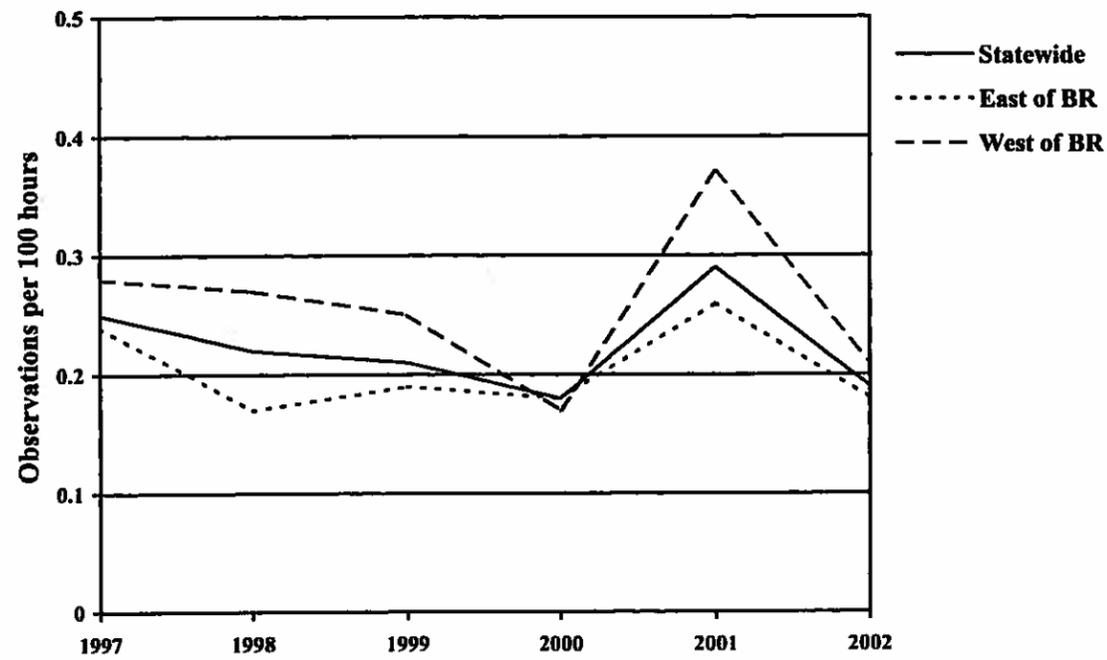


Figure 24. Bobcats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

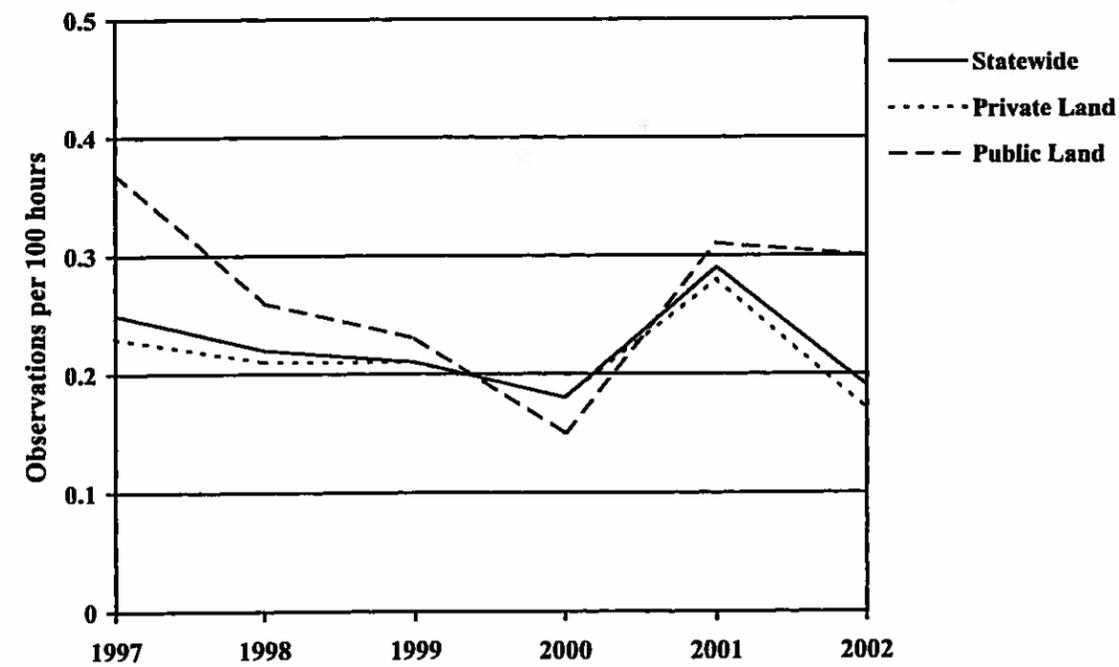


Figure 25. Bobcats