A Comparison of Hunter Movement, Activities and Opinions During Two Pennsylvania Hunting Seasons

A.E. Luloff
J.C. Finley
D. Diefenbach
R.C. Stedman
G. San Julian
H. Zinn
C. Swope
M.A. Brennan
D. Matarrita

Final Report

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We dedicate to this report Dennis Jones. Without his help we could not have completed this research project. His grace, kind words, and know how will be missed.

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INTRODUCTION

Studies of Pennsylvania's hunters suggest they believe public lands have lower deer densities and greater hunting pressures which together contribute to lower hunter success than experienced on private lands (Diefenbach et al., in review, (see Appendix B)). Beyond such perceptions, however, little is known about hunter's actual behavior on public lands. For example, how far do they hunt from roads and how far do they walk? Knowledge of these practices is essential to public game and land agencies charged with developing effective tools for managing deer. This project was designed to provide such information.

There has been extensive research conducted on free-ranging deer and other North American big game species, but hunter field behavior or the factors that influence this behavior is less well understood. Our research in the Sproul State Forest (hereafter, Sproul) was based on three integrated protocols designed to estimate hunter density, distribution, movements, habitat use, characteristics, and attitudes, all of which can be used on large areas with unrestricted access.

Members of The Pennsylvania State University Human Dimensions Unit (HDU) spent two deer hunting seasons (2001 and 2002) collecting data on hunter movement on the Sproul. Following each season, HDU contacted hunters using either a mail or telephone survey to learn about hunting attitudes and experiences on the Sproul.

This multi-method study increased interest in deer management issues in the Commonwealth. Essential information about hunting opportunities on public lands has been generated and this study provides insights into hunter behavior on public land. Its innovative research design can be implemented elsewhere for studies that simultaneously monitor deer and hunter movement and will contribute to the development of creative solutions to deer

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management. Results of this research clearly have contributed to an enlightened debate over deer numbers and hunting opportunities on public versus private lands.

This project used aerial surveys, in conjunction with distance sampling techniques and a geographic information system (GIS) database of landscape characteristics, to generate estimates of hunter density and a map of hunter distribution and habitat use. The distribution of global position system (GPS) units to hunters so that their locations could be systematically recorded facilitated this effort. In addition, hunters were asked to complete a simple field questionnaire.

Although aerial surveys are limited to discrete points in time and relate only to aggregations of hunters, GPS unit carriers provide information on hunter habitat use and distribution at different times of day across the landscape. When coupled to information gathered via traditional mail and telephone surveys, we are better able to assess how hunter characteristics (e.g., age, physical condition, and attitudes) are related to field behavior.

The Sproul was chosen as the study site because it is representative of large tracts of contiguous forested public land commonly referred to as Big Woods. Forested habitats across the Commonwealth often exhibit evidence of the effects of deer overabundance. Questions exist about the relationship between those areas most severely damaged and hunter success – that is, is damage more common in areas where hunter access is difficult or hunting effectiveness is low?

It is generally thought that many such sites are big woods areas where hunter use or access, especially for harvesting antlerless deer, is low or difficult. The latter can result in a forested landscape characterized by moderate to high hunting pressure in some areas, and deer refuges with little or no hunting pressure in others. Such refugia may retain deer densities large enough to continue to degrade habitat. Until the implementation of our study, natural resource managers in Pennsylvania knew relatively little about hunter behavior in big woods areas.

Our research focused on two objectives during the two years of fieldwork:

(1) Monitor hunter movement and distribution on a large tract of public land where hunter numbers are not restricted; and

(2) Explore hunter concerns, motivations, strategies, and habitat use when hunting in this landscape.

STUDY AREA

The study area was located in north-central Pennsylvania (Clinton and Centre counties) in the Allegheny Plateau physiographic province that contains large tracts of public land. The 45,907 ha study area encompassed the southern portion of the Sproul managed by the Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry (38,909 ha), and State Game Lands 100 (6,998 ha) managed by the Pennsylvania Game Commission (PGC). Its center is characterized by nearly flat to gently rolling terrain, 500–600 m in elevation, which terminates at abrupt drainages to the Susquehanna River to the east, north, and west (200–300 m in elevation). A north-south paved, 2-lane state highway bisects the study area; all other roads in the study area are dirt and gravel. Numerous hiking and snowmobile trails, gas wells, and natural gas and electric utility corridors exist throughout the area. Although much of the forest was generally accessible via study area roads and trails, 16% was >1 km from the nearest road open to the general public.

Forest cover is primarily second- and third-growth mature hardwood forest and regenerating stands with few, small, and scattered herbaceous openings, including utility corridors. The study area is in the transition zone of the northern hardwoods forests to the north and oak-hickory (Quercus and Carya spp.) forests to the south. Common tree species include red maple (Acer rubrum) and red and white oak species (Quercus spp.) with lesser amounts of black cherry (Prunus serotina), American beech (Fagus grandifolia), and hickory (Carya spp.).

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Evergreens are scarce (1%), but when present primarily **are** hemlocks (Tsuga canadensis) in drainages and wetlands, with some larch (Larix kaempferi) and pine (Pinus spp.) in rare plantations. Regeneration is sparse and a distinct browse line from deer is evident throughout much of the area. Understory vegetation is dominated by mountain laurel (Kalmia latifolia), sweet fern (Comptonia peregrina), huckleberry (Vaccinium spp.), and ferns (primarily hay-scented fern [Dennstaedtia punctilobula]). In addition to deer browsing, large forest fires and tornadoes in the late 1980s and early 1990s as well as outbreaks of forest insects have affected the area.

North-central Pennsylvania is known as the "Big Woods" habitat because of its large tracts of public land (>800,000 ha) that are primarily forested. The Big Woods has a long history of deer hunting. By 1900 this area of the state contained the only huntable populations of black bear and white-tailed deer (Kosack 1995). In the early 1900s, the state Bureau of Forests and Waters leased hundreds of small plots of land on state forestlands to Pennsylvania citizens to build camps, and camps were developed on private in-holdings. Consequently, generations of hunters have evolved a tradition of hunting bear and deer, primarily antlered bucks, during the regular rifle seasons in the Big Woods of Pennsylvania. This means that deer were hunted on the study area by local county residents, and by a greater number of Pennsylvania residents from all counties of the state (PGC, unpublished data) who used hunting camps located in the Sproul. Deer densities in this region of Pennsylvania in 2002 were estimated to be 81 deer/1,000 ha prior to the hunting season (PGC, unpublished data) and bear densities were approximately 2.7 bear/1,000 ha (D.R. Diefenbach, unpublished data).

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METHODS

The southern portion of the West Branch of the Susquehanna River between Snowshoe and Renovo, along Route 144, served as the study site during the 2001 and 2002 deer hunting seasons (Appendix A). This area was selected because it represents a large public hunting area where hunter movement may limit success and subsequently result in continued habitat degradation even with relatively low deer density. For five days during both the 2001 and 2002 hunting seasons, hunter movement was monitored by three procedures: (1) multiple flyovers along predetermined flight lines using trained observers to locate and record hunter locations on a GIS layer (Appendix B); (2) self-selected hunters (those who agreed to participate in the study) were asked to carry GPS units which automatically recorded their movement throughout the hunting day (Appendix C); and (3) self-selected hunters (those who agreed who were either were in the cars coming into the Sproul or who stayed at camps selected for study) were asked to document on paper maps their approximate movements and maximum distance traveled from a "drivable road" at the end of their hunting day (Appendix D).

The study days were the first Monday, Tuesday, Wednesday, and each of the two Saturdays during the 2001 and 2002 seasons. Our efforts focused on two hunter groups in the study population – those who had camps on the study forest and those who drove into the study area via various access routes. The afternoon and evening before the opening morning of each of the two deer seasons, a random sample of camp owners was approached and asked to participate in our study by either completing the map or carrying the GPS unit. At the end of each study day, completed maps and GPS units were retrieved, the information from the latter was downloaded, and GIS units were redistributed along with maps to the next set of sampled camp hunters.

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Further, we staffed three "check stations" proximate to Route 144 (State Line, Beech Creek Road, and Jesse Hall Picnic Area). At each location, hunters were stopped and asked to participate in the study by either carrying a GPS unit or by completing a map. We attempted to stop all cars and invite the occupants to participate in the study. If the hunter(s) agreed, they were instructed to enter the check station where a standard random protocol for selecting individuals (the person 18 or over with the most recent birthday) to participate in the study was used. During the 2001 season, hunters taking deer in the study area were asked to have these deer examined and measured at the check stations to determine herd condition (age, sex, body weight, and antler development). During the 2002 season this was not done; however, if hunters requested this service, our staff aged and estimated weight of deer as a courtesy.

In 2002, hunting camps were pre-selected and located on a GIS layer. This reduced travel time and helped improve cooperation rates over those experienced in the 2001 season. Pre-selected camp owners received a letter describing the study that asked the owner to indicate the days when we anticipated the camp would be requested to participate in the study.

At the three check stations, the Pennsylvania Game Commission stationed uniformed officers for all five days to assist with requesting cooperation from hunters in 2002. These officers greatly increased participation and added credibility to the study. This was particularly useful because deep snow and cold weather reduced hunter use of the Sproul during the second study year.

At both the camps and road check stations, hunters were asked to provide names and addresses so that we could forward a follow-up mail survey to them to gauge their concerns and experiences in Big Woods habitats. One purpose of the survey was to identify differences

between hunters willing to hunt deeper in big woods habitats and those hunting peripheral areas, and to identify mechanisms that might encourage changed hunting patterns.

It was difficult to predict sampling frames for most treatments (i.e., distributing self-report maps, and GPS units and conducting mail surveys). However, our study protocol for all treatments attempted to avoid bias by randomly selecting sampling units (i.e., camps and vehicles). Our intent was to ensure that the sample included hunters that used various hunting styles or methods throughout the regular rifle deer hunting season.

Aerial Survey Methods

Aerial surveys from a fixed-wing aircraft that flew at approximately 90 knots airspeed and 1,100 m elevation (~ 450 m above ground level) were conducted. To navigate transects we used a handheld PC running ArcPad 6.0 linked to a Garmin GPS III+ global positioning system (GPS) unit (Diefenbach et al. 2002). We used a geo-referenced image of the study area overlaid with an ESRI shapefile containing the transect lines and boundary of the study area as a visual aid in navigating the pre-determined transects. Exact navigation of transect lines was attempted, but was not necessary because flight paths of the aircraft were recorded.

Transects were labeled 1-13 from south to north, in which odd-number transects were flown in order beginning with transect 1 and even-numbered transects were flown in descending order beginning with transect 12. For example, transect 1 was the first transect navigated from east to west, followed by transect 3 west to east, and so on until the last transect navigated was transect 2. A pilot, navigator, and 2 observers conducted surveys. The navigator indicated when observers should start and stop recording observations and directed the pilot to each transect. Observers were seated in the rear of the aircraft and wore sunglasses with vermillion-tinted lenses to reduce glare and enhance the visibility of fluorescent orange clothing. In Pennsylvania,

hunters are required by law to wear $\geq$1600 cm^2 ($\geq$250 square inches) of fluorescent orange

clothing on their head, chest, and back combined, making them easily visible from aircraft

because most of the study area is deciduous forest and leaf drop was complete prior to the

regular rifle season.

We recorded the locations of hunters on a tablet PC equipped with a digitizing pen and

integrated GPS. A software program used input from the GPS to display either a geo-referenced

topographic 1:24000 USGS quadrangle or a digital orthophoto quadrangle (DOQ) image

referenced to the observer's view out the aircraft window. The software oriented the geo-

referenced image such that the location of the aircraft was on one edge of the computer screen

(depending on the observer being seated on the port or starboard side of the aircraft). The

observer's position was held in the center and the image scrolled by as the aircraft flew the

transect. The digitizing pen allowed observers to plot the locations of hunters directly on the

DRG or DOQ and the program stored hunter locations in an ESRI shapefile, as well as the

associated transect number from which the hunter was observed. Also, the flight path of the

plane was recorded in a separate ESRI shapefile.

