2004 VIRGINIA BOWHUNTER SURVEY

by

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Abstract: Initiated in 1997, the Virginia Bowhunter Survey provides information for annually monitoring the status and relative abundance of certain wildlife species within the state. Population indices are calculated based on the number of animals observed per unit of hunting effort during the early special archery season. Surveys were mailed to 465 cooperating hunters who participated in the 2003 Virginia Bowhunter Survey. Useable responses were received from 285 hunters. Hunts were reported in all but one of the 98 counties and cities surveyed. Archery hunters participating in the survey recorded over 14,917 hours of hunting observations. A large majority (85.3%) of hunts were reported on private lands versus public lands. Frequency of hunts was highest during the first 2 weeks of the 6-week season. Average hunt length was greatest on the first day and during the last week of the season. Annual, weekly, and regional index ratios were calculated for selected species as the number of animal observations per 100 hours of hunting effort. Cooperating hunters observed most species of animals more frequently on private lands than on public lands. Even though only 9% of Virginia lands are publicly owned, 14.7% of all reported hunts occurred there. Cooperating hunters also reported longer hunts (4.9 hrs) on public lands than on private lands (4.1 hrs). Graphs illustrating animal observations per 100 hours of hunting effort reported from 1997 through 2004 are presented. Time-series analyses suggest that ruffed grouse populations have decreased since 1997 when the survey was initiated. Although coyote populations increased substantially from 1997 to 2001, populations have been relatively stable since then. Continued effort is needed to increase cooperator participation and improve the geographic distribution of survey respondents.

The 2004 Virginia Bowhunter Survey is a cooperative effort by volunteer sportsmen and the Department of Game and Inland Fisheries (DGIF) to annually monitor the status and relative abundance of certain wildlife species within the state. This annual survey of early season archery hunter observations was established in 1997 to provide harvest independent data for evaluating the status of certain wildlife species. Observations of wildlife per unit of bowhunting effort provides a useful index of annual population abundance for these species.

Monitoring wildlife populations with archery hunter observation data is a technique also used in several other eastern and midwestern states (Dwyer 1997, Glasscock et al. 1997, Hamilton and Fantz 1997, Ver Steeg and Warner 1997,

Lehman and Weaver 1998). These surveys have proven successful in detecting annual population changes and have advantages that include 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 Virginia (Jagnow and Steffen 2005). The early archery season generally occurs from the first Saturday in October through the Friday proceeding the firearms deer season and provides sportsmen with an opportunity to observe animals with relatively little disturbance. Virginia archery license sales totaled 58,675 resident hunters and 2,798 non-resident hunters during the 2004-2005 hunting season. Jagnow and Steffen (2005) estimated that 65,888 bowhunters spent approximately 394,778 days afield during the 2004-2005 deer archery season.

The bowhunter survey also provides a means for validating other techniques used for monitoring certain wildlife species (Lehman and Weaver 1998). In general, population indices derived from chance observations of wildlife per unit of effort (e.g., bowhunter surveys) provide more accurate assessments of population abundance than those derived from harvest data. For example, furbearer indices derived from fur-buyer surveys or pelt tagging data are known to be biased because harvest efforts are influenced by annual variations in pelt prices (Obbard et al. 1987).

Unfortunately, harvest independent surveys used for monitoring furbearer populations, 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 often problematic. Difficulties using these methods have led Virginia and other states to adopt bowhunter surveys as a preferred method 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 for assistance in collecting archery hunter license data, and Carole Martin for organizing and coding data forms. This publication was funded in part by Pittman-Robertson Federal Aid to Wildlife Restoration Project – WE99R.

Methods

Survey forms (Appendix 1 and 2) were mailed in late September, approximately 1 week prior to the opening of the 2004 early archery season (2 Oct). Survey forms were mailed to 465 archery hunters who participated in the 2003 Virginia Bowhunter Survey and several other individuals who expressed interest in participating.

The survey form 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 (2 Oct - 12 Nov 2004). 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 geographic region (Figure 1), by week of the survey period, by land ownership (private versus public), 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 Mountain 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 per unit of time (i.e., 100 hours) were calculated using ratio-estimators (Cochran 1977).

Results

Participation and Hunter Effort

A total of 285 early archery hunters returned useable survey forms. Cooperating archery hunters reported 3,544 total hunts averaging 4.2 hours per hunt (Table 1) for a total of 14,917 hours of observation. Hunts were reported in all but 1 of the 98 counties or cities (no hunts were reported in Lunenburg County). The counties/cities of Amelia, Buckingham, Chesapeake, Craig, Grayson, Greene, Highland, James City, Mathews, Newport News/Hampton, Smyth, Suffolk, Virginia Beach, Warren, and York had fewer than 10 hunts reported (Appendix 3). Shenandoah County had the highest number of reported hunts (n = 205) and accounted for 5.8% of all hunts reported.

The number of reported hunts was greater east (n = 2,428) than west (n = 1,116) of the Blue Ridge Mountains, although average hunt length was slightly greater west (4.4 hrs) than east (4.1 hrs; Table 1). A large majority (85.3%) of reported hunts were on private lands. Even though only 9% of Virginia lands are publicly owned, 14.7% of all reported hunts occurred there. Cooperating hunters also reported longer hunts (4.9 hrs) on public lands than on private lands (4.1 hrs; Table 1). The proportion of hunts on public lands was greater west of the Blue Ridge Mountains (25.4%) than east of the Blue Ridge Mountains (9.6%; Table 2).

The average number of hunts reported by archers varied by geographic region (Figure 1). Hunters in the Southern Mountain region were the most avid, averaging 11.8 hunts per hunter. The average number of hunts was slightly lower in the Northern Piedmont ($\bar{x}$ = 11.1) and Tidewater ($\bar{x}$ = 11.1) regions. The lowest number of hunts reported per archer was in the Northern Mountain ($\bar{x}$ = 10.0) and Southern Piedmont ($\bar{x}$ = 9.9) areas. The average number of hunts was slightly higher east of the Blue Ridge Mountains ($\bar{x}$ = 11.8) than west of the Blue Ridge Mountains ($\bar{x}$ = 11.2). Cooperating archery hunters reported slightly longer hunts (hrs/hunt) in the Northern Piedmont ($\bar{x}$ = 4.5) and Southern Mountain ($\bar{x}$ = 4.5) regions, versus the Northern Mountain ($\bar{x}$ = 4.3), Tidewater ($\bar{x}$ = 4.0) and Southern Piedmont ($\bar{x}$ = 3.8) regions (Table 3).

The average number of hunts per hunter varied throughout the 6-week season (2.5 to 3.1 hunts/week). Average hunt length (hrs/hunt) was highest on the first day ($\bar{x}$ = 5.1) and last week ($\bar{x}$ = 4.9) of the early archery season (Table 4).

Selected Animal Observations

Animal observation data reported by cooperating hunters during the 2004 early archery season are summarized for selected species in Tables 1-6. In addition, the observational data of selected species per 100 hours hunting effort reported in surveys conducted from 1997 through 2004 (Lafon et al. 1998, 2004; Farrar et al. 1999, 2000, 2001, 2002; Fies and Norman 2004) 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 – Cooperators observed more antlered bucks, gray squirrels, gray foxes, bobcats, raccoons, otters, and domestic dogs per hour of hunting east versus west of the Blue Ridge Mountains (Table 1). Deer does, fawns, fox squirrels, wild turkeys, ruffed grouse, black bears, coyotes, opossums, skunks, mink, and house cats were observed more frequently per hour of hunting west of the Blue Ridge Mountains. Observation rates of red fox and other hunters were similar east and west of the Blue Ridge Mountains.

Private vs. Public Land – Most wildlife species, domestic dogs, and house cats were observed more frequently on private lands than on public lands (Tables 1 and 2). Exceptions were ruffed grouse, bear, and gray foxes. Bobcats were more frequently observed on public lands west of the Blue Ridge Mountains. Almost twice as many hunters were seen on public lands than on private lands west of the Blue Ridge Mountains. Frequency of hunter observations east of the Blue Ridge Mountains was similar on public and private lands.

Geographic Regions – Observations of selected animal species by cooperating archery hunters varied by geographic region (Table 3). Archery hunters in the Northern Piedmont and Tidewater regions reported the highest frequency of antlered bucks seen. Hunters in the Southern Mountain region reported the highest frequency of does, fawns and deer of unknown age/sex. As expected, observations of fox squirrels and ruffed grouse were greatest in the mountain regions. Black bear observation rates were highest in the Northern Piedmont and lowest in the Tidewater region. Red foxes were observed much more frequently in the Northern Piedmont and Northern Mountain regions, whereas gray foxes were observed most frequently in the Tidewater region. Observation rates for coyotes were higher in the Southern Mountains than in any other region. Bobcats were most frequently observed in the Southern Piedmont region. No bobcats were observed in the Northern Mountain region during 2004, an area that traditionally has higher bobcat populations than several other portions of the state.

Observation rates for wild turkeys were highest in the Southern Mountains and lowest in the Northern Mountain and Northern Piedmont regions. Ruffed grouse were seen more often in the Southern Mountains, compared to other regions. Raccoon observation rates were highest in the Tidewater region and lowest in the Northern Mountains. Observation rates for dogs were highest in the Southern Piedmont and lowest in the Northern Mountains. Other hunters were seen most often in the Southern Mountain, Northern Piedmont, and Tidewater regions.

Weeks – Frequency of animal observations by week of the season is summarized in Table 4. Antlered deer were observed most frequently during the last 2 weeks of the early archery season, close to the rut. Observation rates of does were also highest during this period. Wild turkey observations were similar during most weeks, but noticeably lower during weeks 2 and 3. Observation rates of black bears were highest during the early to mid portion of the archery season, perhaps because acorns were more abundant. Bears feeding heavily on acorns are more active and predictable, increasing their likelihood of being seen by archery hunters. One of the highest observation rates for bears was during week 1, prior to the time when bears could be legally harvested. Gray squirrel observations declined as the archery season progressed. Observation rates for most other species appeared to fluctuate throughout the season without an apparent pattern. More hunters were encountered during week 5 (3-8 November) and on opening (4 October) than during other portions of the season.

Deer – Does to antlered buck ratios estimated from survey data were higher west of the Blue Ridge Mountains than east (Table 5a). Public lands had a higher doe to buck ratio than private lands (Table 6b). The South Mountain region reported the highest ratio of does to antlered bucks; the Tidewater region reported the lowest doe to antlered buck ratio (Table 6c). The doe to buck ratio peaked during the middle of the season (week 3), then decreased as bucks became more active with the approaching rut (Table 6d).

Observation rates for deer on public lands appear to be decreasing, particularly since 2001 (Figures 3, 5, and 7). Deteriorating habitat

conditions and a series of poor mast crops may be responsible for this trend. Hunting pressure also declined on public lands during this period (Figure 35), most likely causing deer to move less and be observed less frequently. Anecdotal reports from hunters during the muzzleloader and general firearms seasons also suggest that deer populations are declining on public lands.

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 = 443) represented 39.0% of all mammalian predators observed. The combined dog and cat observations east and west of the Blue Ridge Mountains comprised 40.4% and 35.3% of the total number of mammalian predators observed, respectively. Combined dog and cat observations on private and public lands represented 40.5% and 31.4% of total mammalian predators observed, respectively.

Other Species Observations

Bowhunters were asked to record incidental observations of miscellaneous species ("other animals") not listed on the survey sheet. (Appendix 1). Twenty-two different types of "other animals" were reported (Table 6). Geese, ducks, bobwhite quail, groundhogs, hawks, and chipmunks were some of the incidental species most commonly observed. Caution should be used when interpreting these data 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 for some species.

Discussion and Summary

Observational data reported in surveys from 1997 through 2004 has proven useful for monitoring populations of certain wildlife species. Although population information derived from an 8-year period is generally not sufficient to detect long-term changes, some trends are becoming apparent. Time-series data illustrated in Figures 2 through 35 suggests that turkey populations are stable statewide but may be decreasing on public lands (Figure 13). Ruffed grouse numbers appear to be decreasing (Figure 14). The statewide population of coyotes seems to have increased from 1997 to 2001, then stabilized or decreased slightly from 2002 to 2004 (Figure 22). Populations of most other species appear to fluctuate annually, but are relatively stable over the long-term. Information collected from successive bowhunter surveys should provide sufficient time-series data for performing detailed trend analyses in the future.

The high variability associated with some observation estimates suggests that the survey may not be adequate for monitoring population trends for certain animals. High variability may be a consequence of small sample size (e.g., only 6 mink were seen) or a non-uniform sampling distribution (poor regional estimates). Annual and weekly variability can also be attributed to abiotic (e.g., weather) and biotic influences (e.g., breeding seasons and mast availability). Annual fluctuations in food availability and timing of the breeding season affect animal activity and movement patterns.

Despite these potential problems, bowhunter surveys still provide useful information for the more observable species and for those whose populations are difficult to monitor using any other method. 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. More detailed analyses of animal observation data in relation to weather conditions and mast availability may also help explain annual fluctuations in hunter success.

For this survey to achieve its full potential, continued effort is needed to improve the sample size and distribution of survey respondents. Additional bowhunter cooperators can be recruited by sending an invitation letter to a stratified sample of hunters who purchased an early archery license. By stratifying the sample to target areas with poor cooperation, a more uniform distribution of survey respondents can be developed and the opportunity for regional bias can be minimized.

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Table 1. Observations of selected animals (per 100 hours hunting) by cooperating archery hunters from 2 October to 12 November 2004 statewide, east (EBR) and west (WBR) of the Blue Ridge Mountains, and on private and public lands in Virginia.

		Animals Seen/100 hrs. ± SE				
Animal	Total Seen	State	EBR	WBR	Private Land	Public Land
Deer (antlered)	1,779	11.93 ± 0.90	12.54 ± 1.21	10.68 ± 1.16	13.49 ± 1.07	4.93 ± 0.74
Deer (doe)	4,877	32.69 ± 3.33	30.51 ± 2.90	37.18 ± 8.17	36.43 ± 4.04	15.92 ± 2.06
Deer (fawn)	2,353	15.77 ± 2.33	13.24 ± 1.56	20.96 ± 6.29	17.83 ± 2.84	6.53 ± 1.19
Deer (unknown)	1,780	11.93 ± 1.41	10.43 ± 1.10	15.01 ± 3.59	13.24 ± 1.69	6.01 ± 1.70
Gray Squirrel	13,392	89.77 ± 4.63	96.27 ± 6.33	76.46 ± 5.45	91.49 ± 5.14	85.39 ± 10.65
Fox Squirrel	787	5.28 ± 0.96	0.62 ± 0.38	14.83 ± 2.32	5.43 ± 1.11	5.29 ± 1.46
Wild Turkey	3,575	23.97 ± 2.41	21.33 ± 2.24	29.37 ± 5.69	27.40 ± 2.91	9.94 ± 2.09
Grouse	179	1.20 ± 0.32	0.46 ± 0.36	2.72 ± 0.56	0.87 ± 0.34	2.97 ± 0.87
Bear (adult)	36	0.24 ± 0.08	0.22 ± 0.10	0.29 ± 0.11	0.18 ± 0.07	0.56 ± 0.25
Bear (cub)	12	0.08 ± 0.03	0.09 ± 0.05	0.06 ± 0.05	0.03 ± 0.02	0.32 ± 0.19
Bear (total)	48	0.32 ± 0.10	0.31 ± 0.13	0.35 ± 0.13	0.22 ± 0.09	0.88 ± 0.37
Red Fox	159	1.07 ± 0.17	1.13 ± 0.19	0.94 ± 0.33	1.14 ± 0.20	0.76 ± 0.33
Gray Fox	128	0.86 ± 0.12	0.98 ± 0.16	0.61 ± 0.16	0.85 ± 0.12	0.96 ± 0.37
Coyote	38	0.25 ± 0.08	0.15 ± 0.08	0.47 ± 0.19	0.27 ± 0.09	0.24 ± 0.12
Bobcat	27	0.18 ± 0.05	0.20 ± 0.05	0.14 ± 0.12	0.17 ± 0.04	0.24 ± 0.17
Raccoon	277	1.86 ± 0.26	2.13 ± 0.36	1.29 ± 0.26	1.95 ± 0.26	1.64 ± 0.87
Opossum	28	0.19 ± 0.05	0.14 ± 0.04	0.29 ± 0.12	0.19 ± 0.05	0.20 ± 0.09
Striped Skunk	36	0.24 ± 0.07	0.19 ± 0.08	0.35 ± 0.12	0.27 ± 0.08	0.16 ± 0.10
River Otter	33	0.22 ± 0.12	0.32 ± 0.17	0.02 ± 0.02	0.27 ± 0.14	0.00 ± 0.00
Mink	6	0.04 ± 0.02	0.03 ± 0.02	0.06 ± 0.03	0.05 ± 0.02	0.00 ± 0.00
Dog	374	2.51 ± 0.35	2.94 ± 0.48	1.62 ± 0.41	2.77 ± 0.40	1.60 ± 0.63
House Cat	69	0.46 ± 0.08	0.39 ± 0.09	0.61 ± 0.16	0.51 ± 0.09	0.32 ± 0.13
Hunter	840	5.63 ± 0.78	5.55 ± 0.99	5.79 ± 1.22	5.11 ± 0.82	7.42 ± 2.14
Total Hunters		285	205	100	261	73
Total Hunts		3,544	2,428	1,116	2,963	510
Avg. Hrs. Per Hunt		4.21 ± 0.04	4.13 ± 0.05	4.38 ± 0.07	4.07 ± 0.04	4.89 ± 0.11

Table 2. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters from 2 October to 12 November 2004 on private and public lands east (EBR) and west (WBR) of the Blue Ridge Mountains in Virginia.