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

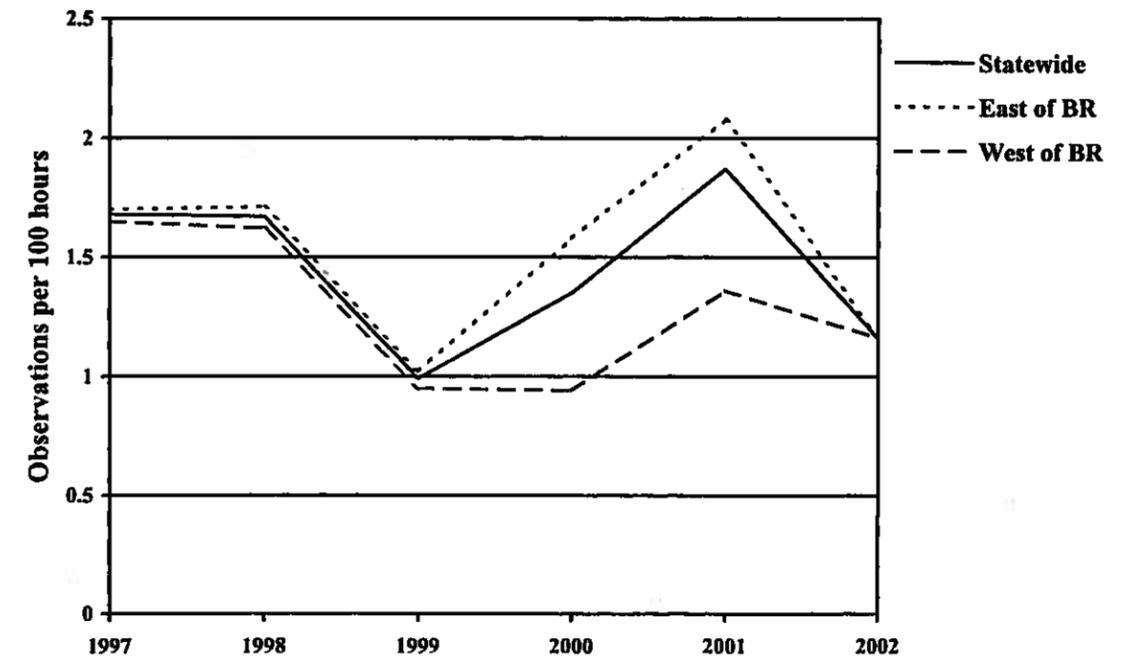


Figure 26. Raccoons observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

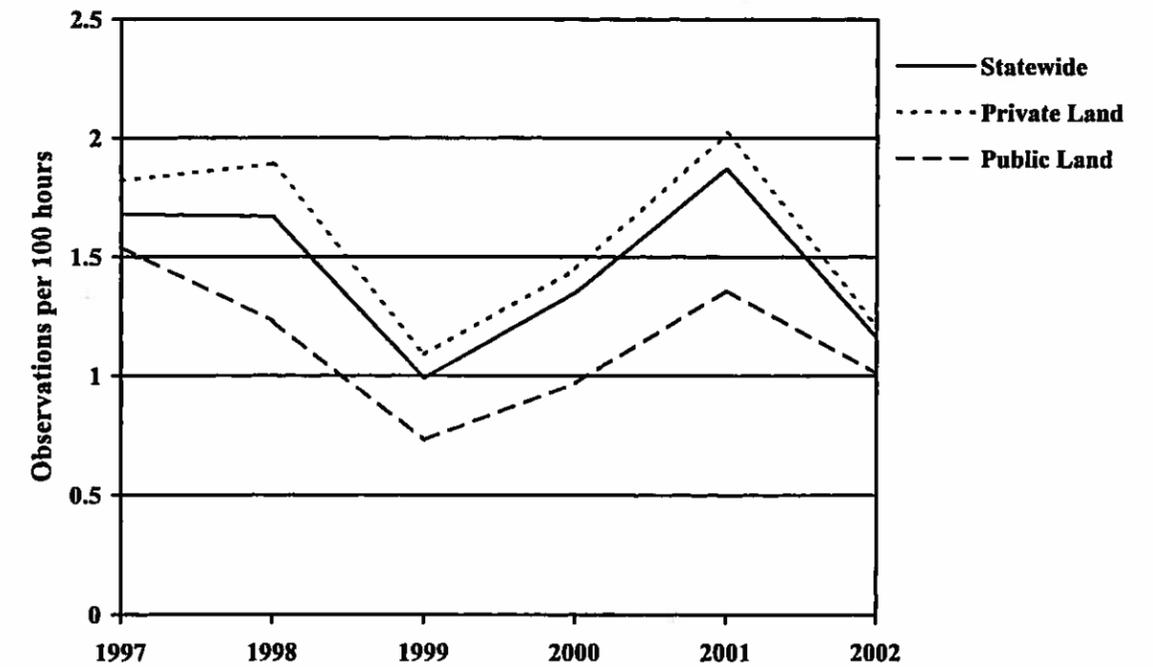