We conducted a trial aerial survey across the study area, prior to the hunting seasons, to

train observers so they were familiar with use of equipment, software, and navigating transects.

During the regular rifle season for deer, we planned to conduct surveys the first three days (2-4

December 2002) and both Saturdays (7 and 14 December 2002). Each survey took about two

hours to complete; we conducted morning surveys from approximately 0730 to 0930 hours

(EST) and afternoon surveys from 1400 to 1600 hours. Legal hunting hours at that time of year

began approximately 0645 and concluded at 1645 hours.

Survey Methods

In this study, human dimension research methods were integrated with traditional wildlife field study techniques to provide a better understanding of hunters and recreational hunting as a wildlife management tool. To accomplish this, we conducted a detailed mail survey following each of the two hunting season using names and addresses collected from maps distributed to check station and camps hunters.

The survey instruments were each 12 pages in length and consisted of about 45 questions, many with multiple parts (see Appendix E). Most items had either been used in earlier related research or were developed to address attitudes toward specific proposed or actual regulation changes in the Commonwealth. Questions addressed the following topics: (1) individual hunting experience (number of years hunting) and preferences, (e.g., types of license purchased and type of hunter); (2) hunter field behavior and harvest success for the past three years of deer hunting season(s) (including regular firearm, archery, muzzleloader, etc.); (3) level of support for actual and proposed changes in harvest regulations; (4) hunter attitudes and beliefs; (5) hunter post-harvest use of venison and estimates of the number of deer they would harvest if given additional permits; and (6) hunter sociodemographic and health questions.

In Spring 2002, we mailed surveys to the 762 Sproul hunters for whom we had names and addresses, using a three-step mailing procedure (Dillman, 2000) that consisted of: (1) an initial mailing that included the survey instrument and cover letter explaining the research; (2) a postcard reminder that followed several weeks later; and (3) a second full mailing, including a new copy of the survey instrument and reminder letter. In Spring 2003, we mailed surveys to 427 hunters and contacted another 287 hunters via phone (Table 1).

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Table 1: Disposition Table		
Characteristics	**2001 Mail Survey**	**2002 Mail and Telephone Survey**
Mail Survey		
Sample Size	726	427
Undeliverable/Bad Address	13	12
Complete	633	208
Response Rate	**84.5%**	**50.1%**
Telephone Survey		
Sample Size	n/a	287
Phone busy	n/a	1
Disconnected phone	n/a	21
Business/government phone	n/a	3
Respondent not available	n/a	2
Initial refusal	n/a	17
Computer tone	n/a	4
Schedule callback	n/a	21
No answer	n/a	19
Answering machine	n/a	24
Over quota	n/a	1
Incomplete do not callback	n/a	1
Privacy manager	n/a	3
Complete	**n/a**	**170**
Response Rate	**n/a**	**59.2%**

Of the 762 survey instruments mailed in 2002, 13 were returned as undeliverable and 633 (84.5%) were completed by hunters. We were able to match 182 surveys to hunters who carried a GPS unit and completed a field survey map. Of the 427 survey instruments mailed in 2003, 12 were returned as undeliverable and 208 (50.1%) were completed by hunters and returned. In the telephone survey segment, 170 of the 287 telephone interviews attempted (59.23%) were completed by hunters. And, in the second year, we matched 165 surveys to hunters who carried a GPS unit.

COMPARISON OF 2001 AND 2002
GEOGRAPHIC LOCATIONS AND MOVEMENTS

In 2001, weather conditions limited the number of aerial surveys that could be conducted. Density estimates for opening day of deer season (Monday) were 7.0 hunters/1,000 ha (95% CI = 4.2 – 10.3) in the morning and 6.3 hunters/1,000 ha (95% CI = 3.5 – 10.0) in the afternoon, corresponding to 324 hunters on the study area in the morning (95% CI = 192 - 471) and 290 hunters in the afternoon (95% CI = 161 – 461). Density estimates for the first Saturday were lower: 2.1 hunters/1,000 ha (95% CI = 1.2 – 3.2) in the morning and 1.9 hunters/1,000 ha (95% CI = 0.9 – 4.4) in the afternoon. This corresponded to 94 hunters on the study area in the morning (95% CI = 54 - 146) and 87 hunters in the afternoon (95% CI = 39 – 200).

In 2002, we conducted five morning or afternoon surveys during the second and third day (3-4 December) and first Saturday (7 December). Hunter densities ranged from 0.4 – 1.0 hunters/1,000 ha, which corresponded to 20 – 45 hunters (Table 2).

Table 2. Density ($\hat{D}$) and abundance ($\hat{N}$) estimates, measures of precision (CV and 95% CI), and survey effort for white-tailed deer hunters on 460 km^2 of the Sproul State Forest in north-central Pennsylvania, 2002.

Date	Time	n[a]	L[b]	Density (hunters/1,000 ha)			Abundance		
				$\hat{D}$	CV	95% CI	$\hat{N}$	CV	95% CI
3 December	Morning	17	391.7	1.0	46.7	0.2 – 2.0	45	46.6	8 – 92
	Afternoon	16	413.5	0.9	31.0	0.4 – 1.4	40	31.0	19 – 66
4 December	Afternoon	9	422.8	0.5	40.0	0.2 – 0.9	22	40.0	7 – 41
7 December	Morning	33	384.6	1.9	39.9	0.7 – 3.8	89	39.8	30 – 174
	Afternoon	8	418.7	0.4	39.0	0.2 – 0.8	20	38.6	8 – 39

[a] Number of hunters observed during survey.
[b] Total km of transects flown.

We found that hunter density was negatively related to distance from roads and slope. In 2001, there was a negative interaction between distance from roads and slope, such that steep areas far from roads were even less likely to be used by hunters. In 2002, hunters were nearly 3 times more likely to hunt in an area for each additional km closer to the nearest road (Odds Ratio = 2.97, 95% CI = 1.89 – 4.67) and for every 10º decrease in slope were 1.25 times more likely (95% CI = 1.23 – 1.28) to hunt in an area.

Most hunters preferred stand hunting in the early morning hours (0600 – 0800 hr; 72% stationary), but more walked or stalked in the afternoon (1400-1600 hr; 58% stationary). The average maximum distance hunters reached from a road open to public vehicles was 0.84 km (SE = 0.03), and they walked an average of 5.48 km (SE = 0.193) during their daily hunting activities.

We compared camp hunters with drive-in hunters as an example of the kind of analysis made possible by linking the research approaches. Despite anecdotal assertions that camp hunters were more dedicated and experienced, we found that hunters who hunted from camps differed little from hunters who traveled each day to the study area. Hunters from camps hunted no farther from roads ($\bar{x} = 0.85$ km, n = 139, SD = 0.41) than hunters who traveled into the study area the morning of the hunt ($\bar{x} = 0.79$ km, n = 70, SD = 0.482). Camp hunters began their hunt later in the morning ($\bar{x} = 0632$ hr, n = 43, SD = 18 min) than offsite hunters ($\bar{x} = 0515$ hr, n = 41, SD = 11 min). However, camp hunters hunted later in the day ($\bar{x} = 1628$ hr, SE = 17.84 min., n = 43) than offsite hunters ($\bar{x} = 1519$ hr, SE = 19.00 min, n = 41). We detected no difference between camp and non-camp hunters in the number of years they had hunted deer (t = 0.80, df = 627, P = 0.423), the importance of hunting to them, their perceived crowding, nor their self-reported maximum distance from a public road (t = 0.54, df = 602, P = 0.588). We found no

differences in actual distance traveled from a public road by self-rated health categories (using a 4-point scale from poor to excellent; $F_{1, 178} = 2.82$, $P = 0.095$) or by age categories ($F_{1, 177} = 3.01$, $P = 0.085$).

## FINDINGS OF THE 2001 SURVEY

To better describe the 2001 sample, we developed a hunter profile. Sproul's typical 2001 hunter was 47.8 years old, had completed high school or its equivalent, had a household size of 2.97, and an annual household income greater than $45,000. Respondents had been hunting deer an average of 31.5 years and on average for 22.6 years in the Sproul State Forest. Besides the regular firearm license, these hunters also purchased antlerless (58%) and archery licenses (35%). On average, respondent households had 1.4 adult (>16 years old) hunters, and 0.17 junior (12 – 16 years old) hunters.

Behaviors and Activities

Twenty-six percent of respondents reported killing an antlered deer in 2001, 30% harvested an antlered deer in 2000, and 32% did so in 1999. About 25% of respondents killed an antlerless deer in 2001; 28% did so in 2000 and 1999. For both types of deer, the majority of kills occurred in the regular hunting season. On average, hunters were willing to travel up to 169 miles to hunt antlered deer, 90 miles for antlerless deer, and 118 miles to hunt in the Sproul Forest.

During the 2001 season, the average maximum distance respondents reported hunting from paved roads was four miles. The average self-reported distance hunting distance from "open" or non-gated dirt roads was two miles. Slightly more than half (fifty-four percent) indicated they walked gated roads to access hunting areas. Respondents spent the most days

Figure 1: Average Number of Days Afield for Various 2001 Hunting Seasons
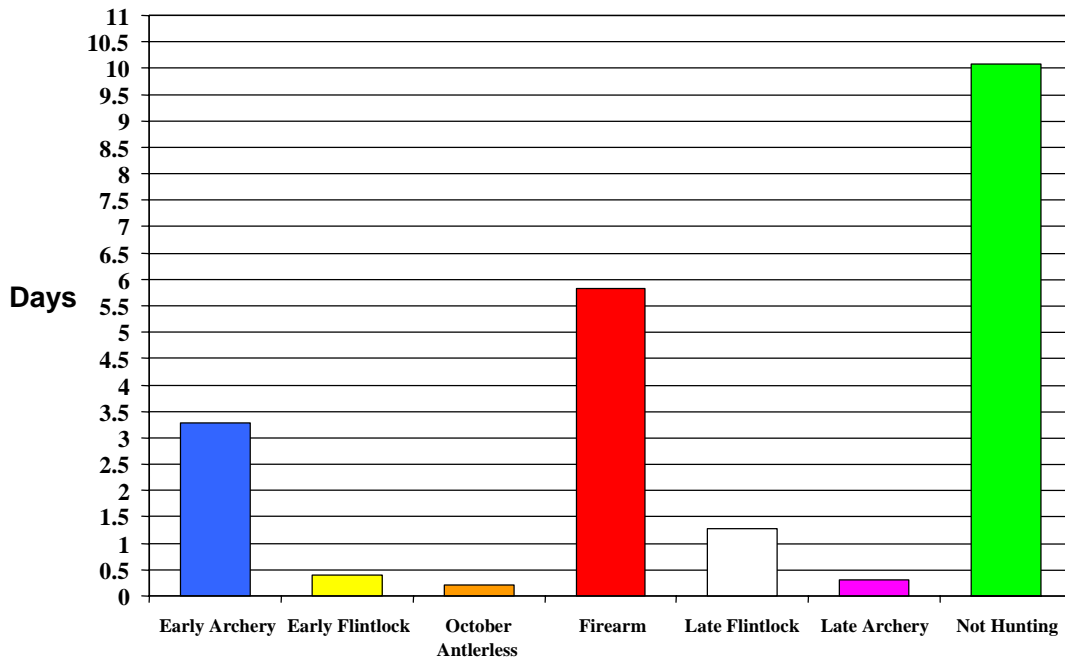
afield for the firearm season (5.8 days), followed by early archery (3.3 days), and late flintlock/muzzleloader (1.2 days) (Figure 1). On average, hunters spent 10 days in hunting areas participating in other forms of outdoor recreation.