	Animals Seen/100 hrs. ± SE			
	EBR		WBR	
Animal	Private Land	Public Land	Private Land	Public Land
Deer (antlered)	13.38 ± 1.37	6.89 ± 1.37	13.77 ± 1.47	3.65 ± 0.79
Deer (doe)	32.34 ± 3.30	16.73 ± 3.43	46.95 ± 11.41	15.39 ± 2.61
Deer (fawn)	14.17 ± 1.76	5.78 ± 1.58	27.22 ± 8.88	7.03 ± 1.66
Deer (unknown)	11.17 ± 1.25	4.36 ± 1.16	18.57 ± 4.92	7.10 ± 2.72
Gray Squirrel	95.94 ± 6.63	112.11 ± 24.07	80.07 ± 6.86	67.91 ± 7.49
Fox Squirrel	0.68 ± 0.44	0.30 ± 0.30	17.65 ± 3.11	8.55 ± 2.11
Wild Turkey	23.10 ± 2.50	11.66 ± 4.10	38.48 ± 7.99	8.82 ± 2.09
Grouse	0.45 ± 0.41	0.71 ± 0.71	1.96 ± 0.54	4.44 ± 1.28
Bear (adult)	0.17 ± 0.10	0.71 ± 0.48	0.21 ± 0.09	0.46 ± 0.22
Bear (cub)	0.05 ± 0.03	0.51 ± 0.42	0.00 ± 0.00	0.20 ± 0.14
Bear (total)	0.22 ± 0.12	1.22 ± 0.82	0.21 ± 0.09	0.66 ± 0.28
Red Fox	1.15 ± 0.21	1.01 ± 0.70	1.10 ± 0.46	0.60 ± 0.31
Gray Fox	0.93 ± 0.15	1.52 ± 0.77	0.62 ± 0.19	0.60 ± 0.31
Coyote	0.16 ± 0.10	0.10 ± 0.09	0.53 ± 0.23	0.33 ± 0.19
Bobcat	0.20 ± 0.05	0.20 ± 0.12	0.09 ± 0.07	0.27 ± 0.27
Raccoon	2.08 ± 0.34	3.24 ± 2.01	1.60 ± 0.31	0.60 ± 0.30
Opossum	0.16 ± 0.04	0.00 ± 0.00	0.27 ± 0.15	0.33 ± 0.15
Striped Skunk	0.21 ± 0.09	0.10 ± 0.10	0.41 ± 0.13	0.20 ± 0.15
River Otter	0.37 ± 0.20	0.00 ± 0.00	0.03 ± 0.03	0.00 ± 0.00
Mink	0.03 ± 0.02	0.00 ± 0.00	0.09 ± 0.05	0.00 ± 0.00
Dog	3.15 ± 0.52	2.13 ± 1.40	1.78 ± 0.48	1.26 ± 0.53
House Cat	0.40 ± 0.10	0.41 ± 0.20	0.77 ± 0.21	0.27 ± 0.16
Hunter	5.34 ± 1.08	5.47 ± 2.06	4.50 ± 0.96	8.69 ± 3.26
Total Hunters	186	32	84	44
Total Hunts	2,131	227	832	283

Avg. Hrs. Per Hunt	4.08 ± 0.05	4.35 ± 0.16	4.06 ± 0.08	5.33 ± 0.15

Table 3. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters from 2 October to 12 November 2004 within geographic regions of Virginia.

	Animals Seen/ 100 hrs. ± SE				
Animal	Tidewater	S. Piedmont	N. Piedmont	S. Mountain	N. Mountain
Deer (antlered)	13.01 ± 1.72	9.09 ± 1.14	14.53 ± 2.83	11.03 ± 1.56	10.18 ± 1.73
Deer (doe)	29.48 ± 3.74	27.48 ± 3.58	33.99 ± 6.91	44.33 ± 13.70	27.22 ± 3.62
Deer (fawn)	12.92 ± 1.62	11.18 ± 2.49	15.18 ± 3.76	24.45 ± 10.48	16.10 ± 3.54
Deer (unknown)	10.24 ± 1.66	9.92 ± 1.61	11.04 ± 2.30	17.84 ± 5.96	11.06 ± 1.92
Gray Squirrel	71.24 ± 5.72	100.19 ± 10.54	123.31 ± 14.54	74.29 ± 7.48	79.49 ± 7.91
Fox Squirrel	0.15 ± 0.11	0.08 ± 0.08	1.56 ± 1.12	15.42 ± 3.57	14.00 ± 2.45
Wild Turkey	25.36 ± 3.34	26.18 ± 4.22	12.89 ± 3.68	41.13 ± 9.15	12.97 ± 3.40
Grouse	0.00 ± 0.00	0.31 ± 0.27	1.12 ± 1.06	3.20 ± 0.79	2.06 ± 0.73
Bear (adult)	0.00 ± 0.00	0.16 ± 0.09	0.53 ± 0.26	0.18 ± 0.07	0.44 ± 0.25
Bear (cub)	0.00 ± 0.00	0.16 ± 0.15	0.15 ± 0.07	0.00 ± 0.00	0.15 ± 0.11
Bear (total)	0.00 ± 0.00	0.31 ± 0.23	0.68 ± 0.33	0.18 ± 0.07	0.59 ± 0.03
Red Fox	0.69 ± 0.15	0.24 ± 0.09	2.32 ± 0.53	0.21 ± 0.09	1.96 ± 0.77
Gray Fox	1.54 ± 0.31	0.71 ± 0.26	0.50 ± 0.17	0.56 ± 0.17	0.69 ± 0.31
Coyote	0.02 ± 0.02	0.16 ± 0.09	0.29 ± 0.24	0.70 ± 0.31	0.15 ± 0.10
Bobcat	0.07 ± 0.04	0.39 ± 0.12	0.21 ± 0.10	0.25 ± 0.21	0.00 ± 0.00
Raccoon	3.06 ± 0.68	1.30 ± 0.33	1.64 ± 0.62	1.55 ± 0.36	0.93 ± 0.33
Opossum	0.25 ± 0.07	0.04 ± 0.04	0.09 ± 0.06	0.42 ± 0.19	0.10 ± 0.07
Striped Skunk	0.17 ± 0.07	0.04 ± 0.04	0.32 ± 0.22	0.46 ± 0.19	0.20 ± 0.09
River Otter	0.44 ± 0.35	0.16 ± 0.16	0.29 ± 0.27	0.04 ± 0.04	0.00 ± 0.00
Mink	0.05 ± 0.03	0.00 ± 0.00	0.03 ± 0.03	0.07 ± 0.05	0.05 ± 0.05
Dog	2.03 ± 0.45	4.49 ± 0.95	2.88 ± 1.08	2.67 ± 0.66	0.15 ± 0.10
House Cat	0.32 ± 0.11	0.28 ± 0.10	0.56 ± 0.21	0.70 ± 0.25	0.49 ± 0.15
Hunter	6.35 ± 2.00	2.64 ± 0.76	6.78 ± 1.45	7.62 ± 1.94	3.23 ± 1.13
Total Hunters	91	67	68	54	48

Total Hunts	1,011	662	755	636	480
Avg. Hrs. Per Hunt	4.04 ± 0.07	3.84 ± 0.09	4.51 ± 0.09	4.48 ± 0.10	4.26 ± 0.11

Table 4. Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters by week from 2 October to 12 November 2004 in Virginia.

	Animals Seen/100 hrs. + SE						
Animal	Day 1 (10/2)	Week 1 (10/4-9)	Week 2 (10/11-16)	Week 3 (10/18-23)	Week 4 (10/25-30)	Week 5 (11/1-6)	Week 6 (11/8-12)
Deer (antlered)	11.18 ± 1.47	11.19 ± 1.21	10.16 ± 1.14	9.99 ± 1.11	10.74 ± 1.38	15.78 ± 1.42	16.80 ± 2.06
Deer (doe)	26.69 ± 3.30	31.50 ± 2.58	29.38 ± 2.73	30.68 ± 3.09	33.02 ± 5.50	34.89 ± 3.74	44.76 ± 12.71
Deer (fawn)	17.19 ± 2.31	16.09 ± 1.74	14.97 ± 1.63	13.94 ± 1.77	16.03 ± 4.02	12.87 ± 2.27	21.13 ± 9.80
Deer (unknown)	12.51 ± 3.30	13.57 ± 2.34	9.41 ± 1.00	11.52 ± 1.96	12.46 ± 1.86	10.82 ± 1.48	13.48 ± 3.06
Gray Squirrel	90.26 ± 6.43	106.41 ± 6.78	101.96 ± 6.48	89.02 ± 6.41	83.82 ± 5.82	75.11 ± 6.30	64.32 ± 6.27
Fox Squirrel	5.09 ± 1.06	5.93 ± 1.11	5.20 ± 1.17	5.69 ± 1.13	4.18 ± 0.84	5.44 ± 1.59	5.01 ± 2.81
Wild Turkey	20.44 ± 3.53	26.14 ± 4.20	16.27 ± 2.49	16.36 ± 2.67	29.50 ± 4.16	28.16 ± 4.36	33.10 ± 10.66
Grouse	1.00 ± 0.54	0.87 ± 0.28	1.10 ± 0.38	1.10 ± 0.35	1.36 ± 0.54	1.72 ± 0.84	1.44 ± 0.79
Bear (adult)	0.25 ± 0.19	0.32 ± 0.17	0.28 ± 0.14	0.25 ± 0.10	0.18 ± 0.11	0.05 ± 0.05	0.31 ± 0.26
Bear (cub)	0.00 ± 0.00	0.10 ± 0.05	0.04 ± 0.04	0.25 ± 0.13	0.09 ± 0.09	0.00 ± 0.00	0.00 ± 0.00
Bear (total)	0.25 ± 0.19	0.42 ± 0.21	0.32 ± 0.14	0.51 ± 0.22	0.26 ± 0.16	0.05 ± 0.05	0.31 ± 0.26
Red Fox	0.75 ± 0.34	1.29 ± 0.26	1.10 ± 0.39	0.98 ± 0.23	0.57 ± 0.20	1.56 ± 0.36	1.07 ± 0.30
Gray Fox	0.58 ± 0.22	0.97 ± 0.24	1.02 ± 0.23	0.81 ± 0.21	0.84 ± 0.23	1.29 ± 0.37	0.19 ± 0.11
Coyote	0.33 ± 0.20	0.48 ± 0.20	0.16 ± 0.10	0.13 ± 0.07	0.13 ± 0.10	0.27 ± 0.14	0.25 ± 0.13
Bobcat	0.08 ± 0.08	0.16 ± 0.07	0.28 ± 0.10	0.30 ± 0.15	0.09 ± 0.06	0.11 ± 0.08	0.19 ± 0.11

Table 4 (continued). Observations (per 100 hours of hunting) of selected animals by cooperating archery hunters by week from 2 October to 12 November 2004 in Virginia.

	Animals Seen/100 hrs. + SE						
Animal	Day 1 (10/4)	Week 1 (10/6-11)	Week 2 (10/13-18)	Week 3 (10/20-25)	Week 4 (10/27-11/1)	Week 5 (11/3-8)	Week 6 (11/10-14)
Raccoon	1.75 ± 0.68	1.77 ± 0.32	2.24 ± 0.40	1.83 ± 0.40	1.85 ± 0.48	2.80 ± 0.95	0.44 ± 0.16
Opossum	0.33 ± 0.17	0.10 ± 0.06	0.12 ± 0.07	0.17 ± 0.08	0.26 ± 0.11	0.32 ± 0.15	0.13 ± 0.09
Striped Skunk	0.17 ± 0.12	0.19 ± 0.08	0.35 ± 0.15	0.21 ± 0.13	0.35 ± 0.14	0.11 ± 0.08	0.25 ± 0.13
River Otter	0.25 ± 0.19	0.30 ± 0.17	0.04 ± 0.04	0.22 ± 0.16	0.18 ± 0.11	0.33 ± 0.21	0.32 ± 0.23
Mink	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.26 ± 0.11	0.00 ± 0.00	0.00 ± 0.00
Dog	1.92 ± 0.65	2.55 ± 0.55	2.17 ± 0.52	2.51 ± 0.51	1.41 ± 0.36	4.79 ± 1.77	2.32 ± 0.61
House Cat	0.42 ± 0.18	0.58 ± 0.14	0.55 ± 0.19	0.59 ± 0.17	0.53 ± 0.16	0.32 ± 0.15	0.00 ± 0.00
Hunter	7.01 ± 1.15	5.38 ± 1.04	5.20 ± 1.17	3.87 ± 0.78	4.36 ± 0.84	9.58 ± 1.79	5.58 ± 1.24
Total Hunters	209	244	246	226	216	160	105
Total Hunts	235	761	656	591	538	436	327
Avg. Hrs. Per Hunt	5.10 ± 0.16	4.08 ± 0.08	3.87 ± 0.08	3.98 ± 0.09	4.22 ± 0.11	4.26 ± 0.11	4.88 ± 0.15

Table 5. 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 from 2 October to 12 November 2004.

(a)

Ratio	Statewide	East of BR	West of BR
Doe: Buck	2.74	2.43	3.48
Fawn: Doe	0.48	0.43	0.56

(b)

Ratio	Private	Public
Doe: Buck	2.70	3.23
Fawn: Doe	0.49	0.41

(c)

Ratio	Tidewater	S. Piedmont	N. Piedmont	S. Mountain	N. Mountain
Doe: Buck	2.27	3.02	2.34	4.02	2.67
Fawn: Doe	0.44	0.41	0.45	0.55	0.59

(d)

Ratio	Day 1	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Doe: Buck	2.39	2.82	2.89	3.07	3.07	2.21	2.66
Fawn: Doe	0.64	0.51	0.51	0.45	0.49	0.37	0.47

Table 6. Statewide total observations and total observations per 100 hunts of miscellaneous animals by cooperating archery hunters 2 October to 12 November 2004 in Virginia.