Figure 27. Raccoons observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

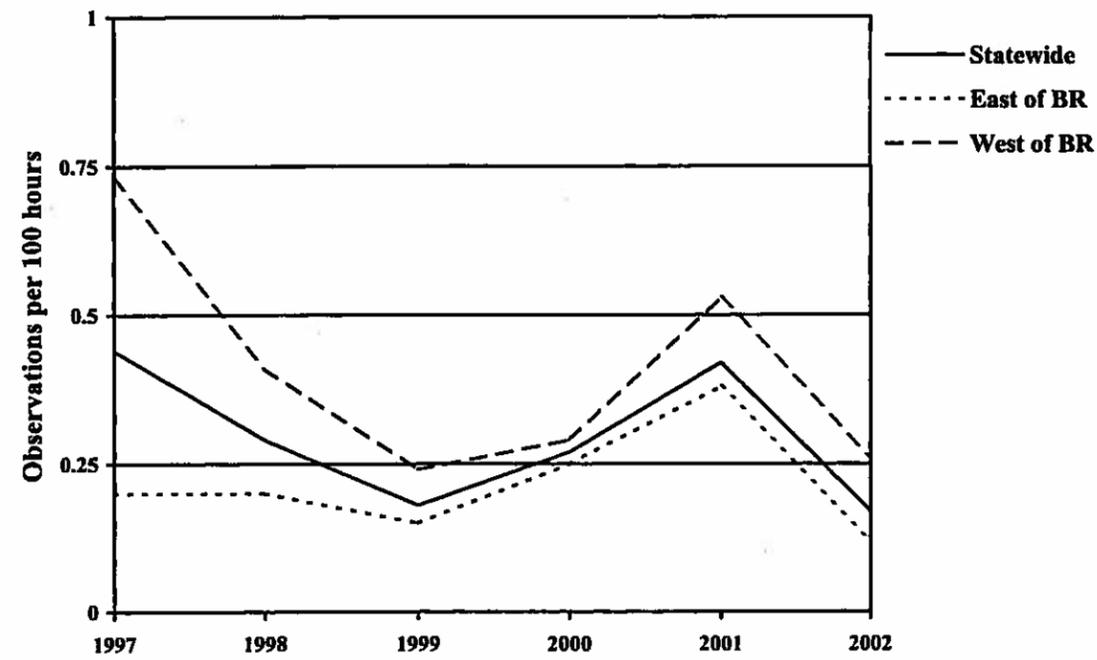


Figure 28. Opossums observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