During the 2001 firearm **season** most respondents hunted on Bureau of Forestry public lands (52%); however, the use of these lands was lower for early archery (34%), and late flintlock/muzzleloader (32%) seasons. The majority of hunters stay away from home while in the Sproul (84%). Forty-three percent were members of a camp, 19% owned a camp, and 15% were guests at a camp. Sixty-four percent hunted in mixed topographical areas, 18% in the upper

plateau flats, and 16% in the side hills. Hunters reported that they most frequently hunted

wooded areas with dense stands of mountain laurel and rhododendron or oak dominated/open

wooded areas.

Fifty-five percent of the 2001 hunters reported hunting alone. Sixty-five percent felt the

Sproul was not at all or only a slightly crowded area for hunting. Ground stands (27%), tree

stands (21%), stalking (21%), and small quiet pushes (11%) were the dominant hunting styles.

Forty-nine percent did not spend any time driving deer in the 2001 rifle season. When asked

about the new concurrent season, 83% percent said that it did not change the way they or their

group hunted deer. Fifty-nine percent reported that they would not be very likely to purchase an

antlerless license to hunt the Sproul.

Respondents were asked about the role of hunting and related attributes in their lives.

Eighty-five percent claimed that hunting was either an important or very important part of their

lives. Numerous characteristics were assessed to determine their importance to hunting (Table 3).

Among the most important characteristics were to get outdoors, the challenge of hunting, to test

outdoor skills, and to spend time with family and friends. The majority (81%) said that venison

from deer harvests was used by their households.

**Table 3: Reasons for Hunting During the 2001 Season**

	Very Unimportant	Unimportant	Neither	Important	Very Important
To get outdoors	1.4	33.4	2.6	1.3	61.3
To get away from my everyday routine	2.6	31.0	7.2	2.1	57.1
To obtain venison	9.4	29.9	37.1	15.0	8.6
To get a large antlered deer	7.4	29.9	33.6	15.8	13.3
The challenge of hunting deer	2.9	47.4	9.1	3.4	37.3
To test my outdoor skills	2.1	46.6	20.9	5.1	25.2
To be with my friends	5.6	42.6	9.1	4.0	38.7
To be with my family	4.7	36.2	15.5	4.7	38.9
To return to traditional sports	3.8	42.2	16.2	5.9	31.8
To help manage the deer population	3.7	40.2	29.3	10.1	16.7

The majority of 2001 hunters reported receiving instruction about hunting from a parent (61%) or relative (13%). Hunting regulation booklets, newspaper, television, hunting magazines, and talking to others were the leading sources of hunting information.

Regulations and Restrictions

Questions also were asked about the newly enacted **statewide** antler restriction regulation (bucks having at least 3 points on one side). Twenty-two percent indicated strong support and 35% indicated moderate support (Figure 2). Only 9% indicated they neither supported nor opposed this regulation. In contrast, 14% indicated that they were strongly opposed and another 20% indicated that they were moderately opposed to this regulation.

Figure 2: Comparison of Support for Statewide and Sproul Forest Antler Restrictions in 2001
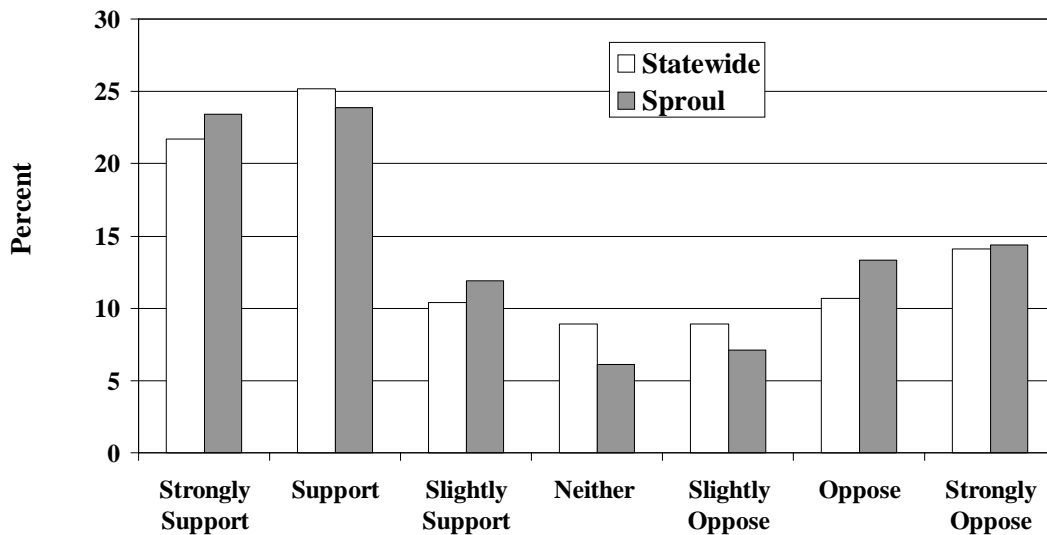
When asked if they supported or opposed such restrictions in the **Sproul**, a similar

pattern emerged. Twenty-three percent indicated strong support and an additional 36% indicated

moderate support. Only 6% said that they neither supported nor opposed this regulation. In

contrast, 14% indicated that they were strongly opposed and another 20% indicated that they

were moderately opposed to this regulation.

Attitudes and Opinions

Hunters were asked their opinions about hunting conditions and practices (Table 4).

Among the items most strongly agreed to by respondents were "I can have a satisfying day of

hunting without harvesting a deer" (93.5% agreeing or strongly agreeing), "keeping deer

populations in balance with natural food supplies is necessary" (81.5%), "public lands are more

heavily hunted than private lands" (74.7%), and "I can have a successful season of hunting

without harvesting a deer" (74.5%).

Table 4: Hunter Attitudes Toward Conditions and Practices in 2001

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Public lands are more heavily hunted than private lands	2.1	9.9	13.3	40.1	34.6
Public lands have higher deer densities than private	35.6	42.9	15.1	3.8	2.6
Public lands have higher hunter success rates than private lands	21.3	43.7	20.9	10.1	4.0
I hunted with the goal of harvesting antlered deer only	12.9	24.7	16.9	23.4	22.1
The number of deer has no effect on plant and animal communities	39.2	38.7	13.6	6.1	2.4
There is enough public hunting land in PA to provide access to anyone who wants to hunt	6.1	15.8	18.7	43.9	15.5
The quality of the hunting experience is higher on private lands than it is on public lands	7.5	19.6	33.7	25.2	14.1
Posting of private lands has made it more difficult for me to find a place to hunt	7.3	20.4	16.5	32.6	23.2
Over time, deer hunting pressure has decreased in the places I hunt	16.0	25.9	16.6	28.5	13.0
It has become increasingly difficult for me to find a good place to hunt deer	7.9	31.3	22.3	26.0	12.5
Deer damage to forests in Pennsylvania is a problem	12.3	25.5	30.3	21.9	10.0
Keeping deer populations in balance with natural food supplies is necessary	1.4	4.9	12.1	57.3	24.2
I don't really care if I shoot an antlered or antlerless deer as long as I get a deer	21.7	29.9	20.1	21.6	6.7
Posting has restricted my access to hunting on private lands	3.8	13.9	20.6	39.0	22.6
Deer cause serious conflicts with other land uses, such as forestry, farming, highways, and other development	6.2	20.6	25.7	37.5	10.0
I would rather harvest a doe than no deer at all	18.2	18.0	13.4	36.2	14.2
The higher the deer population, the better my hunting experience	3.0	16.1	15.2	45.1	20.5
I hunt to harvest a trophy antlered deer	12.3	26.9	21.3	24.8	14.7
I can have a satisfying day of hunting without harvesting a deer	0.2	1.8	4.6	50.6	42.8
I can have a successful season of hunting without harvesting a deer	2.6	14.5	8.3	46.8	27.8
The number of deer has no effect on forest regeneration	24.0	45.4	19.5	9.0	2.1

Among the items respondents most strongly disagreed with were the statements "public lands have higher deer densities than private lands" (78.5%), "the number of deer has no effect on plant and animal communities" (77.8%), and "the number of deer has no effect on forest regeneration" (69.4%).

<center>**Bivariate Analyses**</center>

Additional analyses of survey response were conducted across demographic categories (age, income, educational attainment). Also, those carrying GPS units were compared with those who did not, and those who used hunting camps were compared with those who drove into the Sproul. Only statistically significant relationships are presented, but detailed results are provided in Appendix G.

Behaviors and Activities

Respondents were asked how long they have hunted deer. Significant differences were found by GPS unit status, income, education, and age. Those carrying GPS units (χ^2 = 14.7 p = .005) and those with lower incomes (χ^2 = 38.7; p < .001) reported a longer hunting history as did older respondents (χ^2 = 1137.2; p < .001) and those with lower levels of education (x^2 = 114.0; p < .001).

Similarly, the number of years hunting deer in Pennsylvania differed by educational attainment, GPS unit status, age, and income. While gender is an important contextual variable, in this study population there were less than 5% females. Therefore, we do not report gender differences in this study. Those carrying GPS units (χ^2 = 16.4; p = .002), who had lower incomes (χ^2 = 44.75; p < .001) and lower levels of education (χ^2 = 101.00; p < .001), and older respondents reported hunting longer in Pennsylvania (χ^2 = 1012.51; p < .001).

The number of years hunting deer in the Sproul State Forest differed by educational attainment, income, and age. Respondents with lower incomes (χ^2 = 48.2; p <

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.001), lower levels of education ($\chi^2 = 44.4$; p < .001), and older respondents reported hunting longer in the Sproul ($\chi^2 = 410.5$; p < .001).

The number of years hunting antlerless deer in the Sproul differed by income, age, GPS unit status, and use of hunting camps. Those with lower incomes ($\chi^2 = 39.3$; p < .001), older respondents ($\chi^2 = 45.0$; p = .001), and hunters not carrying GPS units reported having hunted more years in the Sproul ($\chi^2 = 10.5$; p = .033). Those not using hunting camps reported hunting antlerless deer longer than those who used camps ($\chi^2 = 28.9$; p < .001).

Differences were found among the number of days afield in various hunting seasons. Included were days afield in the 2001 early archery season, where younger hunters spent more days afield than older hunters ($\chi^2 = 45.1$; p < .001). In the early flintlock/muzzleloader season, differences were seen by educational attainment, GPS unit status, and income. Hunters who carried GPS units ($\chi^2 = 6.0$; p = .049), had higher incomes ($\chi^2 = 12.9$; p = .045), and lower levels of education ($\chi^2 = 18.2$; p = .02) spent more time afield.

An age difference was noted in the October antlerless firearm season, with younger hunters spending more time afield ($\chi^2 = 23.8$; p = .008). During the firearm season, differences were seen by income, age, and educational attainment. Younger hunters ($\chi^2 = 27.0$; p = .029) with higher incomes ($\chi^2 = 25.9$; p = .002) and education ($\chi^2 = 23.6$; p = .023) spent more days afield. For the late flintlock/muzzleloader season, GPS unit status and income were significant. Those with GPS units ($\chi^2 = 10.1$; p = .018) and higher incomes ($\chi^2 = 32.9$; p < .001) reported spending more time afield. Finally, for days afield not hunting deer, a significant difference was found for those using hunting camps,

who spent more time afield not hunting deer (χ^2 = 12.5 p = .006) than those who did not use camps.