Animal	Total Observations	Observations / 100 Hunts
Bats	1	0.03
Beaver	26	0.73
Buzzard	2	0.06
Chipmunk	72	2.03
Crow	346	9.76
Doves	33	0.93
Ducks	482	13.60
Eagle	31	0.87
Falcon	0	0.00
Flying Squirrels	0	0.00
Geese	452	12.75
Groundhog	85	2.40
Hawk	83	2.34
Herons	25	0.71
Miscellaneous Birds	45	1.27
Mouse	0	0.00
Muskrat	0	0.00
Nutria	0	0.00
Owl	26	0.73
Pheasant	0	0.00
Quail	131	3.70
Rabbit	49	1.38
Red Squirrel	4	0.11
Shrew	0	0.00
Sika & Other Deer	2	0.06
Snake	4	0.11
Snipe	0	0.00
Turtles	2	0.06
Weasel	0	0.00
Woodcock	17	0.48

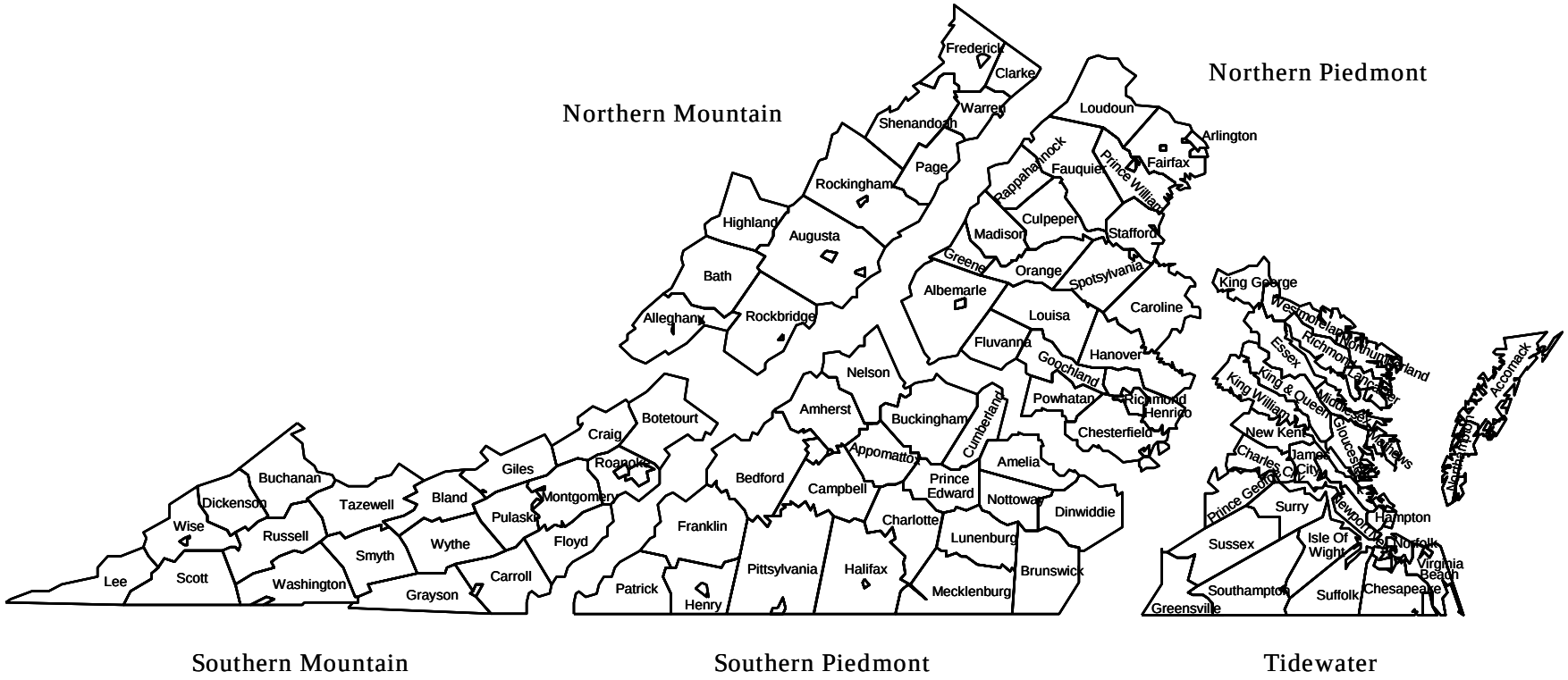

Figure 1. Geographic regions used for analyses in this report.

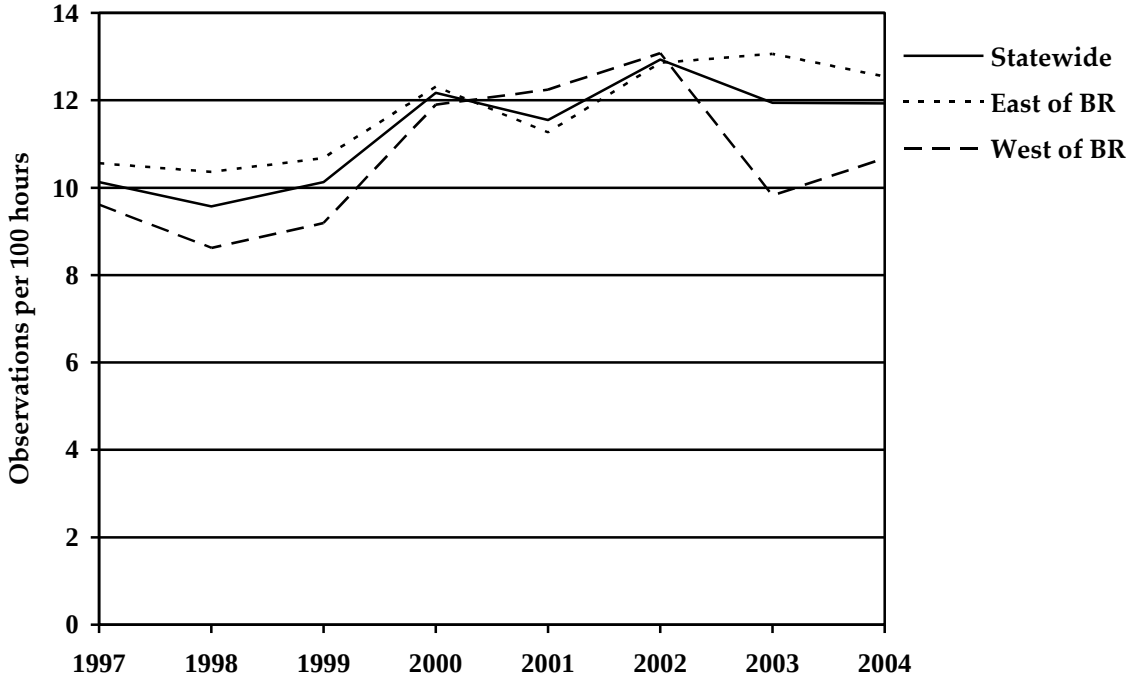

Figure 2. Antlered deer observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

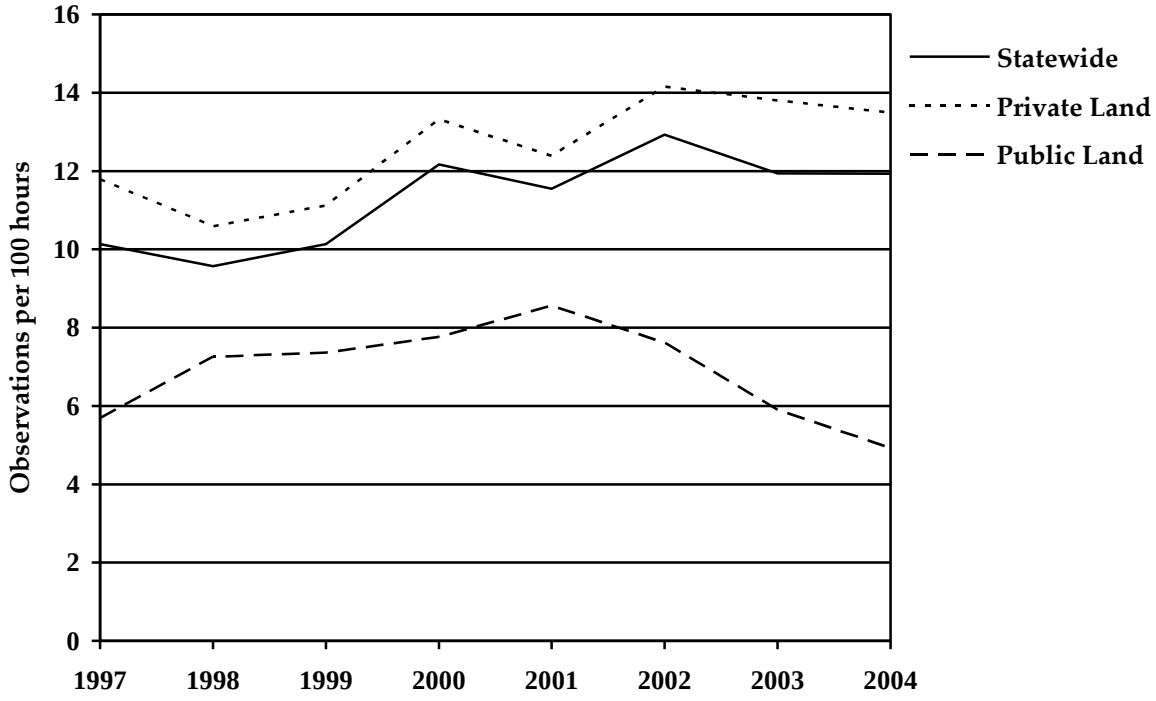

Figure 3. Antlered deer observed (per 100 hours of hunting) by cooperating early archery hunters

from 1997-2004 by land ownership and statewide in Virginia.

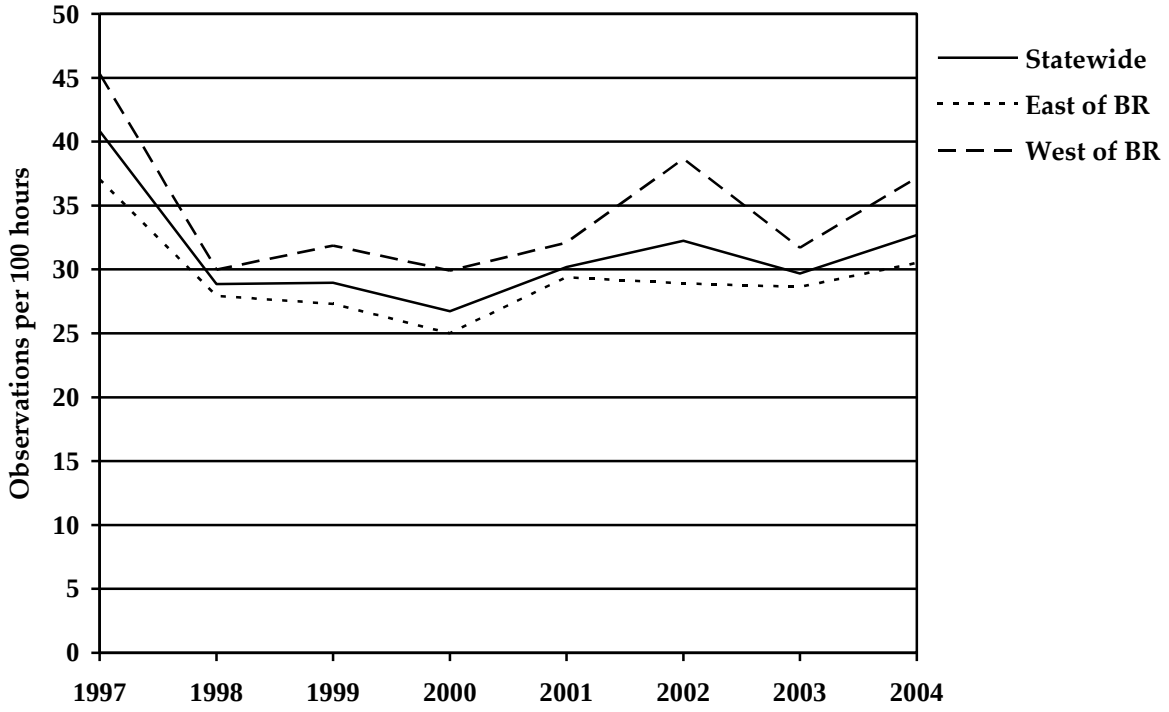

Figure 4. Doe deer observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

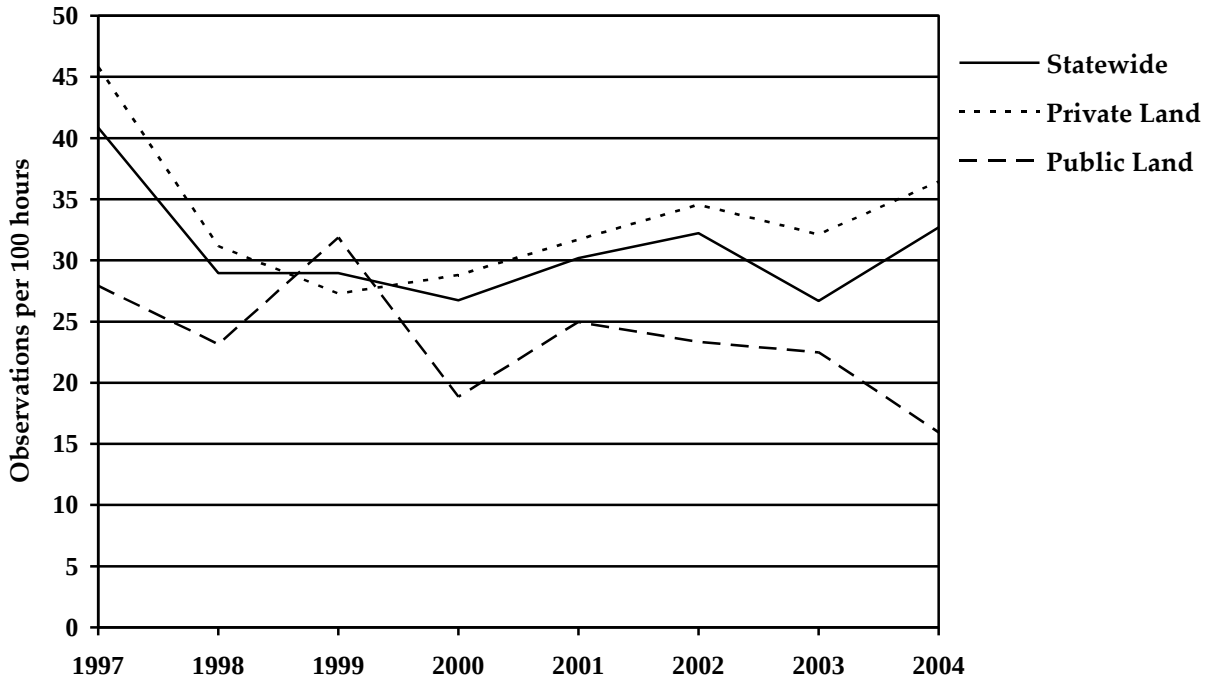

Figure 5. Doe deer observed (per 100 hours of hunting) by cooperating early archery hunters from

1997-2004 by land ownership and statewide in Virginia.