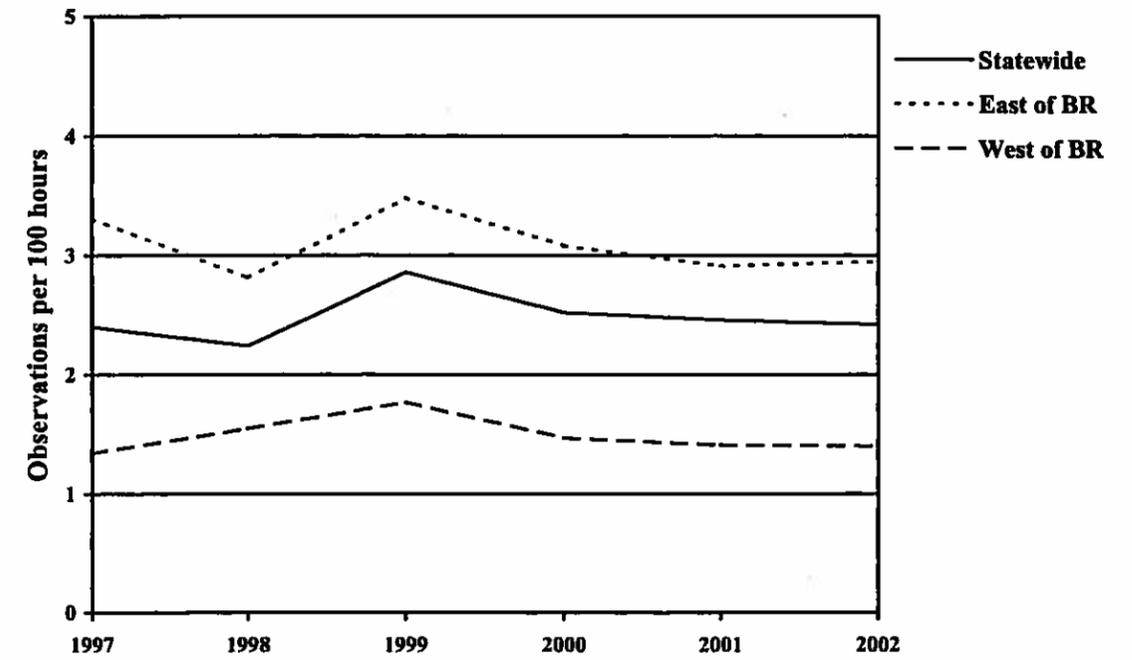


Figure 30. Dogs observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

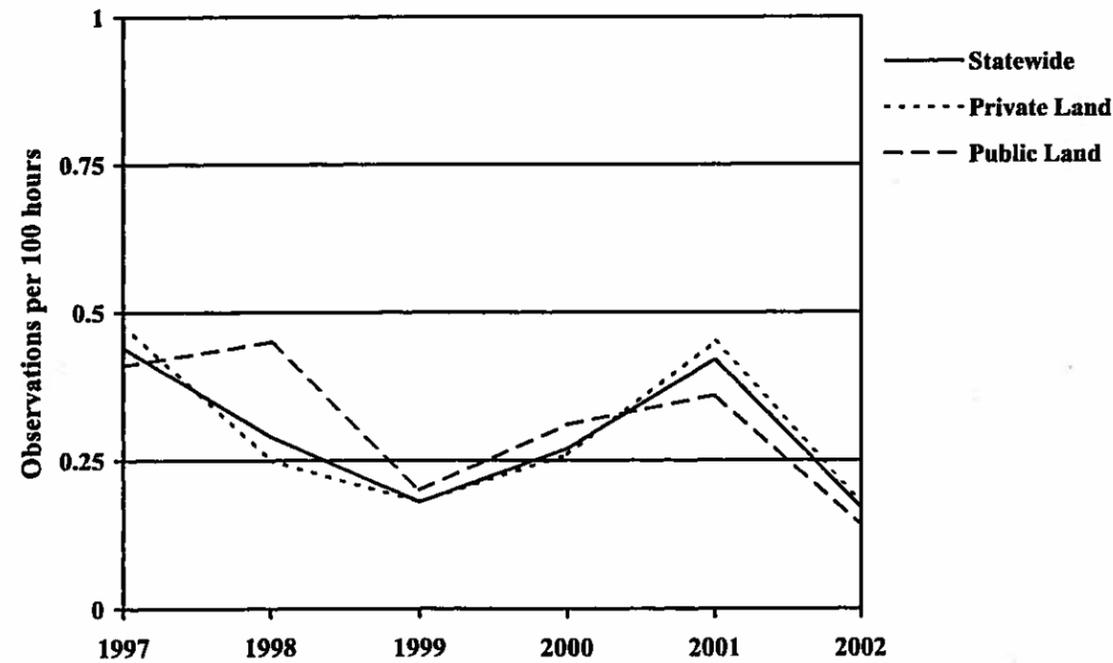


Figure 29. Opossums observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

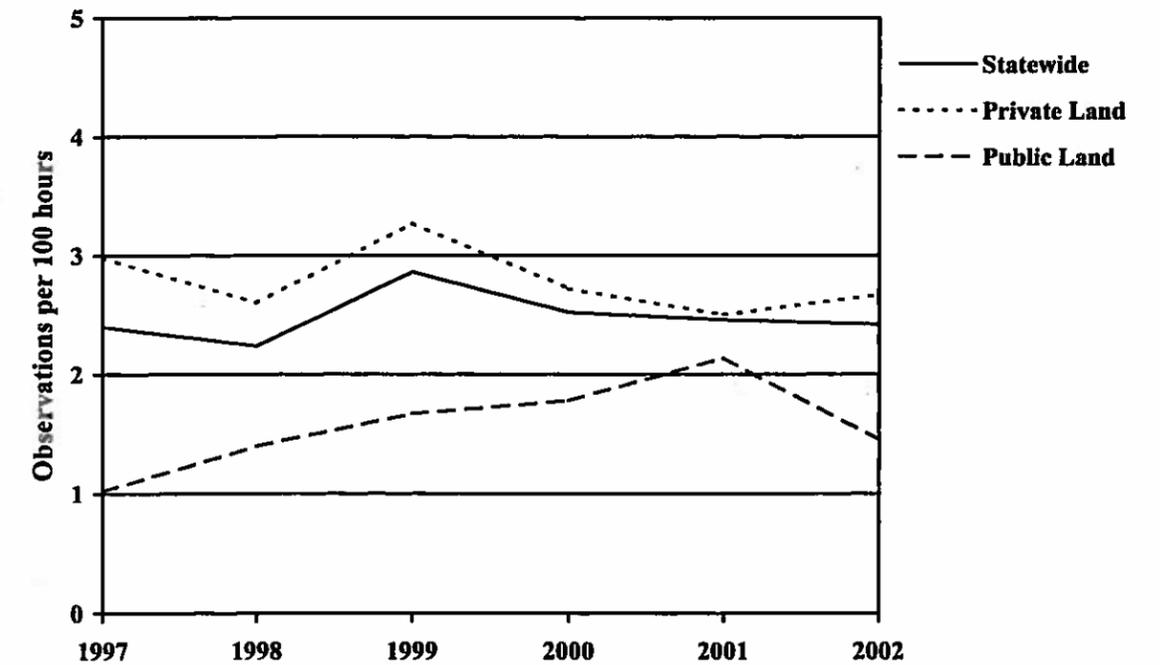


Figure 31. Dogs observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

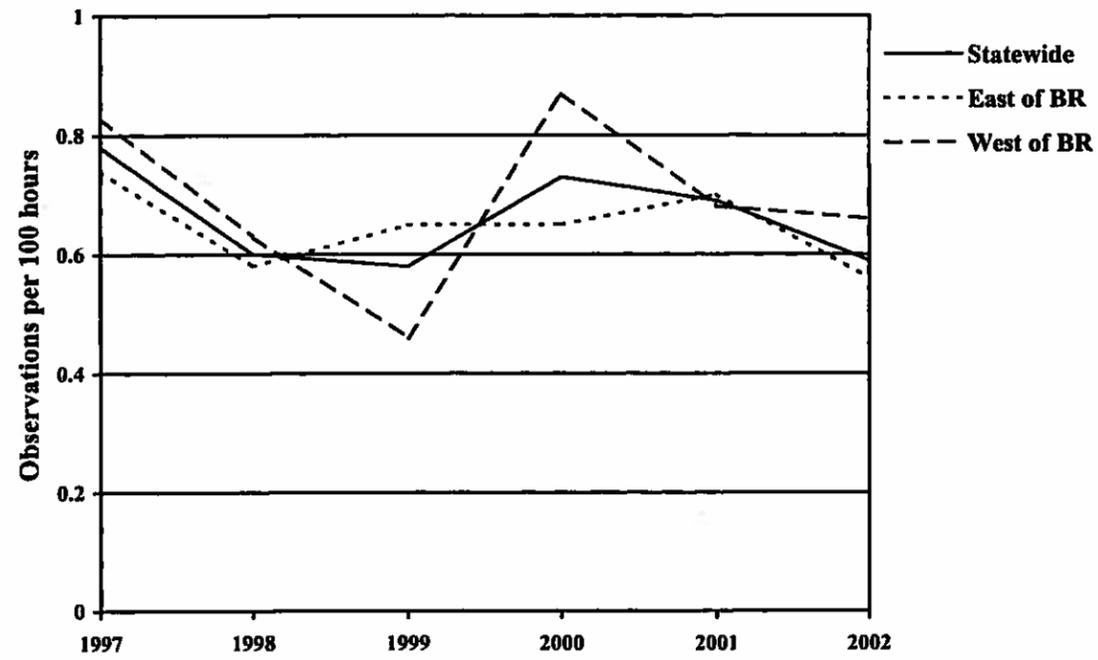