When asked about the distances hunters were willing to travel to hunt, several significant differences emerged. Those with higher levels of education were willing to travel further than those with lower levels of education (χ^2 = 65.8; p < .001). Younger hunters were willing to travel further to hunt for antlerless deer than were older respondents (χ^2 = 63.5; p = .002) and those with higher levels of education were willing to travel further to hunt deer than were those with lower levels of education (χ^2 = 45.6; p = .019). Hunters with higher incomes (χ^2 = 35.9; p = .007), levels of education (χ^2 = 39.9; p = .022), and those who used a camp were willing to travel further to hunt in the Sproul (χ^2 = 37.7; p < .001).

When asked what type of hunter they considered themselves to be, only age group was significant. Older hunters preferred firearms, while younger hunters were more likely to also enjoy archery (χ^2 = 44.2; p < .001).

Harvest of antlered deer differed by age group and whether the hunter carried a GPS unit. Respondents not carrying GPS units (χ^2 = 3.9; p = .048[1]) and those who were older were more likely to report a kill during this season (χ^2 = 13.9; p = .016). The same pattern occurred with the 2000 (χ^2 = 25.9; p < .001) and 1999 (χ^2 = 34.1; p < .001) seasons. Age was the only characteristic significantly related to deer harvesting in the 2000 season. In the 1999 season, beyond age, education, and GPS unit status were significant. For this season, those without GPS units (χ^2 = 4.3; p = .037[2]) and hunters with

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[1] 2 * 2 table, continuity correction must be applied.
[2] Idem.

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higher levels of education ($\chi^2 = 14.7$; p = .005) were more likely to have killed an antlered deer.

For antlerless deer hunting, older hunters were more likely than younger hunters to report a kill during the 2001 ($\chi^2 = 16.7$; p = .005), 2000 ($\chi^2 = 32.1$; p < .001), and 1999 ($\chi^2 = 11.6$; p = .041) seasons. During the 2000 season, differences by educational attainment occurred with hunters reporting lower levels of education being slightly more likely to report a deer kill ($\chi^2 = 10.7$; p = .030).

The use of camps was related to the type of topography hunters frequented. Respondents who did not use camps were more likely to hunt in valley bottoms and in upper plateau flats, whereas those who owned camps were more likely to hunt in mixed topography and on side hills ($\chi^2 = 22.1$; p = .009). Hunters with higher levels of education were more likely to comment on feeling crowded in this area ($\chi^2 = 51.0$; p = .018).

The importance of hunting to respondents' lives did not differ significantly across any of the major comparison areas. However, there were differences in these respondents' reasons for hunting. Those with higher incomes ($\chi^2 = 33.2$; p =.001) and higher levels of education ($\chi^2 = 30.6$; p = .015) were more interested in hunting to get outdoors. Older hunters ($\chi^2 = 54.4$; p < .001) saw hunting as important for obtaining venison. Respondents who used camps were more likely than those who did not, to hunt to be with friends ($\chi^2 = 19.1$; p = .001). Finally, those who hunted to help manage the deer population differed by income, with those having higher incomes more likely to hunt for this reason ($\chi^2 = 22.3$; p = .034).

Respondents were asked about who was primarily responsible for teaching them how to hunt. Differences were found by age and educational attainment, with those

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having higher levels of education more likely to learn to hunt from family and relatives, and those with lower levels more likely to learn on their own or from friends ($\chi^2 = 39.0$; p = .027). No differences were seen across comparison categories for sources and use of hunting information (e.g., PGC, magazines, newspaper).

When asked who most often used the venison from deer they harvest, differences by age and hunting camp usage were found. Younger hunters were more likely to use venison in their own home, while older residents were more likely to give it away (family, friends, others; $\chi^2 = 57.1$; p < .001). Those who used hunting camps were more likely to give away venison (to other hunters, friends, or whoever would take it), while those who did not use camps were more likely to use venison at home ($\chi^2 = 14.3$; p = .014).

Restrictions/Regulations and Hunting Styles

In this section of the report we focus on responses of all of the hunters to specific questions related to the proposed changes in statewide antler restrictions. Significant differences emerged between those who used camps and those who did not. Those who used camps (owned, belonged, or used) were slightly more opposed to statewide antler restrictions than were those who did not utilize camps ($\chi^2 = 16.8$; p = .010). Those using camps were also much more likely to oppose antler restrictions within the Sproul ($\chi^2 = 17.6$; p = .007).

Older hunters were more likely to hunt alone ($\chi^2 = 23.7$; p < .001) than were younger hunters. On the other hand, younger hunters ($\chi^2 = 47.0$; p < .001) and those who used hunting camps ($\chi^2 = 23.7$; p < .001) spent more time driving deer.

No significant differences were found when assessing maximum distances that respondents hunted from paved roads. However, respondents who belonged to hunting camps were less likely to walk gated roads to access hunting areas ($\chi^2 = 10.5$; p = .001[3]).

Opinions and Attitudes

Responses to various opinion questions differed among groups. The perception that public land is more heavily hunted than private land differed by hunting camp usage and educational attainment. Those with higher levels of education ($\chi^2 = 31.7$; p = .011) and those who used hunting camps ($\chi^2 = 10.5$; p = .034) were more likely to agree. Responses to several items including 'Posting of private lands has made it more difficult for me to find a place to hunt'($\chi^2 = 24.4$; p = .018), 'It has become increasingly difficult for me to find a good place to hunt deer'($\chi^2 = 22.6$; p = .031), and 'Keeping deer populations in balance with natural food supplies is necessary' ($\chi^2 = 47.3$; p < .001) differed by income, with higher income respondents being more likely to agree with these statements.

Opinions in response to 'I don't really care if I shoot an antlered or antlerless deer as long as I get a deer' differed by educational attainment, age, and GPS unit status. Those carrying GPS units ($\chi^2 = 12.9$; p = .012), who were younger ($\chi^2 = 49.0$; p < .001), and who had lower levels of education ($\chi^2 = 32.0$; p = .010) were more likely to agree with this statement.

Response to the statement 'The higher the deer population, the better my hunting experience' differed by GPS unit status and income, with respondents not having GPS units ($\chi^2 = 10.4$; p = .034) and with higher incomes ($\chi^2 = 31.9$; p = .001) more likely to

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[3] 2*2, continuity correction applied.

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agree. Perceptions that 'the number of deer has no effect on forest regeneration' differed by educational attainment. Here, hunters with higher levels of education were more likely to disagree ($\chi^2 = 33.8$; p = .006).

FINDINGS OF THE 2002 SURVEY

To facilitate comparison with the 2001 data, a hunter profile was developed using data from 2002. Pennsylvania's typical hunter in 2002 was 48.2 years old, had completed high school or its equivalent, had a household size of 2.81, and an annual household income greater than $45,000. The majority (60.1%) resided in a rural town/village or in the country. Respondents had been hunting deer for 32.1 years and on average for 22.7 years in the Sproul State Forest. In addition to regular firearm licenses, these hunters also held antlerless licenses (46%) and archery licenses (36%). The average household had 1.4 hunting licenses, and .21 junior licenses.

Behaviors and Activities

In 2002, questions were again asked about hunting behaviors and recent hunting history. Twenty-five percent of respondents reported killing antlered deer and 32% antlerless deer in 2002. For both types of deer, the majority of kills occurred in the regular firearm/rifle hunting season. Hunters were willing to travel on average 145 miles to hunt antlered deer, and 116 miles for antlerless. Respondents traveled an average 116 miles to hunt in the Sproul forest. The average maximum distance from paved roads that respondents hunted was 4.5 miles. The average distance from "open" or non-gated dirt roads was 1.9 miles. Sixty-nine percent walked gated roads to access hunting areas.

During the 2002 season, respondents spent the most days afield for the firearm season (6.1 days), followed by the early archery/flintlock/muzzleloader (3.9 days) (Figure 3). Hunters spent an average 10 days in the field not hunting deer.

Figure 3: Average Number of Days Afield for Various 2002 Hunting Seasons
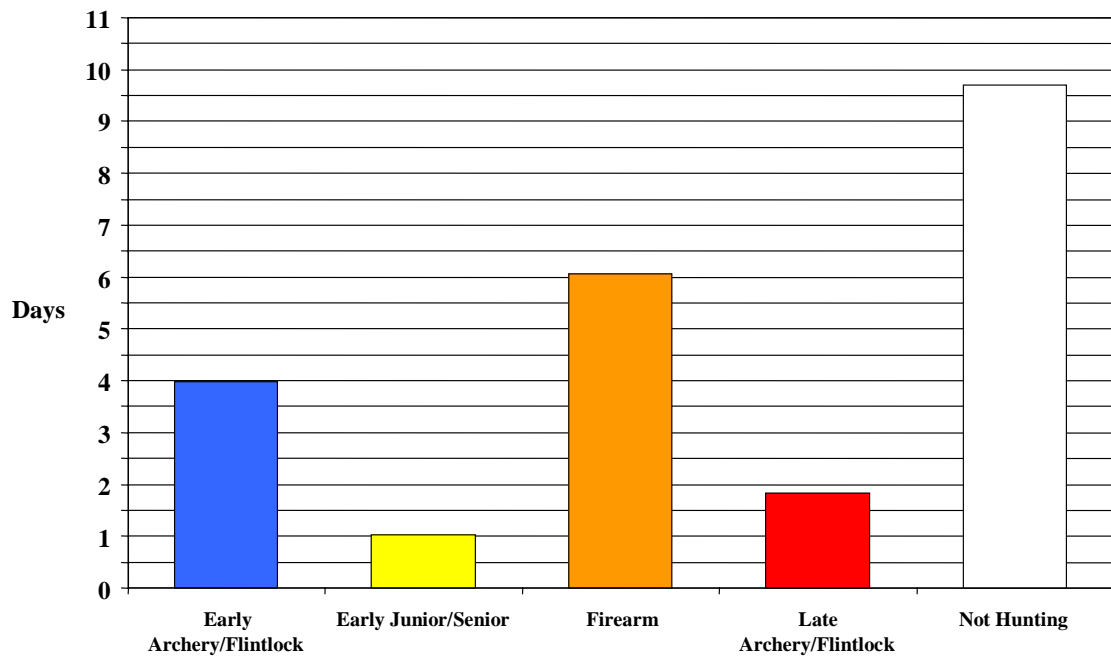
During firearm (90%), late archery/flintlock/muzzleloader (37%), and early archery/flintlock/muzzleloader (47%) seasons most respondents hunted on public lands. The vast majority of hunters stay away from home while in the Sproul (84%). Thirty-nine percent belong to a camp, 26% own a camp, and 16% use a camp. When hunting in the Sproul, 59% hunted in mixed topographical areas, 22% in the upper plateau fields, and 18% on side hills. The most frequently hunted habitats were wooded areas with dense

stands of mountain laurel or rhododendron, oak dominated/open wooded areas, and open forest with mixed aged trees.

Fifty-three percent of the respondents reported hunting alone. Most hunted from ground stands (26%), stalking (25%), tree stands (19%), and small quiet pushes (12%). Forty-four percent did not spend any time driving deer in the 2002 rifle season. Sixty-seven percent felt the Sproul was not at all or only a slightly crowded area for hunting. When asked about the new concurrent season, 84% percent said that it did not change the way they or their group hunted deer. Fifty-one percent reported not being likely to buy an antlerless license to hunt in the Sproul.

Respondents were asked about the role of hunting and related attributes in their lives. Eighty-nine percent claimed that hunting was either an important or very important part of their lives. The majority (82%) claimed that venison from deer harvests was used within their households.

Numerous characteristics were also assessed to determine their importance to hunting (Table 5). Among the most important characteristics were to get outdoors, the challenge of hunting, to test outdoor skills, and to spend time with family and friends.