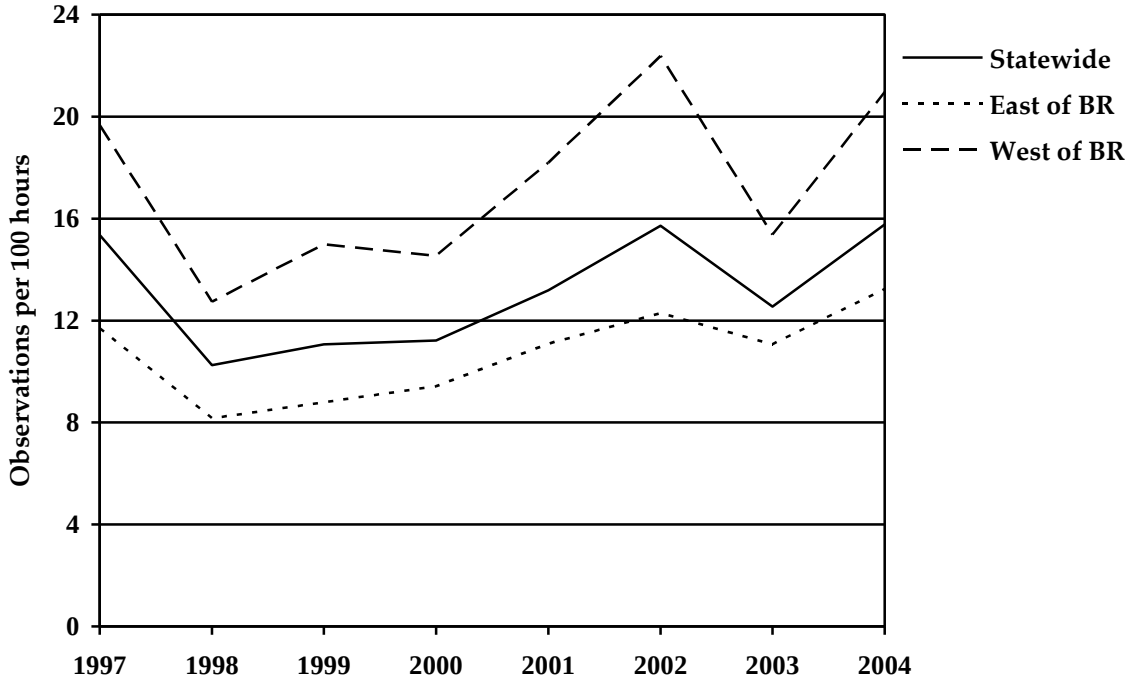

Figure 6. Fawns observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

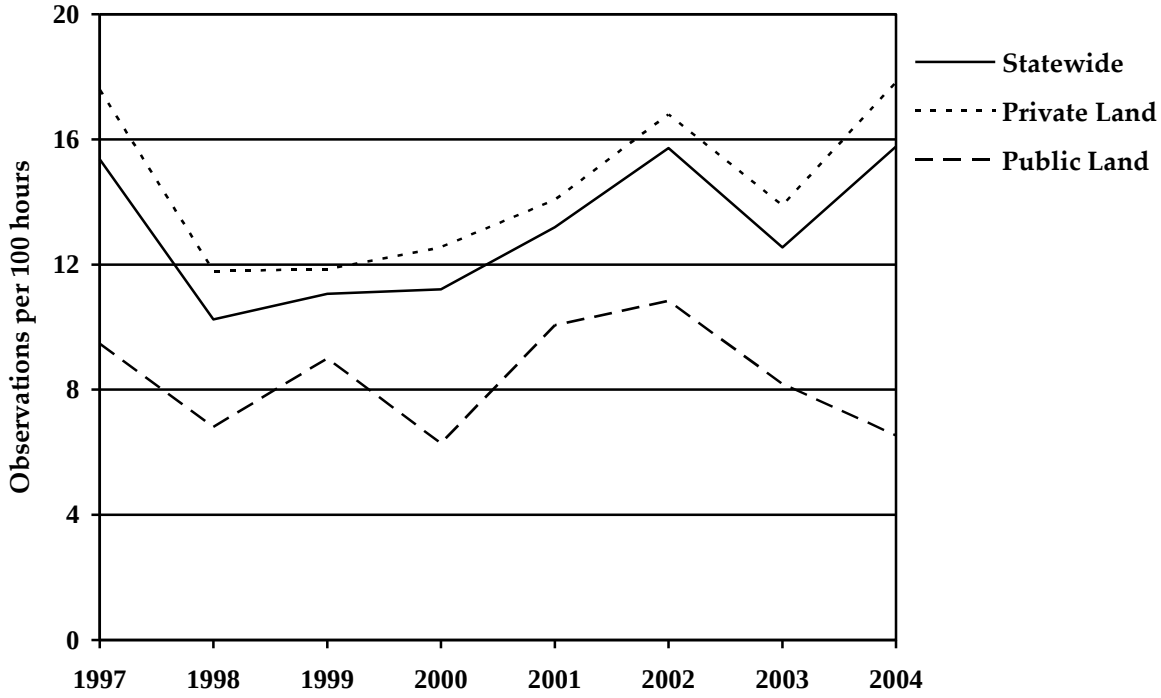

Figure 7. Fawns observed (per 100 hours of hunting) by cooperating early archery hunters from

1997-2004 by land ownership and statewide in Virginia.

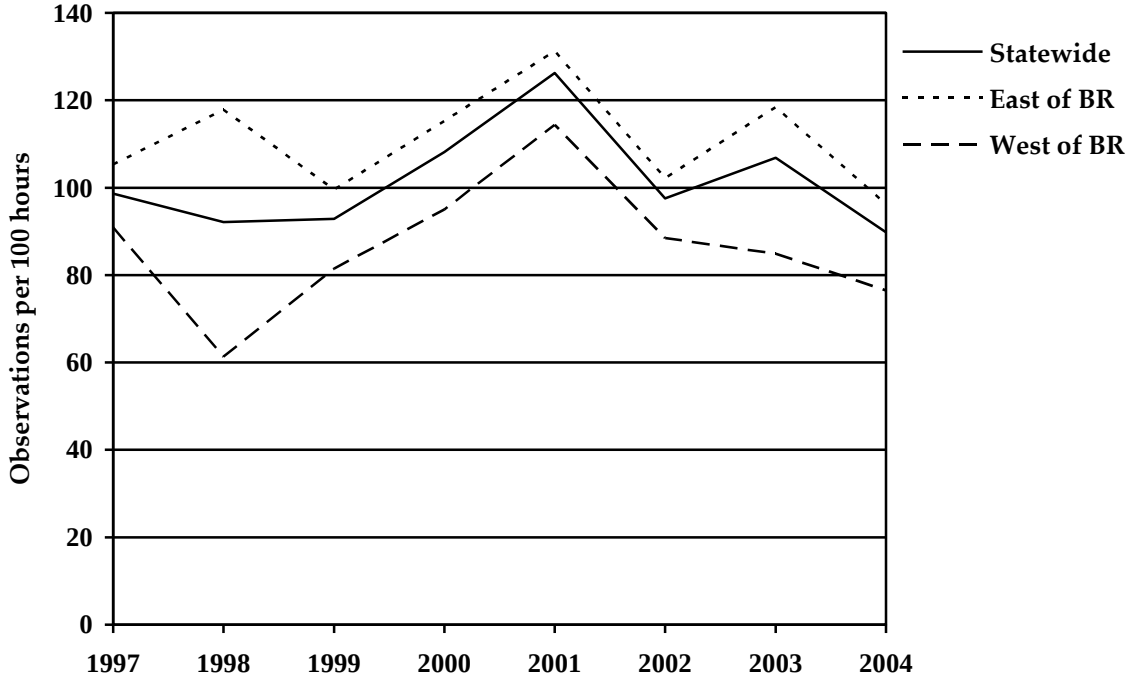

Figure 8. Gray squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

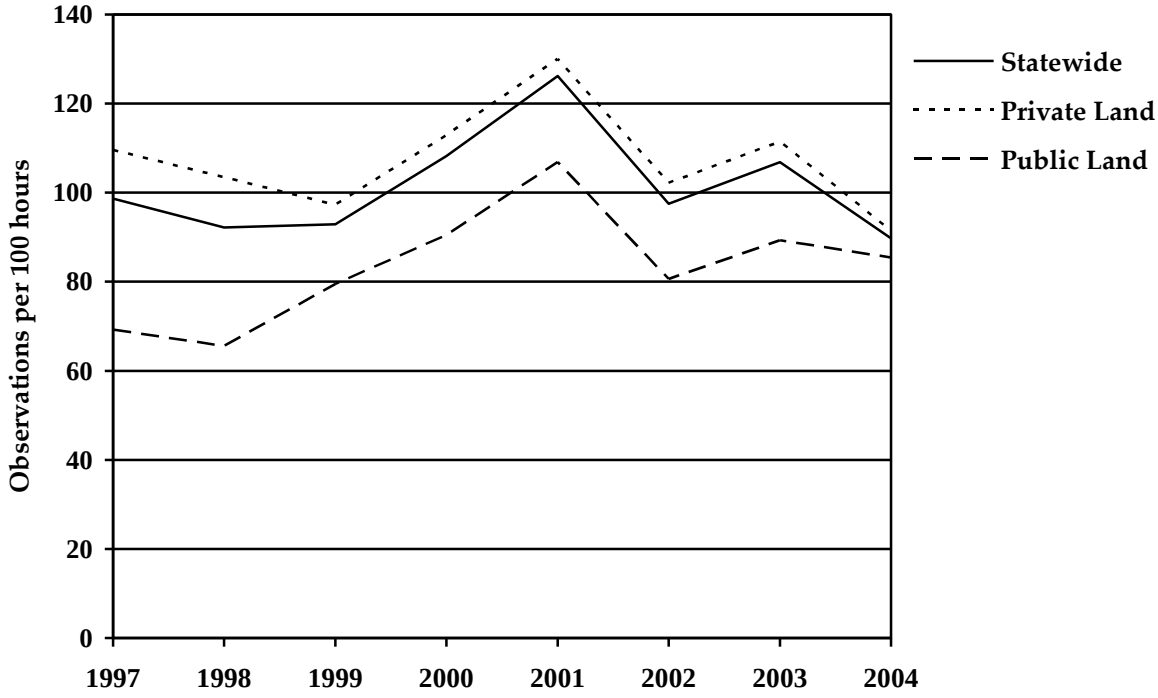

Figure 9. Gray squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

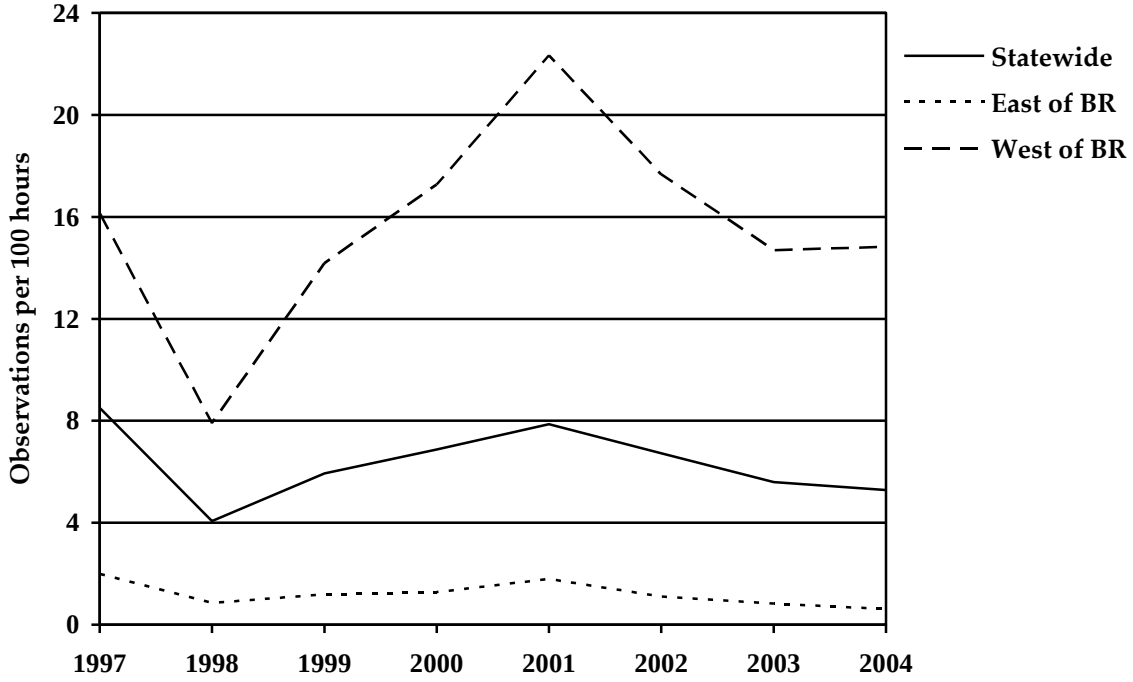

Figure 10. Fox squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

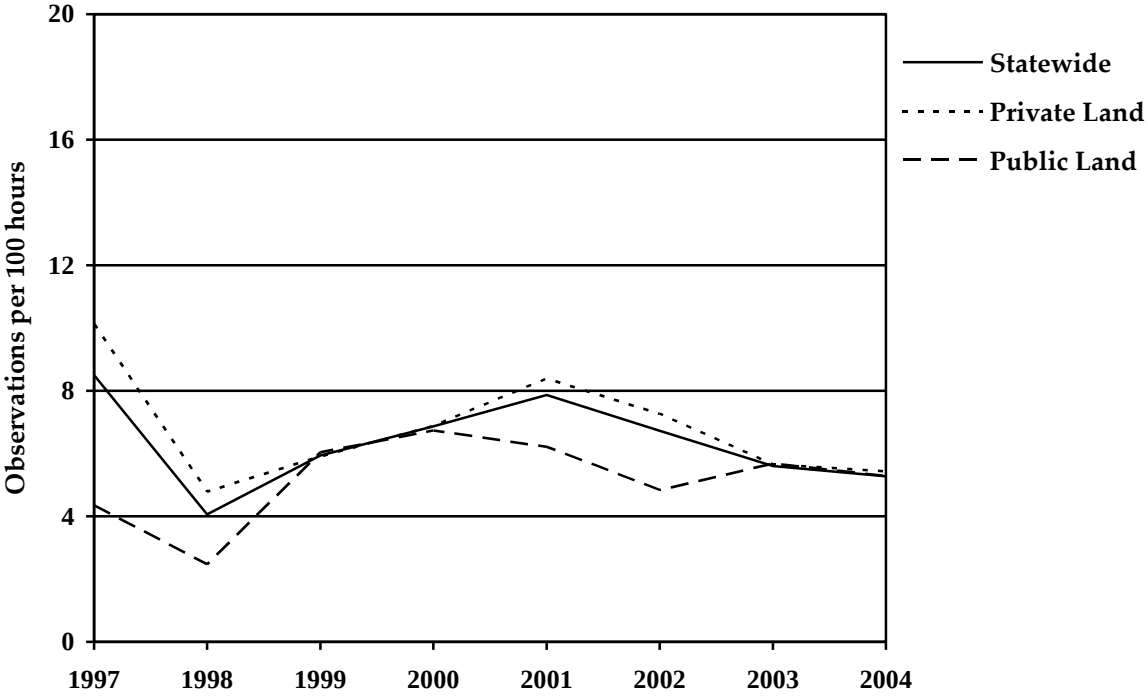

Figure 11. Fox squirrels observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

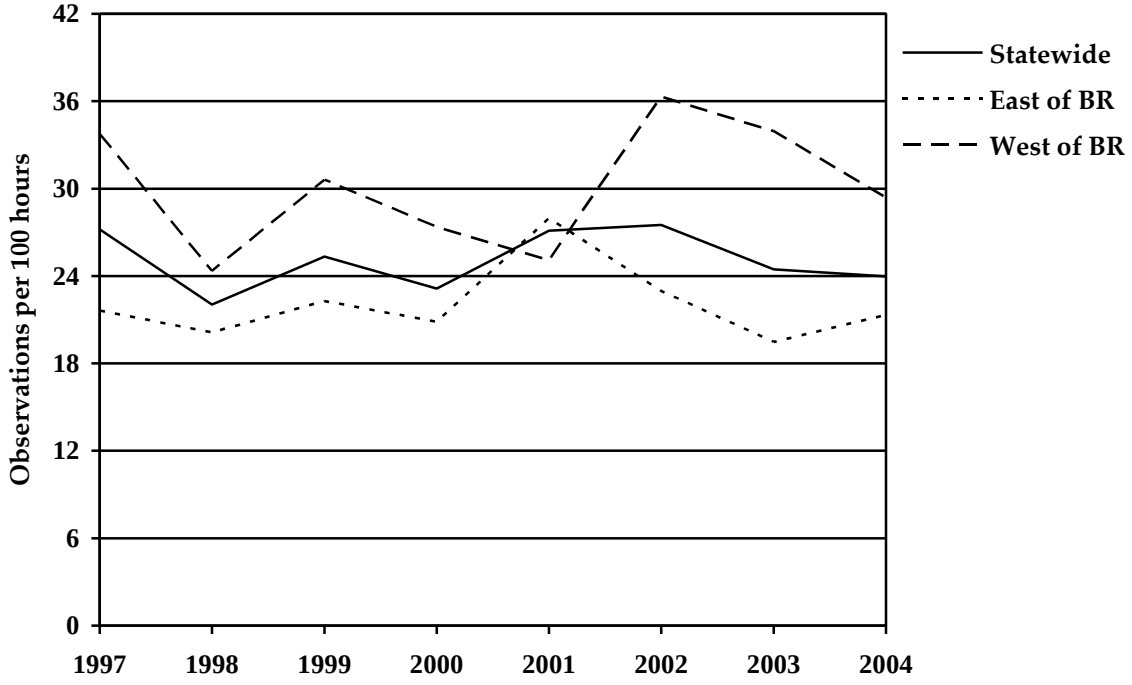

Figure 12. Wild turkeys observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