Figure 32. House cats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

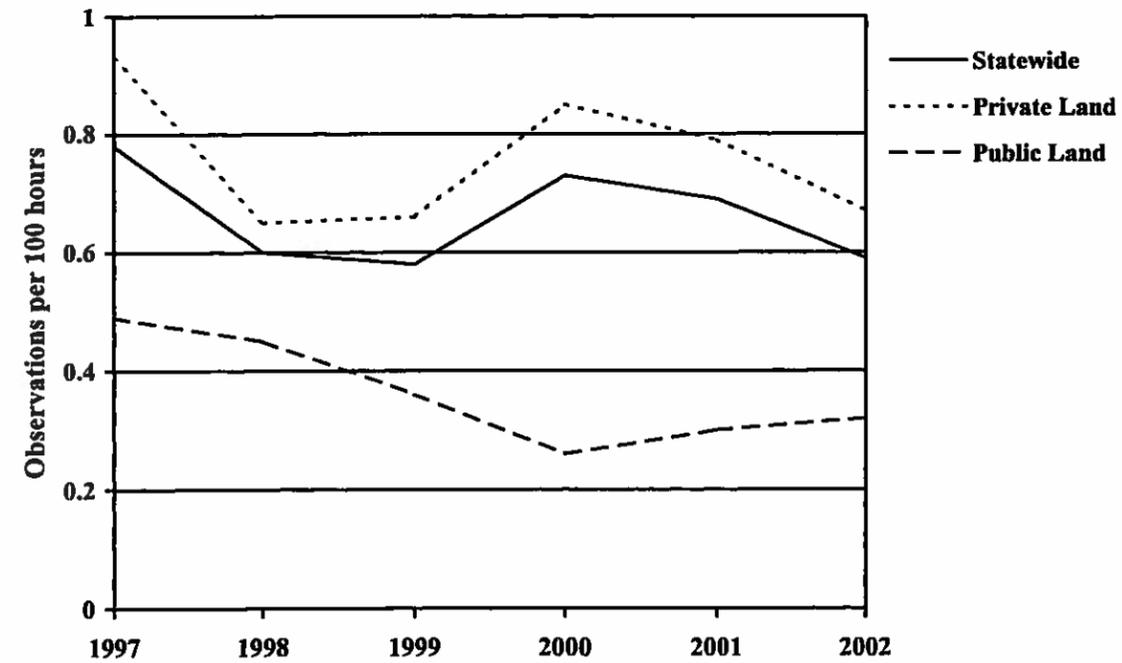


Figure 33. House cats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