**Table 5: Reason for Hunting During the 2002 Season**

	Very Unimportant	Unimportant	Neither	Important	Very Important
To get outdoors	1.1	32.3	2.5	1.0	63.3
To get away from my everyday routine	1.1	36.3	3.6	2.5	56.5
To obtain venison	3.3	31.9	30.5	27.4	6.9
To get a large antlered deer	5.8	30.1	21.3	30.9	11.9
The challenge of hunting deer	1.4	50.8	7.5	3.6	36.7
To test my outdoor skills	1.1	47.1	15.0	9.1	27.7
To be with my friends	1.9	43.4	6.9	4.7	43.1
To be with my family	2.2	39.7	11.7	8.1	38.3
To return to traditional sports	1.0	46.5	14.1	6.4	32.7
To help manage the deer population	2.5	46.4	19.9	10.2	21.0

Finally, questions were asked about sources of hunting information and instructions. Family played a large role in this, with a parent (65%) or relative (13%) providing instruction in hunting. Hunting regulation booklets, newspapers, organization newsletters, television, hunting magazines, and talking to others provided additional sources of hunting information.

Regulations and Restrictions

Respondents were next asked about **statewide** antler restriction regulation (bucks having at least 3 points on one side) (Figure 4). Thirty-three percent indicated strong support and 40% indicated moderate support. Only 9% said that they would neither support nor oppose this regulation. When asked how supportive they would be of a proposal to allow group hunting permits, only 8% indicated strong support and an additional 26% indicated moderate support. Nineteen said that they would neither support nor oppose this option, and 42% indicated that they would be moderately or strongly opposed to such a regulation.

Figure 4: Comparison of Support for Deer Management Programs
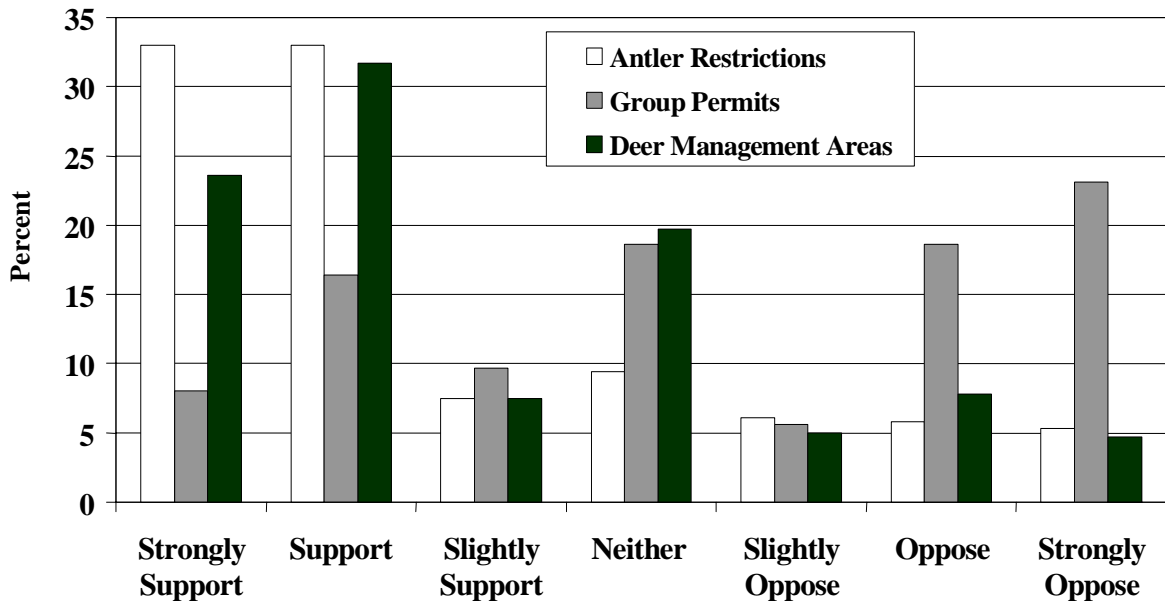
Respondents were also asked how supportive they were of the proposed deer management area approach for allocating antlerless licenses. The majority of hunters

favored this approach, with 24% indicating strong support and an additional 40% moderate support.

Attitudes and Opinions

As in the 2001 survey, hunters were asked about their opinions regarding hunting conditions and practices (Table 6). Among the items most strongly agreed to by respondents were "I can have a satisfying day of hunting without harvesting a deer" (96.4% agreeing or strongly agreeing), "Public lands are more heavily hunted than private lands" (71.5%), and "Keeping deer populations in balance with natural food supplies is necessary" (87.6%).

Among the items that respondents most strongly disagreed with were the statements "The number of deer has no effect on plant and animal communities" (80.6%), "Public lands have higher deer densities than private lands" (73.1%), and "The number of deer has no effect on forest regeneration" (74.3%).

Table 6: Hunter Attitudes Toward Conditions and Practices in 2002

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Public lands are more heavily hunted than private lands	1.1	13.8	13.5	44.8	26.8
Public lands have higher deer densities than private	20.5	52.6	16.9	7.5	2.5
Public lands have higher hunter success rates than private lands	11.9	51.5	22.2	12.2	2.2
I hunted with the goal of harvesting antlered deer only	13.5	34.8	10.5	27.6	13.5
The number of deer has no effect on plant and animal communities	32.3	48.3	7.5	9.1	2.8
There is enough public hunting land in PA to provide access to anyone who wants to hunt	2.8	16.9	13.1	54.1	13.3
The quality of the hunting experience is higher on private lands than it is on public lands	4.2	32	25.9	30.4	7.5
Posting of private lands has made it more difficult for me to find a place to hunt	6.9	24.9	11.6	38.8	17.7
Over time, deer hunting pressure has decreased in the places I hunt	11.7	32.6	14.8	34	7.0
It has become increasingly difficult for me to find a good place to hunt deer	6.4	42.7	15.2	29.1	6.6
Deer damage to forests in Pennsylvania is a problem	5.8	31.9	18.3	31.1	13.0
Keeping deer populations in balance with natural food supplies is necessary	1.1	3.6	7.7	60.5	27.1
I don't really care if I shoot an antlered or antlerless deer as long as I get a deer	15.6	33.1	18.1	26.1	7.2
Posting has restricted my access to hunting on private lands	2.8	19.2	15.0	43.9	19.2
Deer cause serious conflicts with other land uses, such as forestry, farming, highways, and other development	3.9	22.8	15.3	46.9	11.1
I would rather harvest a doe than no deer at all	14.7	24.2	11.9	39.4	9.7
The higher the deer population, the better my hunting experience	3.6	24.9	14.6	43.4	13.5
I hunt to harvest a trophy antlered deer	9.7	33.3	10.3	35	11.7
I can have a satisfying day of hunting without harvesting a deer	0.6	1.4	1.7	57.2	39.2
I can have a successful season of hunting without harvesting a deer	1.9	6.9	5.2	58.8	27.1
The number of deer has no effect on forest regeneration	21.3	53.0	14.9	8.0	2.8

Bivariate Analyses

To further explore the data, comparisons were made across demographic categories (age, income, educational attainment). Those carrying GPS units were compared with those who did not, and those who used hunting camps were compared with those who drove into the Sproul. Only statistically significant relationships are presented.

Behaviors and Activities

Significant differences were found by educational attainment, GPS unit status, and age when respondents were asked how many years they had been hunting. Older respondents ($\chi^2 = 666.6$; $p < .001$) those with lower levels of education ($\chi^2 = 84.3$; $p < .001$), and those who carried GPS units ($\chi^2 = 16.6$; $p = .002$) reported hunting longer.

Similarly, the number of years hunting deer in Pennsylvania differed by educational attainment, age, GPS unit status, and income. Respondents with lower incomes ($\chi^2 = 23.1$; $p = .026$), those carrying GPS units ($\chi^2 = 15.5$; $p = .004$) and older hunters ($\chi^2 = 588.9$; $p < .001$) reported hunting longer in Pennsylvania. Hunters with lower levels of education reported hunting longer in PA than those with higher levels of education ($\chi^2 = 67.2$; $p < .001$).

The number of years hunting deer in the Sproul State Forest differed based on income and age. Older respondents ($\chi^2 = 214.3$; $p < .001$) and hunters with lower levels of income ($\chi^2 = 30.5$; $p = .002$) reported hunting longer in the Sproul. The years hunting antlerless deer in the Sproul differed by income and age, with older respondents ($\chi^2 = 66.9$; $p < .001$) and those with lower incomes ($\chi^2 = 23.5$; $p = .024$) hunting longer.

Differences were noted by days afield for various types of hunting. Included were days afield in the early archery/flintlock/muzzleloader seasons, which experienced differences by income and age. Younger hunters ($\chi^2 = 38.8$; p = .001) and those with higher incomes ($\chi^2 = 31.7$; p < .001) were more likely during early archery/flintlock/muzzleloader seasons to spend days afield. An education difference was noted for the firearm season, with less educated hunters spending more time afield ($\chi^2 = 27.8$; p = .006). For the late archery/flintlock/muzzleloader season, age, and income had significant differences, with younger respondents ($\chi^2 = 30.8$; p = .009) and those with lower incomes ($\chi^2 = 24.0$; p = .004) less likely to spend time afield.

Several differences emerged when location in which respondents hunted were examined. For the early archery/flintlock/muzzleloader season, a difference was seen by age with older respondents more likely than younger hunters to hunt on public lands ($\chi^2 = 30.9$; p = .001). In the early junior/senior (archery, October firearm, flintlock/muzzleloader) seasons, differences were noted by age with younger hunters ($\chi^2 = 19.5$; p = .034) more likely to hunt on public lands. During the late archery/flintlock/muzzleloader seasons, those who carried GPS units were more likely to hunt on public lands ($\chi^2 = 7.7$; p = .021).

Significant differences were obtained for the distances hunters were willing to travel to hunt. Those with higher incomes ($\chi^2 = 38.3$; p = .012) and from more urban areas (cities and suburbs) ($\chi^2 = 62.2$; p = .003) were willing to travel further to hunt. Those who used camps were willing to travel further to hunt for antlerless deer than were those who did not ($\chi^2 = 14.6$; p = .041). Finally, those who used camps $\chi^2 = 22.2$; p = .001) and

came from more urban areas (cities and suburbs) $\chi^2 = 63.1$; p < .001) were willing to travel further to hunt in the Sproul.

When asked about what types of hunting licenses respondents owned in addition to the regular firearm, significant differences were found by age and use of hunting camps. Older hunters were more likely to have antlerless licenses, while archery hunters tended to be younger ($\chi^2 = 19.8$; p =.031). Those using camps were more likely to have antlerless and archery licenses, while those not using camps were more likely to have no other licenses ($\chi^2 = 7.0$; p = .030).

Significant differences in antlerless deer kills for the 2002 season were seen by age with older hunters more likely to report a kill ($\chi^2 = 15.0$; p = .010). No significant differences were seen for antlered kills during the 2002 season.

Hunters were asked if they stayed away from home while hunting the Sproul. Significant differences were noted by use of camps, with those owning, belonging, or using a camp ($\chi^2 = 114.9$; p < .001) more likely to stay away from home. When asked how crowded they usually felt when hunting in the Sproul, differences emerged for educational attainment, with those having higher levels of education more likely to feel crowded ($\chi^2 = 50.5$; p = .020).

The importance of hunting to respondents lives differed by age, education level, and GPS unit status. Older ($\chi^2 = 39.0$; p = .037) hunters with lower levels of education ($\chi^2 = 34.4$; p = .023), and those carrying GPS units ($\chi^2 = 15.3$; p = .009) were more likely to view hunting as being important to their lives.