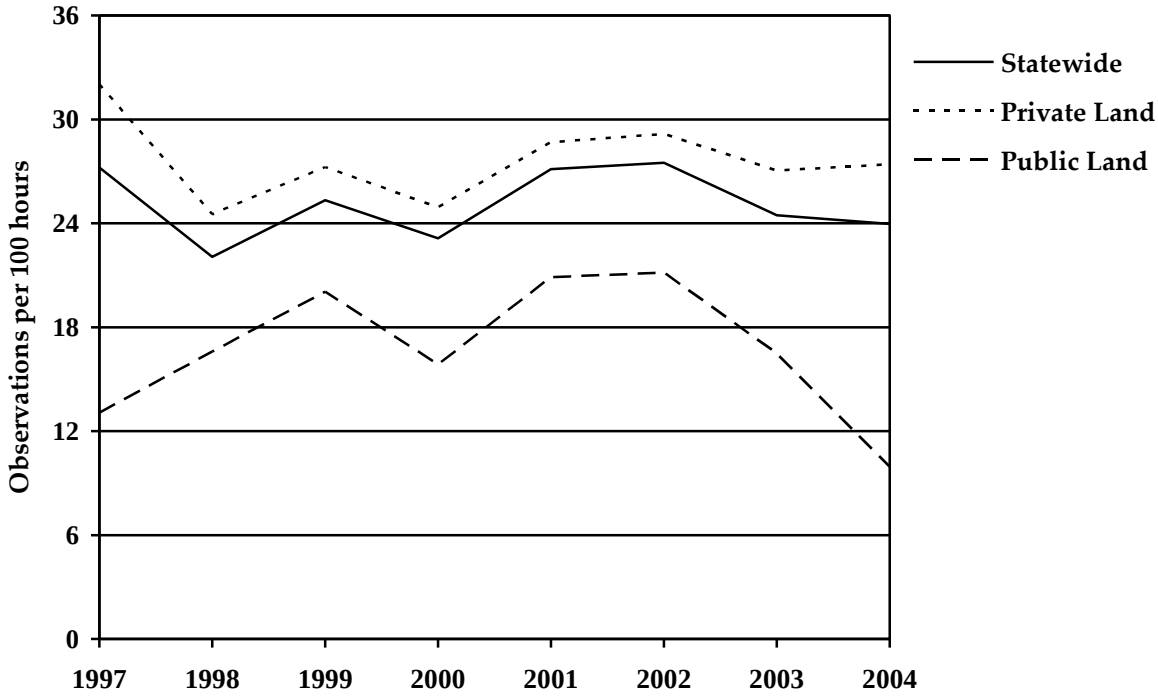

Figure 13. Wild turkeys observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

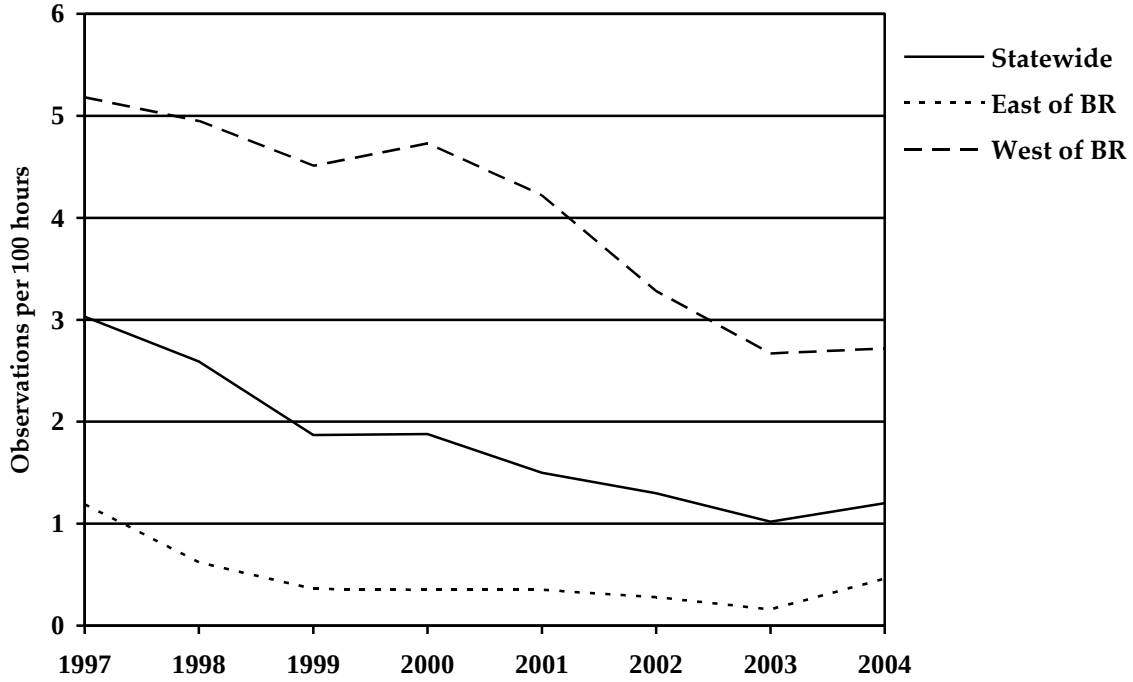

Figure 14. Ruffed grouse observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

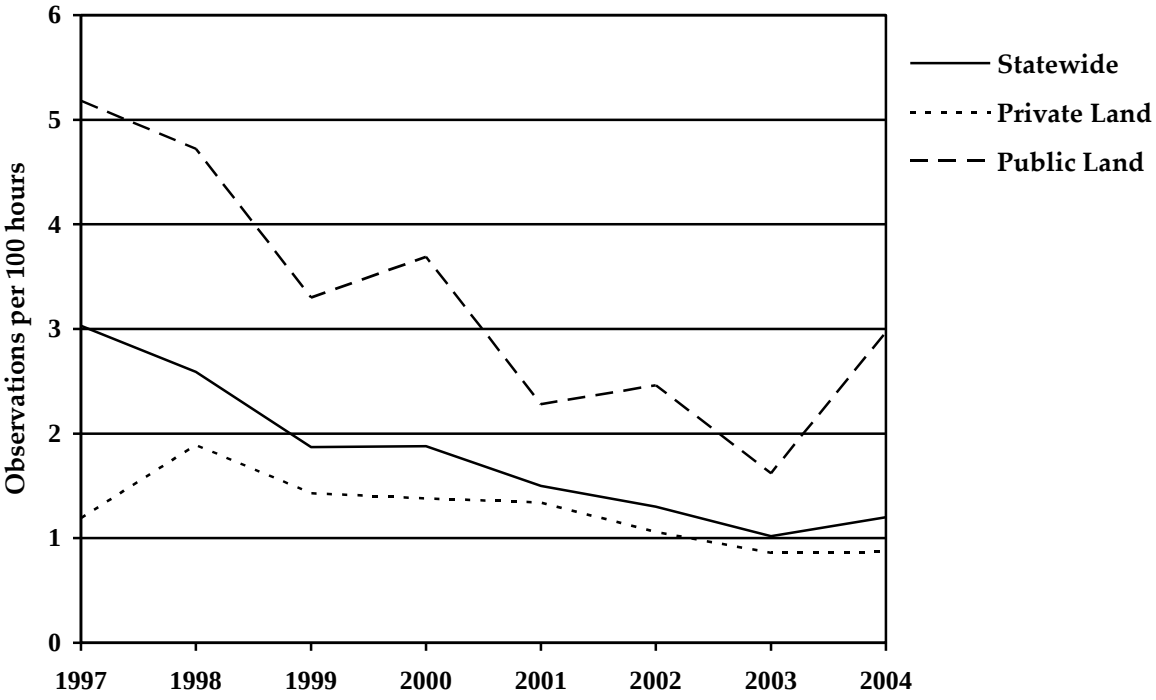

Figure 15. Ruffed grouse observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

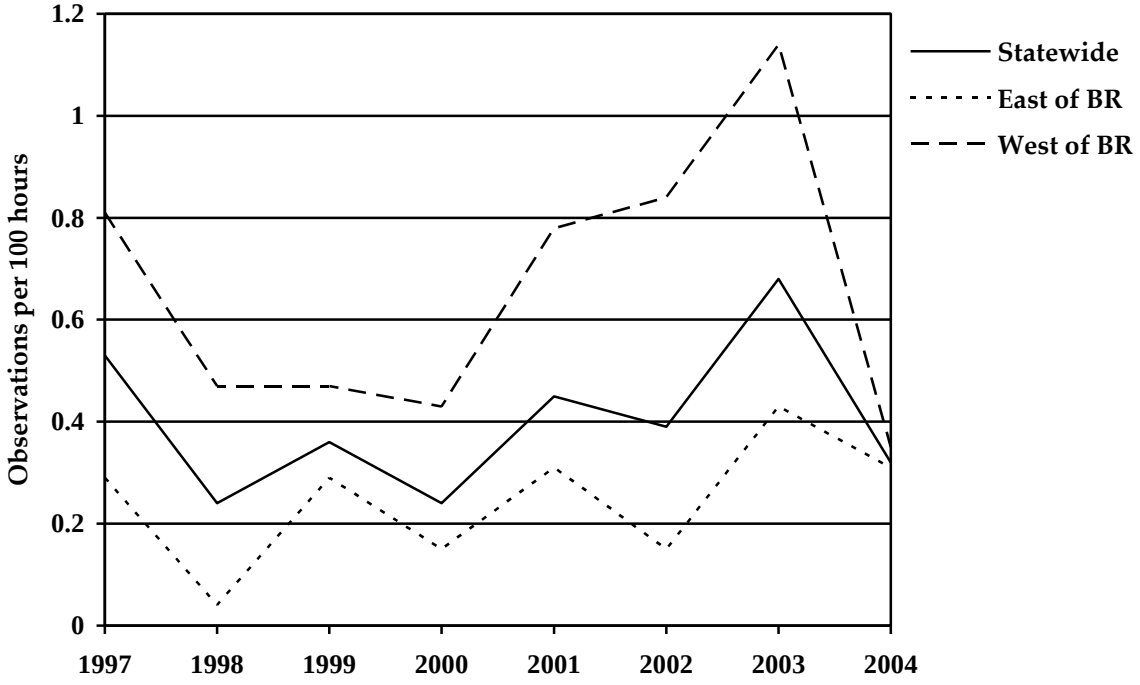

Figure 16. Black bears observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

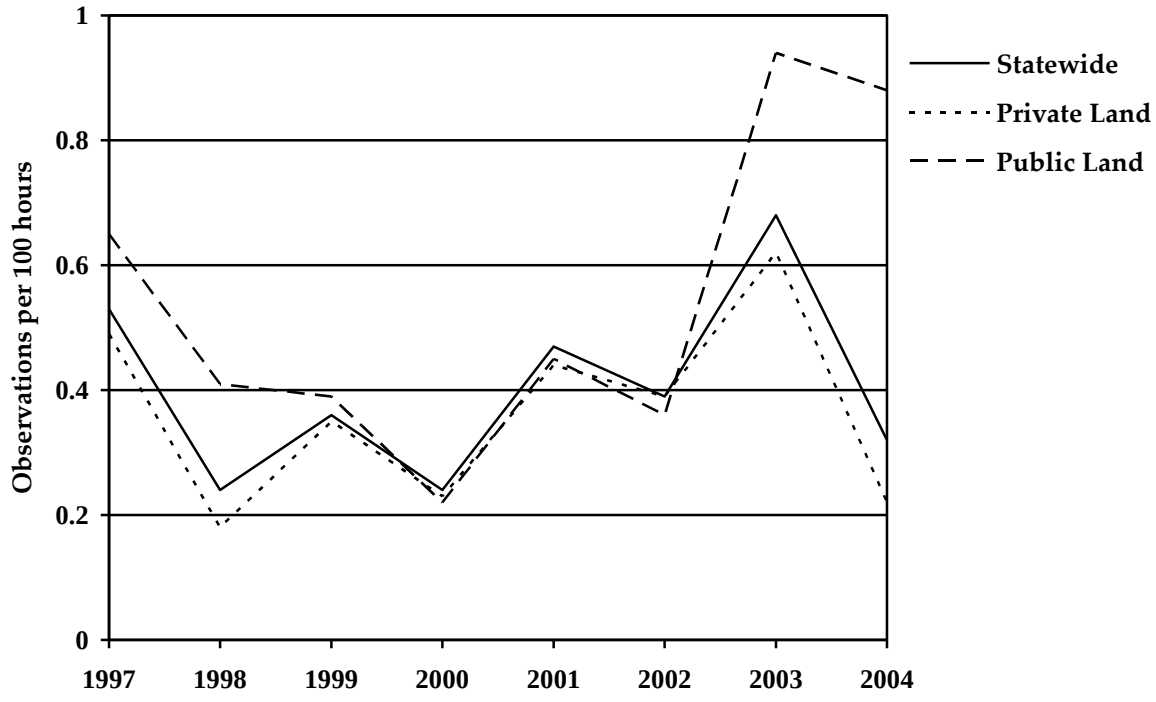

Figure 17. Black bears observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