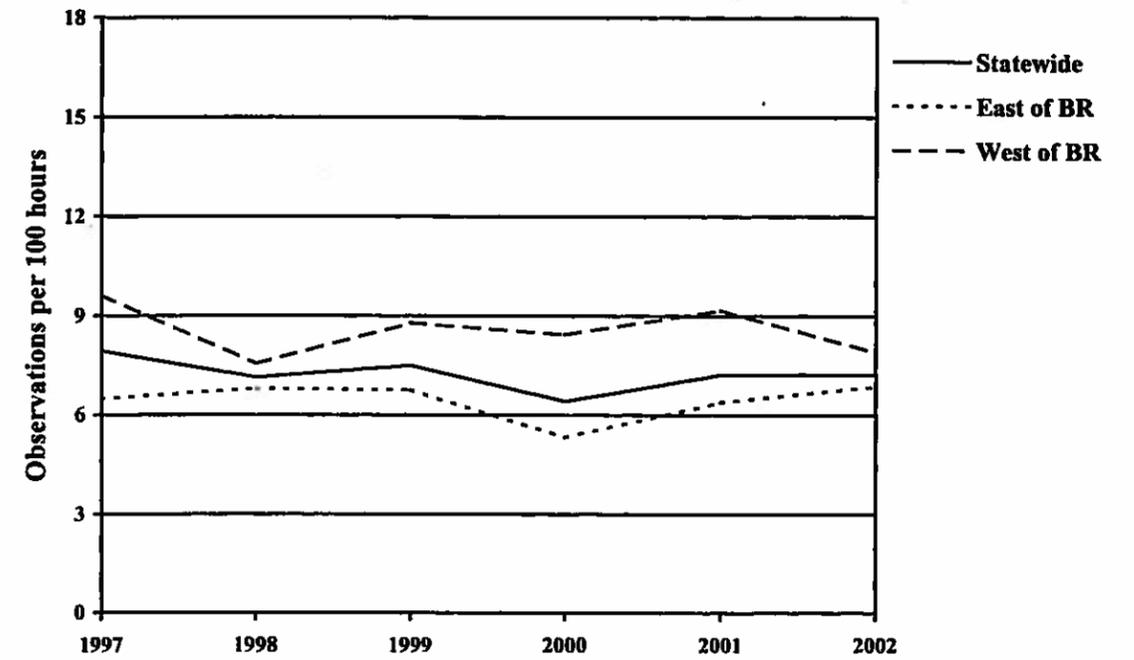


Figure 34. Hunters observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 east and west of the Blue Ridge Mountains and statewide in Virginia.