Respondents with higher incomes ($\chi^2 = 42.1$; p < .001) were more interested in hunting to get outdoors. Those with higher incomes ($\chi^2 = 28.7$; p = .004) and younger

hunters ($\chi^2 = 37.0$; p = .012) were more likely to hunt to get away from daily routines. Older hunters ($\chi^2 = 33.7$; p = .028) were more likely to indicate that hunting for venison was important. Those who used camps were more likely than those who did not, to indicate that they hunted to be with friends ($\chi^2 = 27.7$; p < .001). Finally, older hunters ($\chi^2 = 38.1$; p = .009) and those who used hunting camps ($\chi^2 = 18.6$; p = .001) were more likely to hunt to be with family.

No significant differences were seen when assessing who was primarily responsible for teaching respondents how to hunt. However, with sources and use of hunting information (PGC, magazines, newspaper), differences by age occurred with older respondents getting much of their information from television, newspapers, radio, and hunting magazines, while younger hunters used the internet and PGC website ($\chi^2 = 66.7$; p = .019).

When asked who most uses venison from the harvested deer, a difference by home location was found. Hunters from cities were more likely to give venison to other hunters, friends or charities, while those from rural areas were more likely to use the venison in their own homes ($\chi^2 = 49.6$; p = .002).

Restrictions/Regulations and Hunting Styles

In this section of the report, we focus on responses to specific questions related to proposed changes in statewide antler restrictions and management programs. No significant differences emerged when these hunters were asked about the 3-point antler restrictions or the proposed deer management area approach for allocating antlerless licenses. However, when asked about group permits that would allow parties to hunt

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together to harvest deer (regardless of who actually took the animal), those using camps were more likely to oppose group permits ($\chi^2 = 17.0$; p = .009).

Younger respondents hunted farther away from open/non-grated roads than did those who were older ($\chi^2 = 37.2$; p = .011). Hunters with higher incomes ($\chi^2 = 10.1$; p = .017) were less likely to walk gated roads to access hunting areas. Alternately, hunters who carried GPS units [4]($\chi^2 = 5.4$; p = .020) and those from larger more urban areas ($\chi^2 = 14.3$; p = .014) were more likely to walk gated roads to access hunting areas.

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[4] 2*2 table, continuity correction applied.

Opinions and Attitudes

Responses to the various opinion items differed significantly. For example, perceptions that "public lands are more heavily hunted than private lands" differed by hunting camp usage with those using hunting camps (χ^2 = 12.8; p = .012) more likely to agree. Several items, including 'The quality of the hunting experience is higher on private lands than it is on public lands' (χ^2 = 30.0; p = .003) differed by income with hunters with lower incomes more likely to disagree. Alternatively, in response to the statement 'I can have a successful season of hunting without harvesting a deer' (χ^2 = 23.7; p = .022), those with higher levels of income were more likely to agree. For 'Public lands have higher hunter success rates than private lands' (χ^2 =25.0; p =.015), those with higher incomes were more likely to disagree. Opinions in response to 'I don't really care if I shoot an antlered or antlerless deer as long as I get a deer' differed by age and hunting camp usage. Those who were younger (χ^2 = 36.0; p = .015) and did not use camps (χ^2 = 10.2; p = .037) were more likely to agree with this statement.

Finally, several items focusing on the impacts of deer had significant differences. Responses to the statements 'Deer cause serious conflicts with other land uses, such as forestry, farming, highways, and other developments' (χ^2 = 13.0; p = .011) and 'The number of deer has no effect on forest regeneration' (χ^2 = 11.2; p = .024) differed by hunting camp usage. For the former, respondents who used camps were more likely to agree, but for the latter they were more likely to disagree. Perceptions that "the number of deer has no effect on plant and animal communities" differed by educational attainment. Hunters with higher levels of education were more likely to disagree with this statement (χ^2 = 30.1; p = .017).

DISCUSSION

This report describes methods to estimate abundance, distribution, habitat use, activity patterns, and movement of hunters at various temporal and spatial scales. Further, by coupling such field observation techniques typically used in wildlife research with human dimensions methods, we have created a dataset that links hunter characteristics with actual field behavior, something that has not been routinely accomplished (see Decker et al. 2001).

Our approach was feasible to implement. We were able to use aerial flyovers to ascertain hunter density and spatial distribution, GPS unit information on individual hunter field behavior, and survey research to provide insights into the characteristics of individual hunters. Importantly, hunters cooperated with our research, especially those from hunting camps. The high level of participation among camp hunters may reflect the fact that camp owners were informed about the study ahead of time and contacts occurred either the evening before or following the hunt. Unlike hunters stopped at check stations, those at camps were not pressured by time to get to their hunting location or return home. Stopping hunters as they are traveling to begin the day's hunt is disruptive. Most studies of hunters in the field have taken place when hunters applied for a special permit, were aware that they were hunting in an experimental area, or were not allowed to leave until completing a questionnaire (e.g., Kubisiak et al. 2001).

Our aerial surveys provided information about hunter distribution across the landscape in an area where hunter numbers are not restricted. Usually, information on hunter numbers lacks a spatial component, and accurate hunter densities have only been

reported for areas with limited-access hunts (e.g., Kubisiak et al. 2001). Although our technique for surveying hunters is not possible everywhere (e.g., areas with coniferous cover or when fluorescent orange clothing is not required), similar approaches could be developed. Pollock and Kendall (1987) outlined methods for estimating abundance from aerial surveys that corrected for probability of detection <1.0, and improved technology (e.g., thermal imagery; Havens and Sharp 1998) may help.

The number of deer in Pennsylvania exceeds established deer density goals (Diefenbach et al., 1997; PGC, unpublished data). The PGC has begun to address the issue of deer overabundance by increasing the number of antlerless licenses, but whether simply increasing harvest opportunities will achieve established goals given the overall decline in number of hunters and the increasing average age of hunters (U.S. Dept. of the Interior and U.S. Dept. of Commerce, 2002) is of concern (Brown et al., 2000). If our study area averaged 81 deer/1,000 ha (PGC, unpublished data), then there were approximately 3,500–4,000 deer on the study area, of which 20–40% should be harvested annually (B.D. Wallingford, PGC, pers. commun.). Although our surveys did not encompass opening day (Monday), we did survey hunters on the second and third day and the first Saturday, which are the next greatest daily deer harvests (PGC, unpublished data). We observed too few hunters (< 2 hunters/1,000 ha) to expect recreational hunting to control the deer population, even if the PGC had overestimated deer densities by 100% (i.e., only 1,700–2,000 deer on the study area) and we underestimated hunter densities by 50% (i.e., 44–178 deer hunters on the study area per day).

One of the reasons we observed few deer hunters may have been because of the below-normal temperatures that occurred during the 2002 deer season. Minimum

temperatures at the weather station on the northern boundary of the study area averages –

5 C in December but ranged -16 – -10 C during the deer season. However, DCNR

personnel reported that hunting activity during bear season in recent years has been

generally greater than during deer season (J. Long, DCNR, pers. commun.) so we would

not expect >200 deer hunters on the study area on days of greatest participation.

The hunter distribution model that identified slope and distance from road as

explanatory variables was expected because 16% of the study area was > 1 km from the

nearest road open to vehicular travel (Figure 1) and 21% of the study area had slopes ≥

20 degrees. Because hunters on our study area were not distributed uniformly (73% were

≤ 0.5 km from a road) and hunter density was low overall, there were substantial portions

of the study area where little or no hunting occurred (Figure 1). Most of the hunting

occurred on slightly more than half the study area (Table 2). Thomas et al. (1976)

reported that roads influenced where hunters chose to hunt, but they focused their

research on the effect of hiking trails on hunter distribution. We did not have a map of

hiking trails and logging roads to analyze the effect of trails on hunter distribution, but

movement paths of deer hunters carrying global positioning system units on the study

area indicated that trails and logging roads influenced hunter distribution and movements

(C.B. Swope, unpublished data). We believe more detailed research on hunter habitat use

will identify additional factors (e.g., trails, understory vegetation, etc.) that influence

hunter movements and distribution on the landscape.

The GPS data on hunter movements units allowed us to estimate the relationship

between hunter estimates of distance traveled (or location) from actual movement and

location. This may help to better calibrate studies based on self report maps only because

we found that hunters overestimated their maximum distance from the nearest public road

by nearly 2.5 times. Also, we found that the GPS units were relatively unobtrusive and

recorded accurate information about the location and time spent hunting. Very few

hunters indicated errors with the GPS locations plotted on maps. The fact that we found

substantial differences between self-reported and actual movements raises important

questions about the validity of self-reported information and the latter's use for making

inferences about hunter behavior.

The data from GPS units permitted examination of speed of travel, distance, and

direction. If linked to land cover data, such information would also allow for the

examination of habitat use and habitat selection with techniques designed for wildlife

study (Manly et al. 2002). Our study protocols allowed us to assess habitat use at two

different scales and methods. The aerial surveys allowed us to develop a predictive model

and map of large-scale habitat use and spatial distribution of hunters. This data was a

snapshot of habitat use at one point in time. On the other hand, the data from the GPS

units permitted study of habitat use at finer temporal and spatial scales. We are currently

investigating whether habitat use differs among hunters, and how habitat use changes

temporally. For example, do hunters rely on different habitats depending on hunting

methods (e.g., standing versus stalking)? In the past, researchers have examined the

relationship between self-reported locations on maps and habitat characteristics (e.g.,

Thomas et al. 1976), but questions remain about the accuracy and precision of such

information. To address this issue, we plan to further analyze the location data from the

GPS units to determine if self-reported habitat use of hunters is consistent with observed

behavior. Most importantly, the integration of the more commonly used field methods of

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data gathering with mail and telephone surveys created a database that incorporates valuable quantitative hunter attitude and opinion data facilitating the analysis of hunter movements.

CONCLUSIONS

We developed the research protocols outlined in this report to better understand hunter field behavior and its relationship to variables typically studied via human dimensions methods: i.e., hunter motivations, attitudes, and experiences. If managers seek to use recreational hunting as a primary tool for managing wildlife populations, factors such as loss of access and declining participation suggest the need to maximize hunter effectiveness. To maximize effectiveness requires that hunters hunt in the right places in sufficient numbers to achieve harvest objectives. Our research provides descriptive information about the spatial distribution of hunters in an area with unrestricted access. Furthermore, it provides additional data that can be used to understand the factors that affect this distribution, and subsequently predict hunter behavior.

Predicting hunter behavior may allow managers to better anticipate hunter behavioral reaction to changes in management regulations. We can explore the degree to which hunter field behavior (e.g., number of hours, habitat preferred, techniques used) is related to individual hunter characteristics (e.g., physical fitness, experience) and attitudes (e.g., motivations and willingness to harvest antlerless deer). If we know, for example, that hunters who are motivated primarily by the opportunity to harvest large antlered deer and are unwilling to harvest antlerless deer, venture farther from roads, and use different habitat types, then managers who seek to implement additional opportunities to harvest antlerless deer might anticipate how these factors would alter the density and spatial distribution of hunters. Similarly, if hunting field behavior is tied to hunter age, we may be able to model the effect of changing hunter demographics (the aging of the

hunter population) on what habitats or areas are less likely to receive pressure and act as de facto deer refugia.

The ability to predict what hunters will do in the field based on their characteristics, attitudes, and motivations should provide useful insights to wildlife managers in their attempts to maximize the utility of hunting as a management tool. We believe use of these methods will allow the field of wildlife management to move beyond simply describing hunter attitudes and past experience and instead model hunter behavior as a function of environmental and individual characteristics.