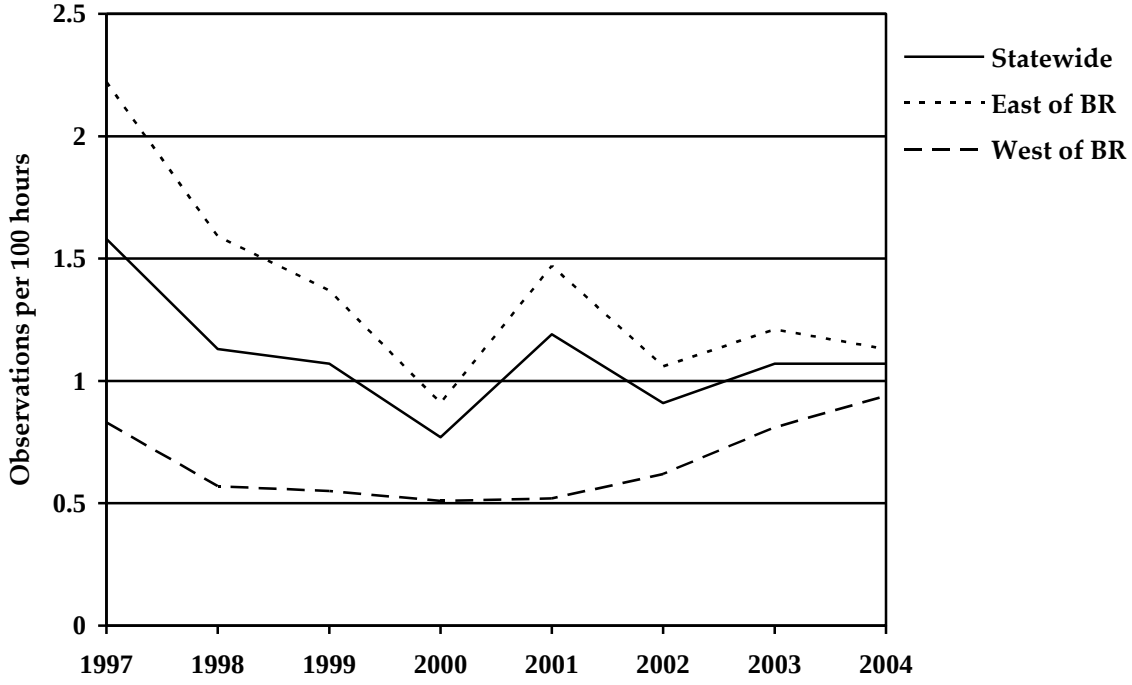

Figure 18. Red foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

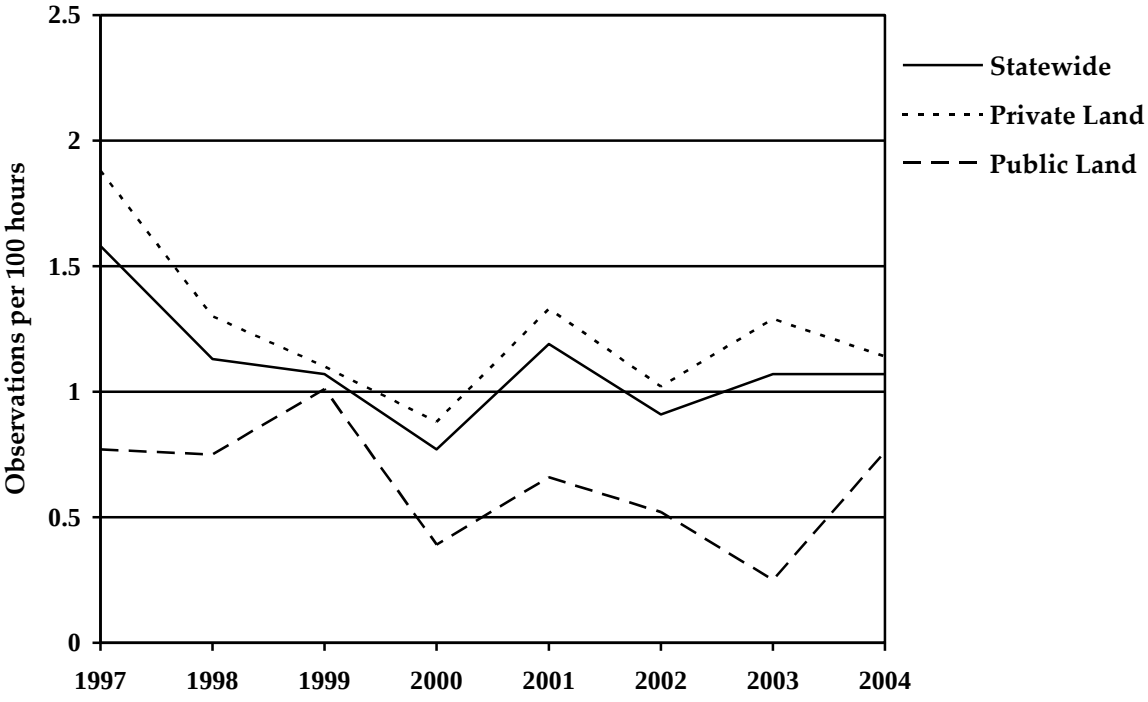

Figure 19. Red foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

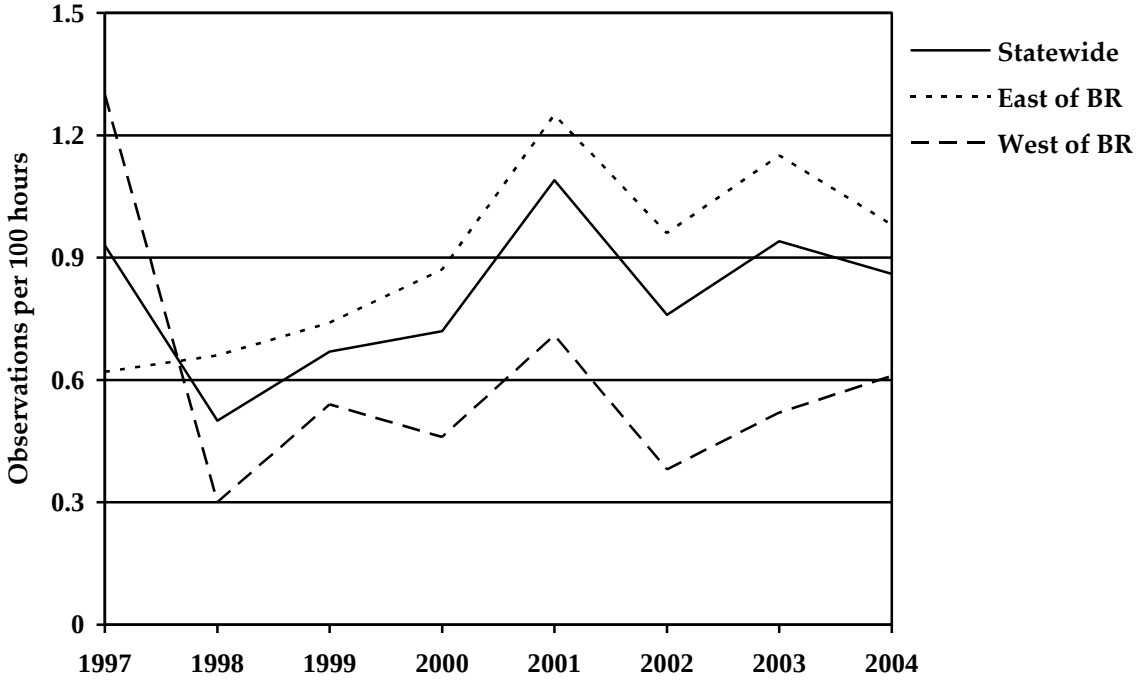

Figure 20. Gray foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

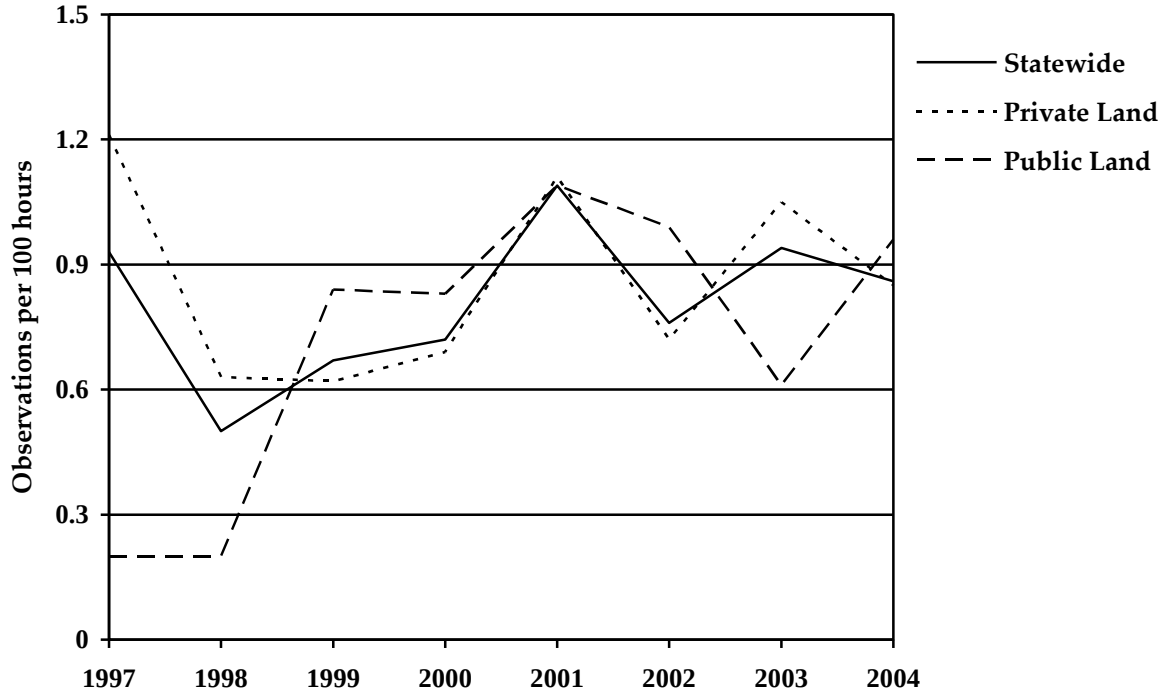

Figure 21. Gray foxes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

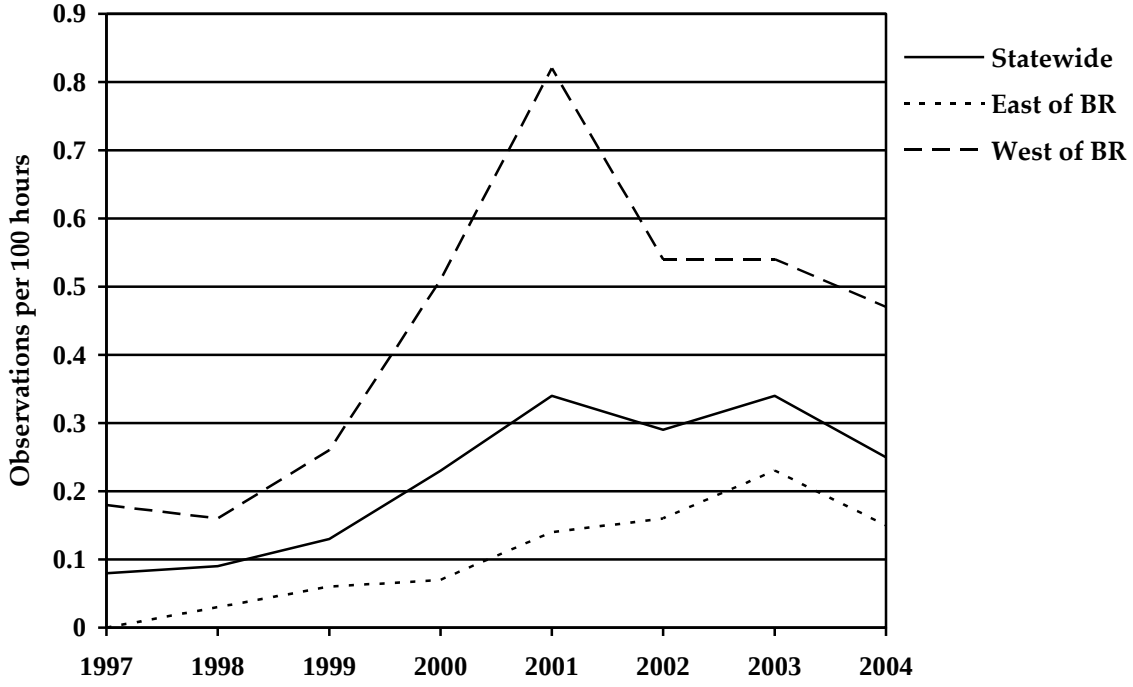

Figure 22. Coyotes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

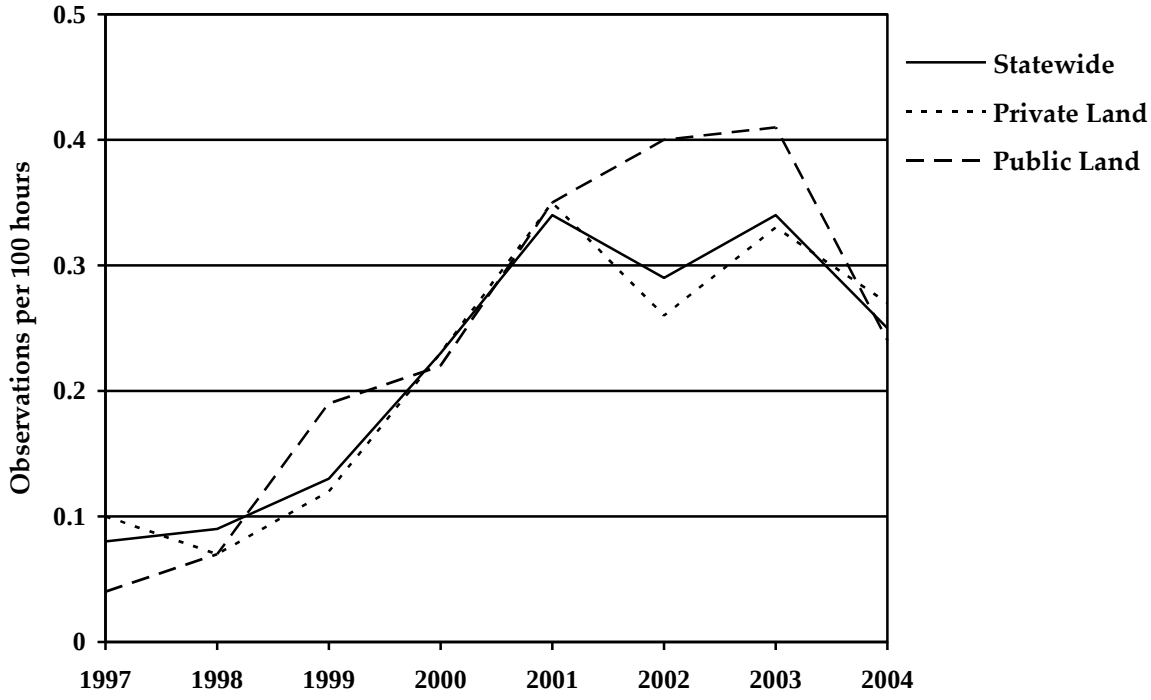

Figure 23. Coyotes observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

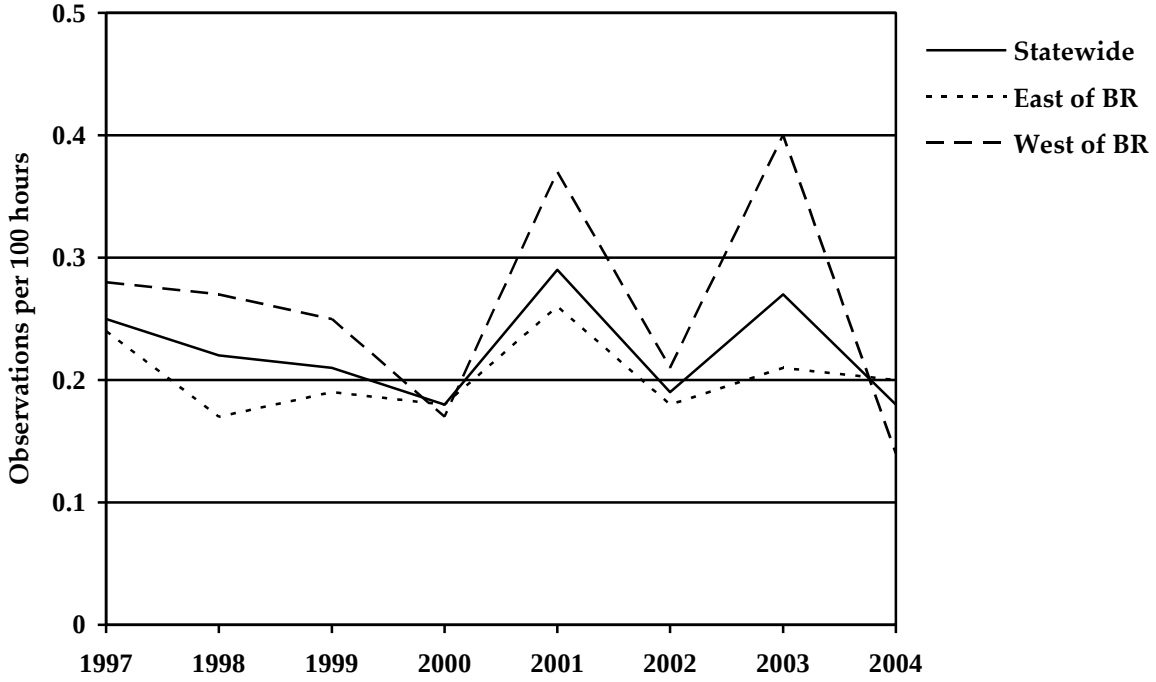

Figure 24. Bobcats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