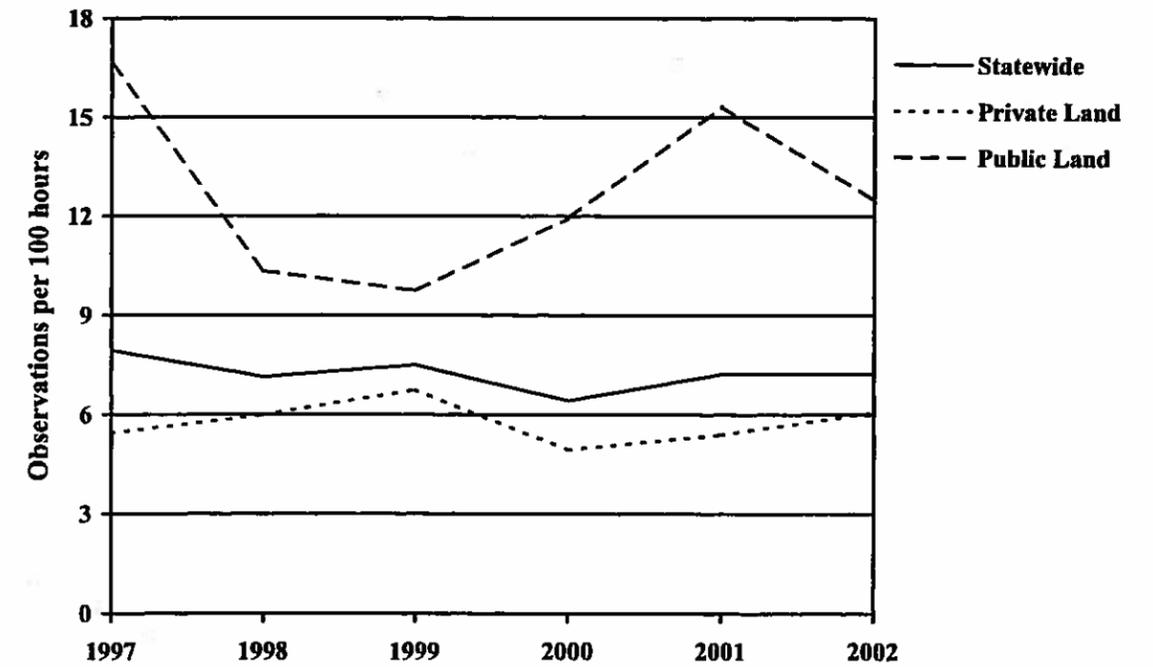


Figure 35. Hunters observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2002 by land ownership and statewide in Virginia.

Appendix 2. Virginia counties hunted, hunts per county, and percentage of total state hunts per county during October 5 - November 16, 2002 by 560 cooperating early archery hunters.

<u>County</u>	<u>No. Hunts</u>	<u>% of Hunts</u>	<u>County</u>	<u>No. Hunts</u>	<u>% of Hunts</u>
Accomack	98	1.50	King William	103	1.58
Albemarle	119	1.82	Lancaster	53	0.81
Alleghany	58	0.89	Lee	97	1.49
Amelia	27	0.41	Loudoun	88	1.35
Amherst	154	2.36	Louisa	57	0.87
Appomattox	60	0.92	Lunenburg	50	0.77
Augusta	51	0.78	Madison	45	0.69
Bath	39	0.60	Mathews	18	0.28
Bedford	117	1.79	Mecklenburg	56	0.86
Bland	91	1.40	Middlesex	34	0.52
Botetourt	62	0.95	Montgomery	68	1.04
Brunswick	28	0.43	Nelson	58	0.89
Buchanan	2	0.03	New Kent	88	1.35
Buckingham	59	0.90	Northampton	60	0.92
Campbell	18	0.28	Northumberland	42	0.64
Caroline	94	1.44	Nottoway	28	0.43
Carroll	42	0.64	Orange	124	1.90
Charles City	82	1.26	Page	69	1.06
Charlotte	65	1.00	Patrick	83	1.27
Chesapeake	8	0.12	Pittsylvania	108	1.66
Chesterfield	47	0.72	Powhatan	75	1.15
Clarke	27	0.41	Prince Edward	19	0.29
Craig	17	0.26	Prince George	102	1.56
Culpeper	43	0.66	Prince William	44	0.67
Cumberland	70	1.07	Pulaski	62	0.95
Dickenson	40	0.61	Rappahannock	68	1.04
Dinwiddie	66	1.01	Richmond	9	0.14
Essex	72	1.10	Roanoke	42	0.64
Fairfax	145	2.22	Rockbridge	74	1.13
Fauquier	108	1.66	Rockingham	163	2.50
Floyd	176	2.70	Russell	21	0.32
Fluvanna	50	0.77	Scott	48	0.74
Franklin	72	1.10	Shenandoah	352	5.40
Frederick	26	0.40	Smyth	61	0.94
Giles	99	1.52	Southampton	128	1.96
Gloucester	29	0.44	Spotsylvania	13	0.20
Goochland	92	1.41	Stafford	8	0.12
Grayson	40	0.61	Suffolk	20	0.31
Greene	21	0.32	Surry	204	3.13
Greensville	73	1.12	Sussex	39	0.60
Halifax	15	0.23	Tazewell	87	1.33
Hanover	31	0.48	Virginia Beach	22	0.34
Henrico	52	0.80	Warren	28	0.43
Henry	143	2.19	Newport News	52	0.80
Highland	36	0.55	& Hampton		
Isle of Wight	69	1.06	Washington	45	0.69
James City	77	1.18	Westmoreland	47	0.72
King & Queen	32	0.49	Wise	34	0.52
King George	96	1.47	Wythe	163	2.50
			York	29	0.44