The unregulated access for hunting on public lands has led to concerns that compared to private lands (1) hunter densities are greater, (2) harvest rates are greater, and (3) deer densities are lower. Consequently, in recent years the PGC has restricted use of antlerless licenses on public lands. In contrast, our data suggest that hunter densities on the Sproul State Forest are low and substantial areas receive little, if any, hunting pressure. Following timber harvests, DCNR Bureau of Forestry protects seedlings from excessive deer browsing by erecting fences to obtain adequate tree regeneration. This study provides further evidence that recreational deer hunting is not keeping deer populations in balance with available habitat (see Brown et al., 2000). The perceived low deer densities in Pennsylvania (Diefenbach, Palmer, and Shope, 1997), especially on public lands, are unlikely the result of excessive hunter harvest.

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APPENDIX A

STUDY AREA MAP: THE SPROUL FOREST

APPENDIX B

JOURNAL OF WILDLIFE MANAGEMENT MANUSCRIPT

DENSITY, DISTRIBUTION, & HABITAT USE OF BIG GAME HUNTERS
ON PUBLIC LANDS
IN NORTH-CENTRAL PENNSYLVANIA

13 August 2003

Send correspondence to:
Duane R. Diefenbach
U.S. Geological Survey
Pennsylvania Cooperative Fish and Wildlife Research Unit
Pennsylvania State University
113 Merkle Lab
University Park, PA 16802
814-865-4511
814-863-4710 (fax)
DRD11@psu.edu

DENSITY, DISTRIBUTION, AND HABITAT USE OF BIG GAME HUNTERS ON PUBLIC LAND IN NORTH-CENTRAL PENNSYLVANIA

DUANE R. DIEFENBACH,[5] U.S. Geological Survey, Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University, 113 Merkle Lab, University Park, PA 16802 USA

CRAIG B. SWOPE, School of Forest Resources, Pennsylvania State University, 7 Ferguson Bldg., University Park, PA 16802 USA

JAMES C. FINLEY, School of Forest Resources, Pennsylvania State University, 7 Ferguson Bldg, University Park, PA 16802 USA

A. E. LULOFF, Dept of Agricultural Economics and Rural Sociology, Pennsylvania State University, 111 Armsby Bldg., University Park, PA 16802 USA

HARRY C. ZINN, School of Hotel, Restaurant and Recreation Management, Pennsylvania State University, 201 Mateer Bldg., University Park, PA 16802 USA

GARY J. SAN JULIAN, School of Forest Resources, Pennsylvania State University, 2B Ferguson Bldg, University Park, PA 16802 USA

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[5] Corresponding author E-mail: DRD11@psu.edu

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RICHARD STEDMAN, Dept of Agricultural Economics and Rural Sociology,

Pennsylvania State University, 111-B Armsby Bldg., University Park, PA 16802 USA

Abstract: Despite extensive literature on density, distribution, population dynamics and

other characteristic of big game species, almost no research has addressed density,

distribution, and habitat use of hunters. We applied field methods and statistical

techniques developed for estimating density and habitat use of wildlife species to big

game hunters in Pennsylvania. In 2002, we conducted aerial surveys on a 45,907 ha area

of public land in north-central Pennsylvania to estimate hunter density, distribution, and

habitat features associated with hunter distribution during the black bear (Ursus

americanus) and white-tailed deer (Odocoileus virginianus) rifle seasons. The study area

was primarily forested, slopes ranged from $0 - 61°$, and the road network provided access

to within 2.5 km of any location in the study area. We found that hunter density during

the second day of bear season was 4.0 hunters/1,000 ha (95% CI = 2.4 – 6.6). During the

second and third day, and first Saturday of deer season hunter density was 0.4 – 1.9

hunters/1,000 ha. Relative hunter density could be predicted based on distance from the

nearest road and slope; for every 1 km closer to the road hunters were nearly 3 times

more likely to be observed hunting (Odds Ratio = 2.98, 95% CI = 1.90 – 4.68) and for

every $10°$ decrease in slope an area was 1.25 times (95% CI = 1.23 – 1.28) more likely to

be hunted. The low density of hunters observed during deer season could be partly

explained by the below-normal temperatures, but even if deer hunter density were

equivalent to bear hunter density hunters would have harvested an insignificant

proportion of the deer population. Under current regulations and low hunter densities,

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recreational hunting may not be an effective tool to control deer populations on large tracts of public land in Pennsylvania that have similar topography and road networks.

Game species have been studied extensively in North America by wildlife biologists. Contemporary applied research topics on white-tailed deer, one of the most extensively studied ungulate species, include population dynamics (White and Bartmann 1998, McCullough 2001), population estimation (Novak et al. 1991, McCullough and Hirth 1988, Morellet 2001), habitat use and modeling (Hehman and Fulbright 1997, Rothley 2001), migratory movements (Van Deelen et al. 1998), dispersal (Rosenberry et al. 2001), and seasonal movements (Grund et al. 2002). Similarly, research on black bears has addressed habitat use (Clark et al. 1993), population dynamics and estimation (Garshelis and Visser 1997, Boersen et al. 2003, Hebblewhite et al. 2003), and movements and activity patterns (Samson and Huot 1998, Gaines and Lyons 2003).

Recent deer research has examined spatial aspects of harvest management relative to the distribution of mortality (Dusek et al. 1992, Hubbard et al. 2000, Nesslage and Porter 2001). Also, deer managers have begun to address controlling deer populations in urban or protected areas (Hansen and Beringer 1997, Doerr et al. 2001, Gogan et al. 2001). Indeed, the future of recreational hunting as an effective tool to control deer populations has been questioned (Brown et al. 2000). In contrast, the vulnerability of

black bears to hunting and other sources of mortality has been a concern for black bears (Powell et al. 1996, Noyce and Garshelis 1997, Beringer et al. 1998).

Despite the wealth of research conducted on bear and deer species, there is a dearth of knowledge about hunters with respect to their abundance, distribution, and habitat use. The few published studies that have been conducted on how and where hunters hunt have depended on hunters' ability to accurately mark their locations on maps (e.g., Thomas et al. 1976). Radiotelemetry and global positioning system (GPS) technology has been recognized as a means to monitor hunter movements (Lyon and Burcham 1998) but rarely has been applied (Broseth and Pedersen 2000, Millspaugh et al. 2000). Moreover, most research on hunters has occurred on relatively small areas where private or public landowners controlled access and cooperation was a condition of being able to hunt (e.g., Broseth and Pedersen 2000, Kubisiak et al. 2001).

Studies of the relationship between hunting activity and prey species have been published (e.g., Sparrowe and Springer 1970, Root et al. 1988), but we are aware of only 1 study that experimentally manipulated hunting activity (Conner et al. 2001) to test the effects of hunting activity on an ungulate species (elk, Cervus elephus). Only 2 studies monitored the specific spatial location of hunters and their prey (Broseth and Pedersen 2000, Millspaugh et al. 2000). Most published studies of hunting effort are limited to hunter density (e.g., Sparrowe and Springer 1970, Kubisiak et al. 2001) with little or no information about distribution.

We used aerial surveys and distance sampling methods (Buckland et al. 2001) to estimate hunter density and resource selection (Manly et al. 2002) to model distribution on the landscape and habitat use. These are techniques developed for studying wildlife

species, which we applied to big game hunters. The large tracts of public land in Pennsylvania (>1 million ha) have important forest resources and effective management of bear and deer is important to their sustained use, but no information is available on abundance and distribution of hunters in these areas.

STUDY AREA

The study area was located in north-central Pennsylvania (Clinton and Centre counties) in the Allegheny Plateau physiographic province that contains large tracts of public land. The 45,907 ha study area encompassed the southern portion of the Sproul State Forest managed by the Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry (38,909 ha), and State Game Lands 100 (6,998 ha) managed by the Pennsylvania Game Commission (PGC). The center of the study area was characterized by nearly flat to gently rolling terrain, 500–600 m in elevation, which terminates at abrupt drainages to the Susquehanna River to the east, north, and west (200–300 m in elevation). A north-south paved, 2-lane state highway bisected the study area; all other roads in the study area were dirt and gravel. Numerous hiking and snowmobile trails, gas wells, and natural gas and electric utility corridors were located throughout the area. Although much of the forest was generally accessible via roads and trails, 16% of the study area was >1 km from the nearest road open to the general public.

Forest cover primarily was second- and third-growth mature hardwood forest and regenerating stands with few, small, and scattered herbaceous openings, including utility corridors. The study area was in the transition zone of the northern hardwoods forests to the north and oak-hickory (Quercus and Carya spp.) forests to the south. Common tree species included red maple (Acer rubrum) and red and white oak species (Quercus spp.)

with lesser amounts of black cherry (Prunus serotina), American beech (Fagus grandifolia), and hickory (Carya spp.). Evergreens were scarce (1%), but when present primarily were hemlocks (Tsuga canadensis) in drainages and wetlands, with some larch (Larix kaempferi) and pine (Pinus spp.) in rare plantations. Regeneration was sparse and a distinct browse line from deer was evident throughout much of the area. The understory vegetation was dominated by mountain laurel (Kalmia latifolia), sweet fern (Comptonia peregrina), huckleberry (Vaccinium spp.), and ferns (primarily hay-scented fern [Dennstaedtia punctilobula]). In addition to deer browsing, the forest had been affected by large forest fires and tornadoes in the later 1980s and early 1990s as well as forest insect outbreaks.

North-central Pennsylvania is known as the "Big Woods" habitat because of the large tracts of public land (>800,000 ha) that are primarily forested. The Big Woods has a long history of deer hunting. By 1900 this area of the state contained the only huntable populations of black bear and white-tailed deer (Kosack 1995). In the early 1900s, the state Bureau of Forests and Waters leased hundreds of small plots of land on state forestlands to Pennsylvania citizens to build camps, and camps were developed on private in-holdings. Consequently, generations of hunters have evolved a tradition of hunting bear and deer, primarily antlered bucks, during the regular rifle seasons in the Big Woods of Pennsylvania. This means that deer were hunted on the study area by local county residents, and by a greater number of Pennsylvania residents from all counties of the state (PGC, unpublished data) who used hunting camps located in the Sproul State Forest. Deer densities in this region of Pennsylvania in 2002 were estimated to be 81

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deer/1,000 ha prior to the hunting season (PGC, unpublished data) and bear densities

were approximately 2.7 bear/1,000 ha (D. R. Diefenbach, unpublished data).

METHODS

Data Collection

We randomly selected a location within the study area and from this point

systematically placed east-west transect lines approximately 1.8 km apart across the study

area in a Geographic Information System (GIS). This provided 13 transects, 5.6 – 19.4

km long, over the complete study area.

We conducted aerial surveys from a fixed-wing aircraft that flew at approximately

90 knots airspeed and 1,100 m elevation (~ 450 m above ground level). To navigate

transects we used a handheld PC running ArcPad 6.0 (Environmental Systems Research

Institute, Redlands, California, USA; hereafter, ESRI) and linked to a Garmin GPS III+

(Garmin International, Olathe, Kansas, USA) global positioning system (GPS) unit

(Diefenbach et al. 2002). We used a geo-referenced image of the study area overlaid

with an ESRI shapefile containing the transect lines and boundary of the study area as a

visual aid in navigating the pre-determined transects. Exact navigation of transect lines

was attempted, but was not necessary because we recorded the flight path of the aircraft.

Transects were labeled 1-13 from south to north, in which odd-number transects

were flown in order beginning with transect 1 and even-numbered transects were flown

in descending order beginning with transect 12. For example, transect 1 was the first

transect navigated from east to west, followed by transect 3 west to east, and so on until

the last transect navigated was transect 2. A pilot, navigator, and 2 observers conducted

surveys. The navigator indicated when observers should start and stop recording observations and directed the pilot to each transect. Observers were seated in the rear of the aircraft and wore sunglasses with vermillion-tinted lenses (Ranger Shooting Glasses, Randolph Engineering Sunglasses, Randolph, Massachusetts, USA) to reduce glare and enhance the visibility of fluorescent orange clothing. Pennsylvania hunters were required by law to wear $\geq$1600 cm^2 ($\geq$250 square inches) of fluorescent orange clothing on their head, chest, and back combined, making them easily visible from aircraft because most of the study area is deciduous forest and leaf drop was complete prior to the regular rifle season.