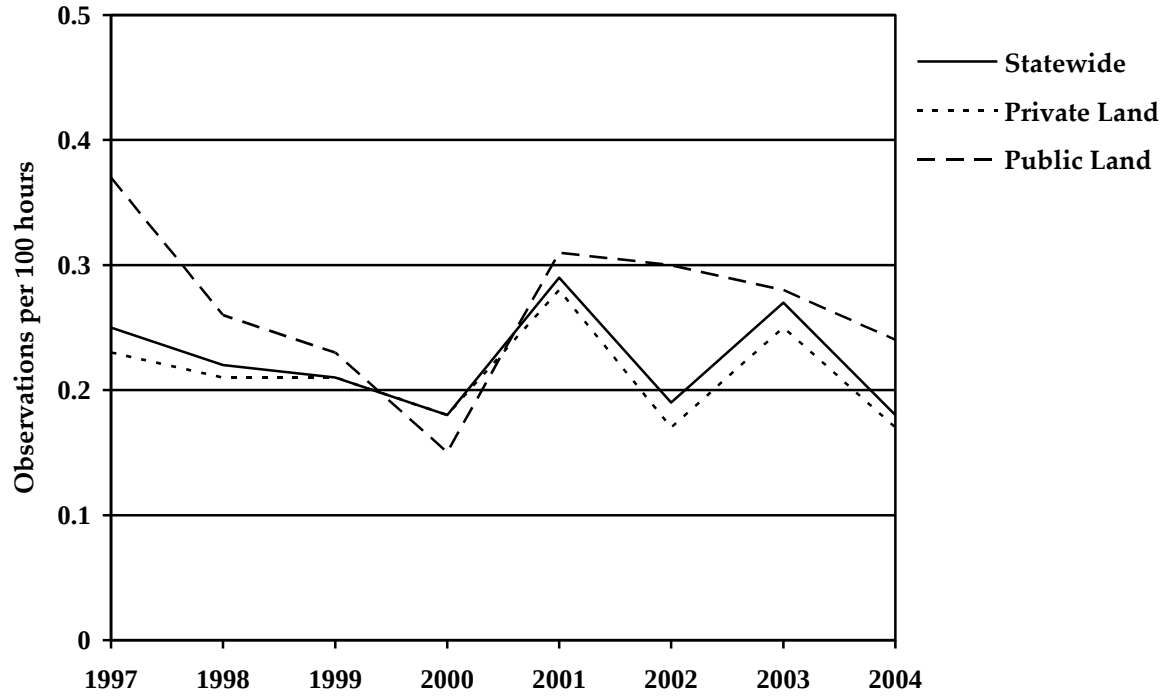

Figure 25. Bobcats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

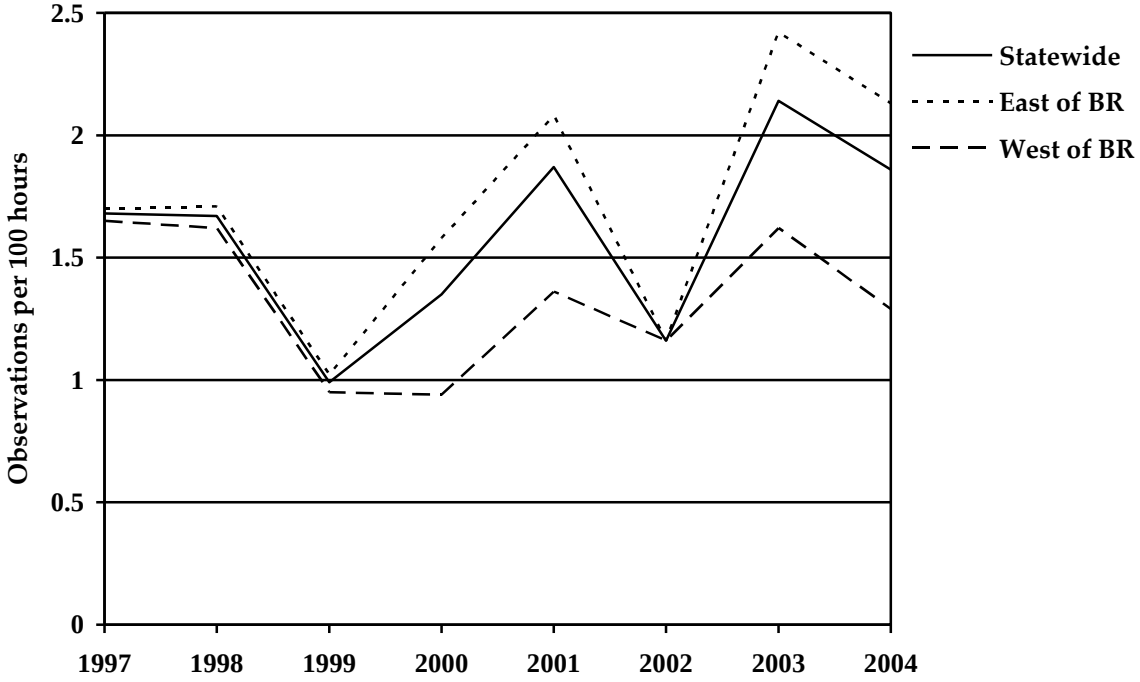

Figure 26. Raccoons observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

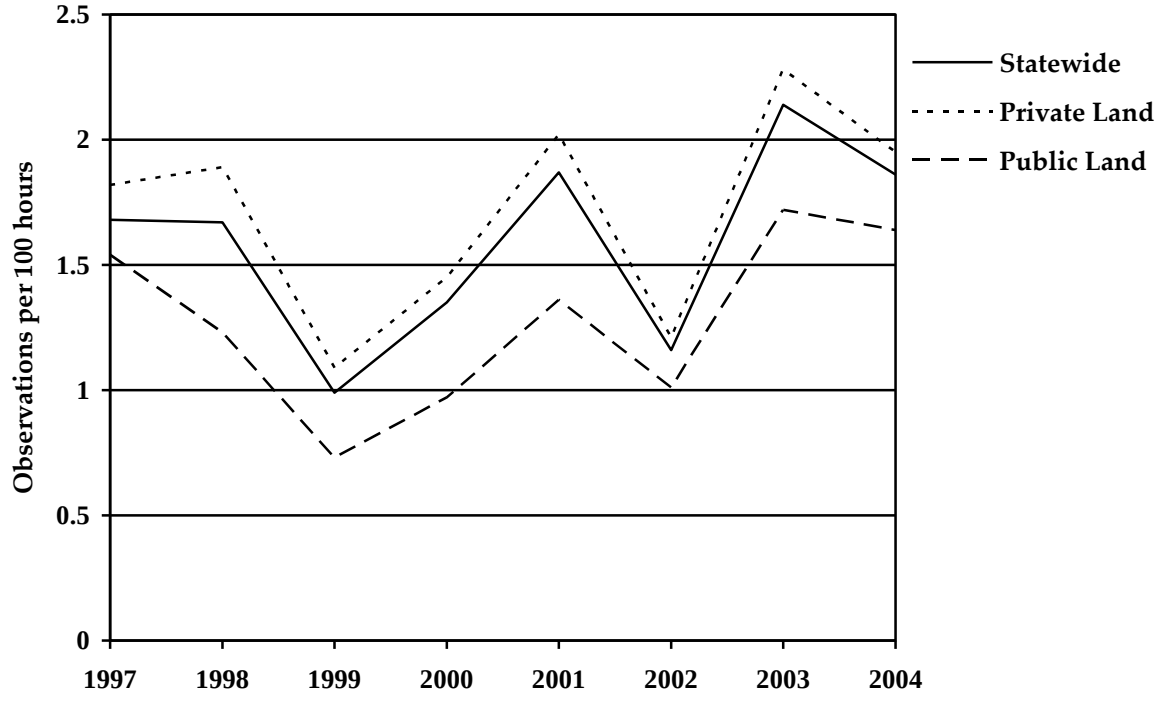

Figure 27. Raccoons observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

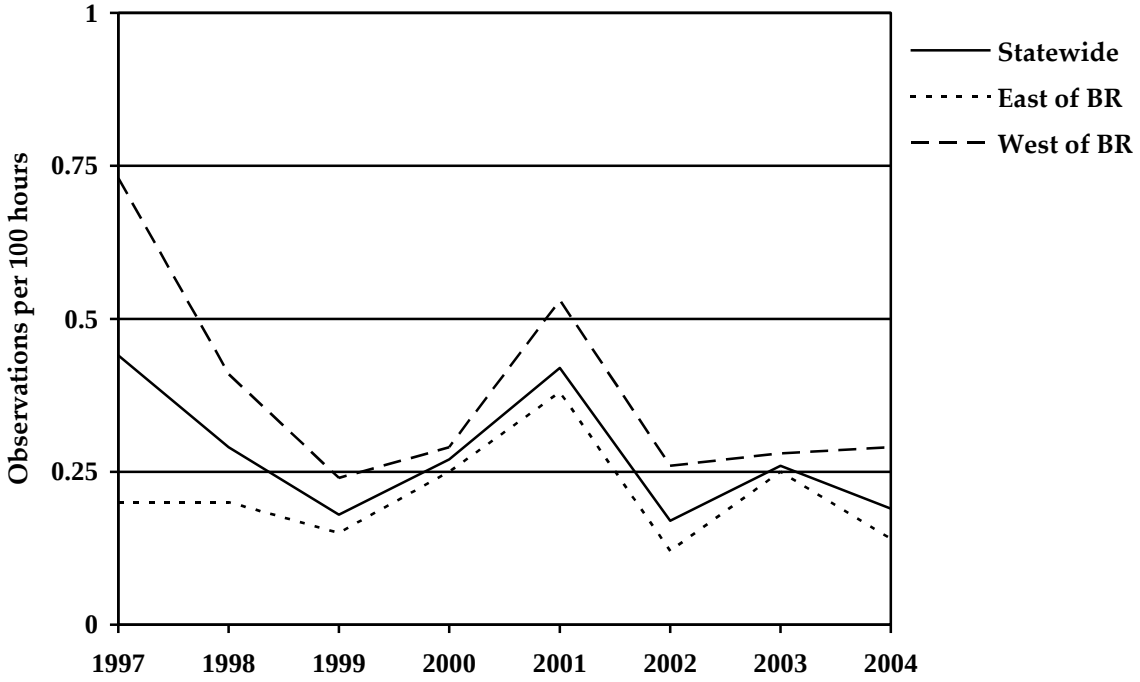

Figure 28. Opossums observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

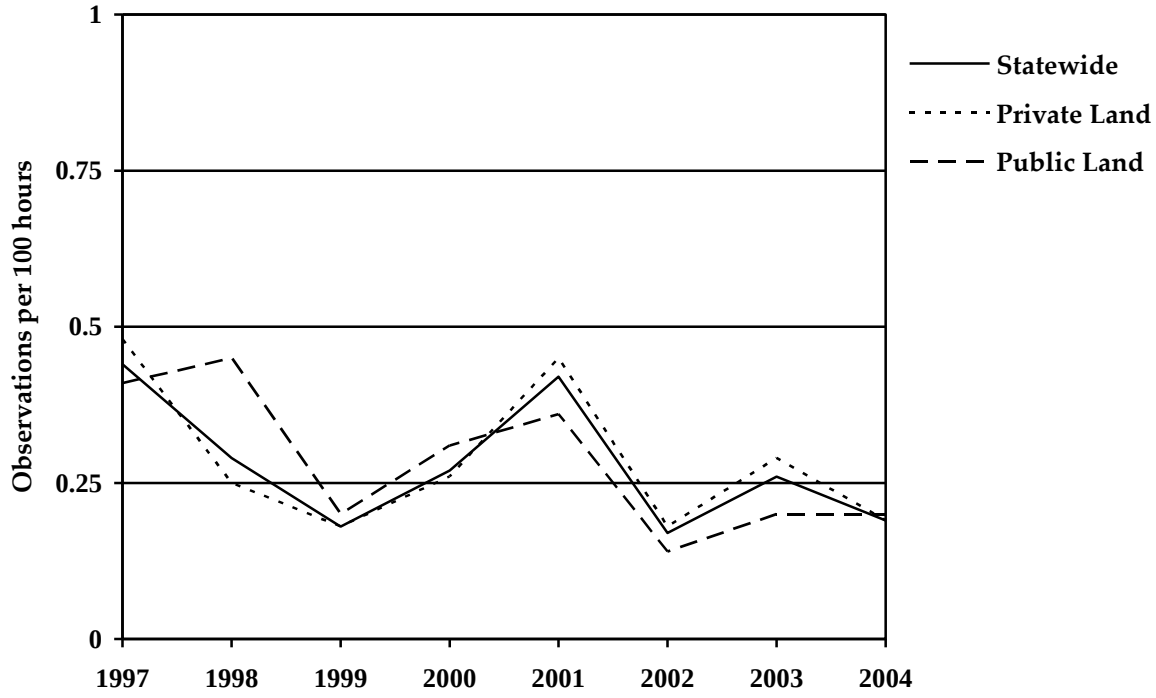

Figure 29. Opossums observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

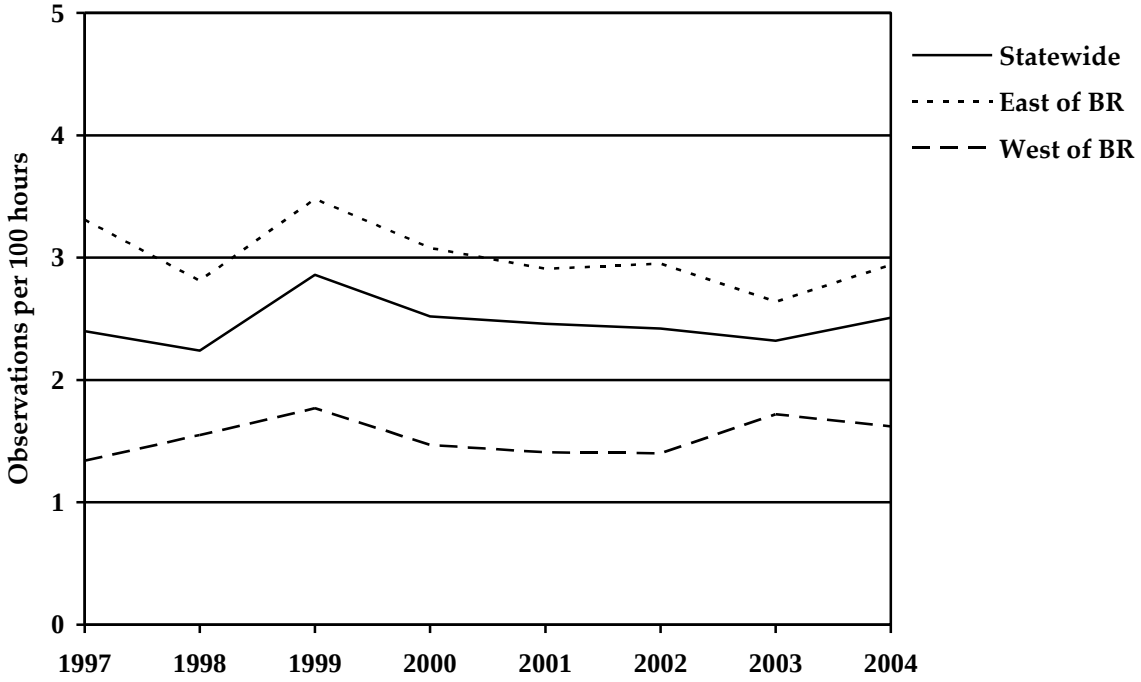

Figure 30. Dogs observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2003 east and west of the Blue Ridge Mountains and statewide in Virginia.

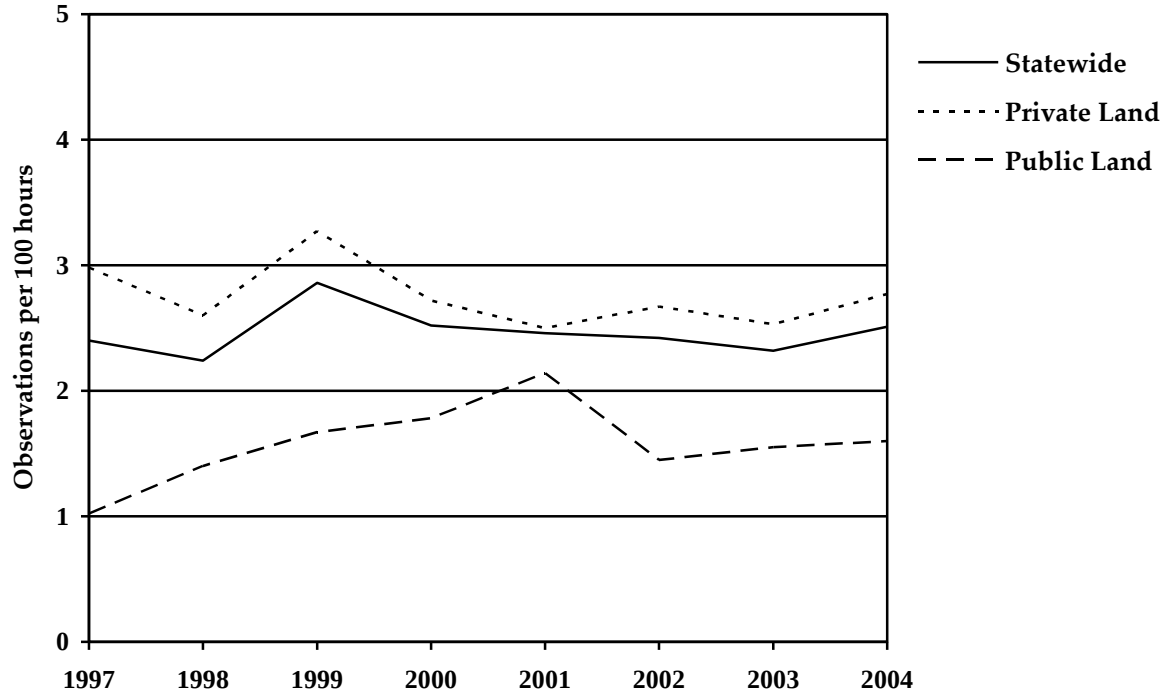

Figure 31. Dogs observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

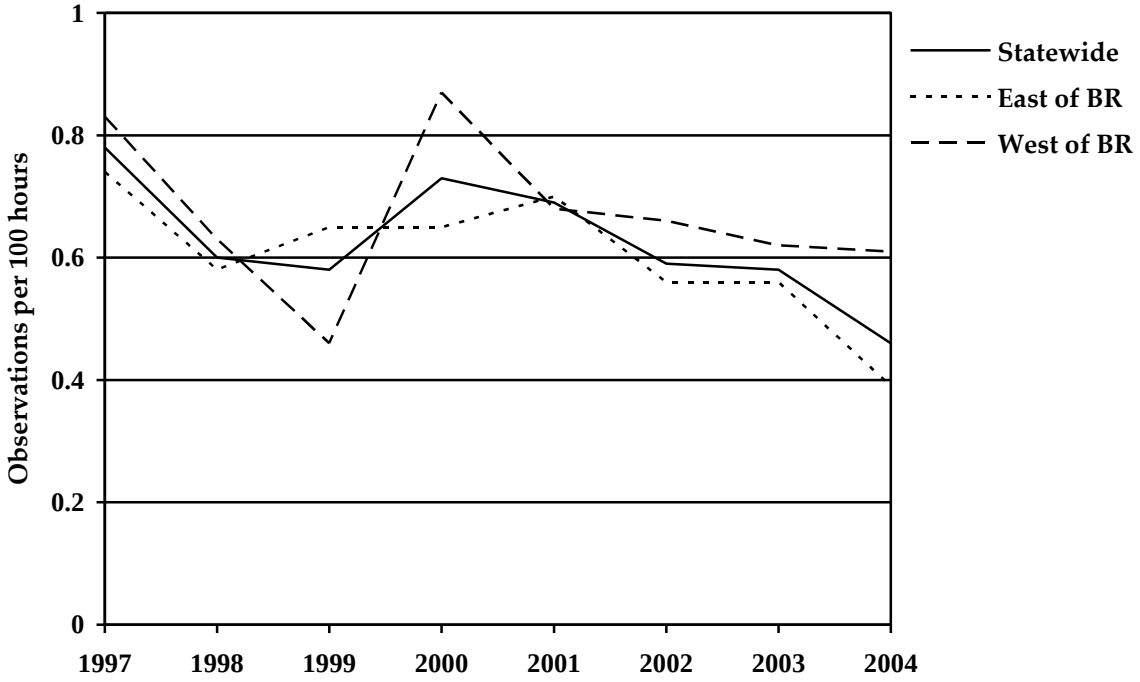

Figure 32. House cats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

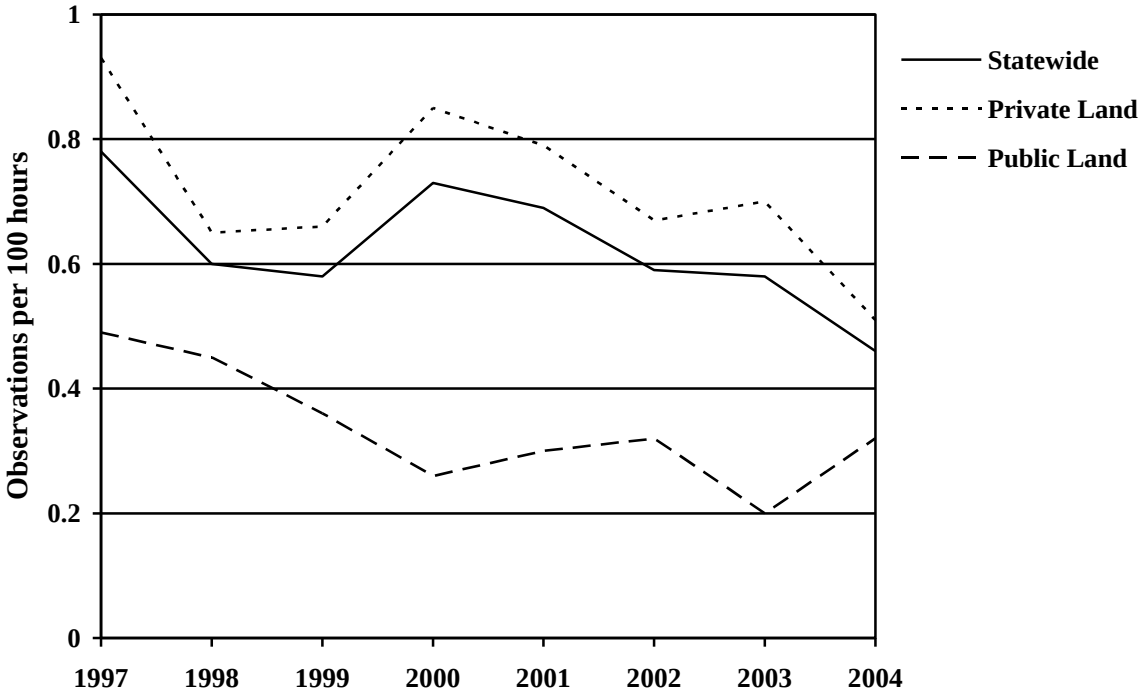

Figure 33. House cats observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

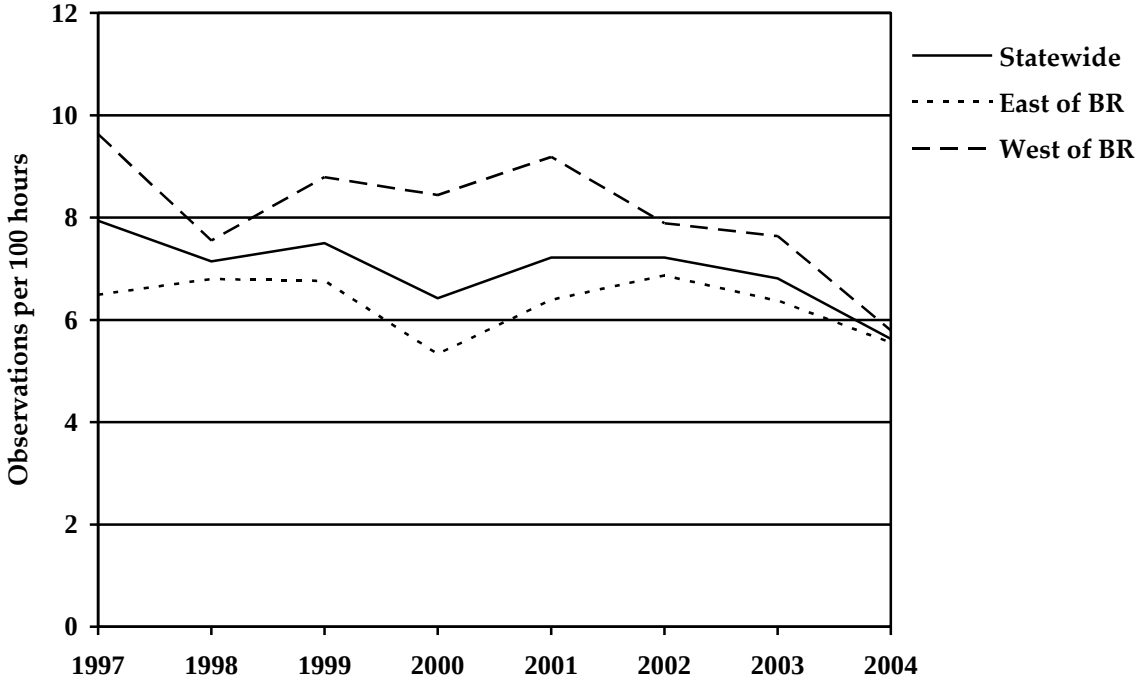

Figure 34. Hunters observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 east and west of the Blue Ridge Mountains and statewide in Virginia.

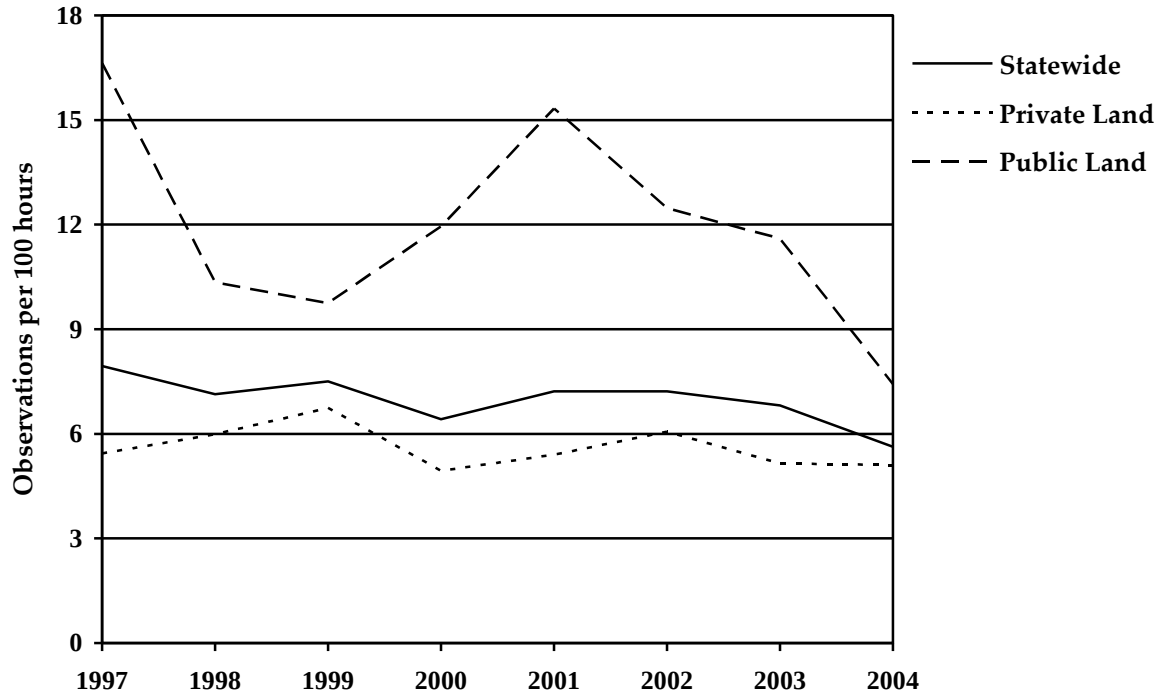

Figure 35. Hunters observed (per 100 hours of hunting) by cooperating early archery hunters from 1997-2004 by land ownership and statewide in Virginia.

2004 Bowhunter Observation Record

Virginia Department of Game and Inland Fisheries

Please see instructions on back of form.

Name: _____

Address: _____

City and Zip Code: _____

* Mast Crop and Weather Codes:

Mast Crop: 1) none 2) light 3) moderate 4) heavy

Precipitation: 1) none 2) drizzle 3) moderate 4) heavy

Wind: 1) none 2) light 3) breezy 4) strong

Temperature: 1) <40° F 2) 40-70° F 3) >70° F

Date	Number of Hours Hunted	County	Public Owned Land? ("Yes" or "No")	Deer (antlered)	Deer (does)	Deer (fawns)	Deer (unknown)	Gray squirrel	Fox squirrel	Turkey	Grouse	Bear (adult)	Bear (cub)	Red fox	Gray fox	Coyote	Bobcat	Raccoon	Opossum	Striped skunk	Otter	Mink	Dog	House cat	Hunter	Other Animals & Number Seen	Mast*	Precipitation*	Wind*	Temperature*
Oct 6	*4 ½*	*Example*	*Yes*		1	2											1									*Fisher:1*	3	2	1	2

Appendix 1. Survey instrument for 2004 Virginia Bowhunter Survey.

INSTRUCTIONS

1. If you wish to participate in next years survey, and do not wish to maintain your confidentiality, please fill in your name and address at the top of the form and in the return address box below.
2. Enter *number of hours* for each *date* you hunted **between Oct. 2 and Nov. 12** (early season) **only.**
3. Write in the *county* where you hunted. If you hunted in more than one county on one day, record different counties on different lines of the form.
4. Report whether or not you are hunting on *publicly owned land* (state or federal).
5. Enter the *number* of animals and other hunters you observed while hunting. Begin observations upon leaving your vehicle and end observations when you return to your vehicle.
6. If you saw a species *not listed* at the top of the chart, enter the *name* and *number* of animals in the "Other Animals" column near the right side of the form.
7. On the last four columns of the chart, record the *mast conditions* and *average weather* conditions for the time period you hunted. Use the *numbers* (*codes)* given at the top right corner of the form.
8. *Fold* this form along the lines below so that our address shows, and *tape* it together.
9. Please *mail* this form to us by **January 1, 2005**. *No postage is needed.*

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 3 VERONA, VA

POSTAGE WILL BE PAID BY ADDRESSEE

VIRGINIA BOWHUNTER SURVEY
VA DEPT OF GAME AND INLAND FISHERIES
PO BOX 996
VERONA, VA 24482-9901

Name: _____

Address: _____

City/Town: _____

If you wish to continue to participate in the Virginia Bowhunter Survey, and do not wish to maintain any confidentiality, please enter your name and address in the return address box. Thank you.

RETURN ADDRESS (OPTIONAL).

DO YOU KNOW OF OTHER HUNTERS WHO WOULD LIKE TO PARTICIPATE IN THE BOWHUNTER SURVEY? IF SO, PLEASE ENTER THEIR NAMES AND ADDRESSES BELOW:

Name: _____

Address: _____

City/Town: _____

Name: _____

Address: _____

City/Town: _____

THANK YOU FOR PARTICIPATING!!

Appendix 2. Instructions for 2004 Virginia Bowhunter Survey Form.

Appendix 3. Virginia counties hunted, hunts per county, and percentage of total state hunts per county by cooperating archery hunters 2 October to 12 November 2004 in Virginia.

County	No. Hunts	% of Hunts	County	No. Hunts	% of Hunts
Accomack	107	3.03	King William	83	2.34
Albemarle	53	1.50	Lancaster	24	0.68
Alleghany	10	0.28	Lee	41	1.16
Amelia	6	0.17	Loudoun	37	1.04
Amherst	90	2.54	Louisa	25	0.71
Appomattox	24	0.68	Lunenburg	0	0.00
Augusta	35	0.99	Madison	41	1.16
Bath	27	0.76	Mathews	6	0.17
Bedford	51	1.44	Mecklenburg	32	0.90
Bland	62	1.75	Middlesex	21	0.59
Botetourt	32	0.90	Montgomery	88	2.48
Brunswick	23	0.65	Nelson	41	1.16
Buchanan	21	0.59	New Kent	45	1.27
Buckingham	9	0.25	Northampton	15	0.42
Campbell	33	0.93	Northumberland	38	1.07
Caroline	53	1.50	Nottoway	60	1.69
Carroll	16	0.45	Orange	58	1.64
Charles City	30	0.85	Page	28	0.79
Charlotte	17	0.48	Patrick	42	1.19
Chesapeake	3	0.08	Pittsylvania	53	1.50
Chesterfield	69	1.95	Powhatan	16	0.45
Clarke	17	0.48	Prince Edward	14	0.47
Craig	3	0.08	Prince George	54	1.52
Culpeper	37	1.04	Prince William	12	0.34
Cumberland	22	0.62	Pulaski	15	0.42
Dickenson	58	1.64	Rappahannock	37	1.04
Dinwiddie	12	0.34	Richmond	18	0.51
Essex	77	2.17	Roanoke	38	1.07
Fairfax	95	2.68	Rockbridge	20	0.56
Fauquier	56	1.58	Rockingham	104	2.93
Floyd	45	1.27	Russell	20	0.56
Fluvanna	34	0.96	Scott	14	0.40
Franklin	28	0.79	Shenandoah	205	5.78
Frederick	22	0.62	Smyth	1	0.03
Giles	41	1.16	Southampton	113	3.19
Gloucester	35	0.99	Spotsylvania	16	0.45
Goochland	21	0.59	Stafford	26	0.73
Grayson	7	0.20	Suffolk	9	0.25
Greene	4	0.11	Surry	88	2.48
Greensville	44	1.24	Sussex	37	1.04
Halifax	32	0.90	Tazewell	39	1.10
Hanover	21	0.59	Virginia Beach	4	0.11
Henrico	44	1.24	Warren	3	0.08
Henry	73	2.06	N. News / Hampton	2	0.06
Highland	9	0.25	Washington	44	1.24
Isle of Wight	60	1.69	Westmoreland	24	0.68

James City	6	0.17	Wise	14	0.40
King & Queen	21	0.59	Wythe	37	1.04
King George	43	1.21	York	4	0.11