We recorded the locations of hunters on a tablet PC equipped with a digitizing pen (Hammerhead HH3, Walkabout Computers, West Palm Beach, Florida, USA) and integrated GPS. A software program (written by J. T. McQuaide, Pennsylvania State University) used input from the GPS to display either a geo-referenced topographic 1:24000 USGS quadrangle (digital raster graphic [DRG]) or a digital orthophoto quadrangle (DOQ) image referenced to the observer's view out the aircraft window. The software oriented the geo-referenced image such that the location of the aircraft was on one edge of the computer screen (depending on the observer being seated on the port or starboard side of the aircraft). The observer's position was held in the center and the image scrolled by as the aircraft flew along the transect. The digitizing pen allowed observers to plot the locations of hunters directly on the DRG or DOQ and the program stored hunter locations in an ESRI shapefile, as well as the associated transect number from which the hunter was observed. Also, the flight path of the plane was recorded in a separate ESRI shapefile.

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We conducted a trial survey across the study area, prior to the hunting seasons, to train observers so they were familiar with use of equipment, software, and navigating transects. We planned to conduct 1 morning or afternoon survey, weather permitting, during the black bear season (25-27 November 2002). During the regular rifle season for deer, we planned to conduct surveys the first 3 days (2-4 December 2002) and both Saturdays (7 and 14 December 2002). Each survey took approximately 2 hours to complete; we conducted morning surveys from approximately 0730 to 0930 hours (EST) and afternoon surveys from 1400 to 1600 hours. Legal hunting hours at this time of year began approximately 0645 and concluded at 1645 hours.

Data Analysis

Distance sampling methods (Buckland et al. 2001) were used to estimate the density and abundance of hunters on the study area and we used program DISTANCE (v. 4.0, Release 2, Thomas et al. 2002) to analyze the data. In our analyses, we used the actual flight path for each transect when calculating the distance of hunters from the transect line. Because the viewing angle from the aircraft window prevented observers from detecting hunters within approximately 122 m, we subtracted 122 m from each distance measured between the transect line and the observed hunter. We modeled detection functions for each observer and a single detection function for both observers and selected the most parsimonious model using Akaike's Information Criterion (AIC).

We developed a model of habitat use by hunters based on distance from road and slope. In a GIS we created a 100 m × 100 m grid over the study area and we used a 30 m digital elevation model (DEM) of the study area to assign each grid cell a slope value (degrees). We used an ESRI shapefile of all roads open to public travel to calculate the

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distance (km) to the nearest road for each grid cell. We estimated available habitat from a systematic random sample of every ninth grid cell in the study area (Erickson et al. 1997, Manly et al. 2002). We estimated habitat use from SLOPE and ROAD values associated with the locations of hunters observed during aerial surveys. We combined data collected during the bear and deer seasons because there were too few observations to analyze the bear season data separately. Also, we had no reason to suspect that hunters used habitat differently for these two seasons because bear and deer occurred throughout the study area, and hunting regulations were the same with respect to pursuit of these two species; baiting and dogs were not allowed and hunters could hunt alone or cooperatively (i.e., drives).

We used standard logistic regression (PROC LOGISTIC, Statistical Analysis System, SAS Institute, Cary, North Carolina, USA) to estimate the relative probability (π) of whether a hunter was associated with SLOPE, ROAD, and the interaction term SLOPE × ROAD (Manly et al. 2002). We used AIC to select the subset of parameters that resulted in the most parsimonious model. To map the relative distribution of hunters across the study area, we applied the logistic regression model using the parameter values associated with each grid cell on the study area and divided the range of relative probabilities into 5 equal intervals. This allowed us to create a chorograph of relative hunter density across the study area. Also, we used this model of habitat use to estimate the density of hunters ≤0.5 km versus >0.5 km from the nearest road open to vehicular travel. We weighted each grid cell in the study area ≤0.5 km from nearest road by π to calculate the proportion hunters ≤0.5 km from nearest road.

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RESULTS

Weather conditions permitted us to conduct aerial surveys during the afternoon of the second day of bear season (26 November 2002), morning and afternoon of the second day of deer season (3 December 2002), the afternoon of the third day of deer season (4 December 2002), and the morning and afternoon of the first Saturday of deer season (7 December 2002).

Truncating observations >457 m from the observer resulted in both observers having uniform detection functions, which was equivalent to a single uniform detection function (i.e., difference in AIC = 0). A single uniform detection function fit the data (χ^2_{10} = 6.89, P = 0.736). Hunter participation was greatest during bear season and was generally less during deer season, with participation greater in morning than afternoon (Table 1).

We selected a systematic random sample of 5,190 grid cells from the study area as the sample of available habitat (i.e., unused habitat), and used 192 grid cells where hunters were observed during aerial surveys (i.e., used habitat). The full model (distance from road, slope, and interaction of distance and slope fit the data (χ^2_8 = 12.12, P = 0.146). The full model had the lowest AIC; however, the estimated interaction parameter was positive, which was opposite from our expectation because it indicated that steep slopes far from roads resulted in greater use by hunters. Consequently, we selected the next best model with only the terms distance to nearest road and slope (ΔAIC = 1.94) as the most general model to compare to other models. A model that excluded SLOPE was inferior (ΔAIC = 3.83), and models with SLOPE or only an intercept were not competitive (ΔAIC ≥ 24.83). The estimated parameters of the best model were intercept

= -2.5847 (SE = 0.1277), SLOPE = -0.0226 (SE = 0.0098), and ROAD = -1.0916 (SE =

0.2301). This model indicated that hunters were approximately a third less likely to hunt

in an area for each additional km from the nearest road (Odds Ratio = 0.336, 95% CI =

0.214 – 0.527) and for every 10º increase in slope were 0.80 times less likely (95% CI =

0.783 – 0.813) to hunt in an area (Figure 2).

We found that 56% of the study area was ≤0.5 km from the nearest road open to

vehicular travel and the probability model estimated that 73% of hunters hunted in this

area. Consequently, the density of hunters ≤0.5 km from a road was >2 times that of

greater distances (Table 2).

DISCUSSION

In Pennsylvania, recreational hunting is the primary tool used to manage bear and

deer populations. Hunting license sales are not limited for bears, but the season is short

(3 days in most of the state), use of bait and dogs are illegal, and the season occurs when

most pregnant females are denned and unavailable for harvest. Deer populations are

managed by limiting the number of antlerless deer harvested via allocation of antlerless

licenses by management unit and issuing ≤2 permits/hunter. Consequently, management

of both species is based on limiting hunter effort, but distribution of hunters on the

landscape is unregulated for bear and only performed at the scale of a management unit

for deer.

The black bear population in Pennsylvania has been increasing over the past 20

years despite annual harvest rates of approximately 20% (M. A. Ternent, PGC,

unpublished data). We believe the density of hunters observed were typical for bear

season, and temperatures during our survey in bear season were normal (minimum

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temperature = -2 C). During the 3-day season approximately 60% of the statewide harvest occurs on opening day and 25 – 30% on the second day (when we conducted the aerial flights). The overall density of hunters (4.0 hunters/1,000 ha) was nearly twice that of the bear population (2.3 bears/1,000 ha), but overall success rate of bear hunters is low (<3%; PGC, unpublished data) and the distribution of hunters was not uniform across the study area (Figure 1). The areas of low hunter density (<2 hunters/1,000 ha; Table 2) could serve as refugia for bears (Powell et al. 1996).

The number of deer in Pennsylvania exceeded established deer density goals during the 1990s (Diefenbach et al. 1997) and into this century (PGC, unpublished data). The PGC has begun to address the issue of deer overabundance by increasing the number of antlerless licenses, but whether simply increasing harvest opportunities will achieve established goals given the overall decline in number of hunters and the increasing average age of hunters (U.S. Dept. of the Interior and U.S. Dept. of Commerce 2002) is of concern (Brown et al. 2000). If our study area averaged 81 deer/1,000 ha (PGC, unpublished data), then there were approximately 3,500–4,000 deer on the study area, of which 20–40% should be harvested annually (B. D. Wallingford, PGC, pers. commun.). Although our surveys did not encompass opening day (Monday), we did survey hunters on the second and third day and the first Saturday, which are the next greatest daily deer harvests (PGC, unpublished data). We observed too few hunters (<2 hunters/1,000 ha) to expect recreational hunting to control the deer population, even if the PGC overestimated deer densities by 100% (i.e., only 1,700–2,000 deer on the study area) and we underestimated hunter densities by 50% (i.e., 44–178 deer hunters on the study area per day).

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One of the reasons we observed few deer hunters may have been because of the below-normal temperatures that occurred during the 2002 deer season (C. B Swope, pers. obs.). Minimum temperatures at the weather station on the northern boundary of the study area (Renovo, Pennsylvania; National Climatic and Data Center, http://www.ncdc.noaa.gov/oa/ncdc.html) averages –5 C in December but ranged -16 – -10 C during the deer season. However, DCNR personnel reported that hunting activity during bear season in recent years has been generally greater than during deer season (J. Long, DCNR, pers. commun.) so we would not expect >200 deer hunters on the study area on days of greatest participation.

The habitat use model that identified slope and distance from road as explanatory variables of hunter distribution was expected because 16% of the study area was >1 km from the nearest road open to vehicular travel (Figure 1) and 21% of the study area had slopes ≥20 degrees. Because hunters on our study area were not distributed uniformly (73% were ≤0.5 km from a road) and hunter density was low overall, there were substantial portions of the study area where little or no hunting occurred (Figure 1). Most of the hunting occurred on slightly more than half the study area (Table 2). Thomas et al. (1976) reported that roads influenced where hunters chose to hunt, but they focused their research on the effect of hiking trails on hunter distribution. We did not have a map of hiking trails and logging roads to analyze the effect of trails on hunter distribution, but movement paths of deer hunters carrying global positioning system units on the study area indicated that trails and logging roads influenced hunter distribution and movements (C. B. Swope, unpublished data). We believe more detailed research on hunter habitat

use will identify additional factors (e.g., trails, understory vegetation, etc.) that influence hunter movements and distribution on the landscape.

MANAGEMENT IMPLICATIONS

As hunter numbers decline in the United States, wildlife managers will need better information about hunter densities and distribution to increase the efficiency of hunters to maintain or increase harvest rates. We found that techniques developed to estimate abundance and habitat use of wildlife species were effective when used to survey the abundance and distribution of hunters in Pennsylvania. Hunters were easily detected from aircraft because the deciduous trees after leaf drop provided little visual obstruction and hunters were required to wear highly visible clothing (1600 cm^2 of fluorescent orange). However, the technique was weather dependent and snow, rain, and fog is not unusual this time of year in Pennsylvania.

The unregulated access for hunting on public lands has led to concerns that compared to private lands (1) hunter densities are greater, (2) harvest rates are greater, and (3) deer densities are lower. Consequently, in recent years the PGC has restricted use of antlerless licenses on public lands. In contrast, our data suggest that hunter densities on the Sproul State Forest are low and substantial areas receive little, if any, hunting. Following timber harvests, DCNR Bureau of Forestry protects seedlings from excessive deer browsing by erecting fences to obtain adequate tree regeneration. This study provides further evidence that recreational deer hunting is not keeping deer populations in balance with available habitat (see Brown et al. 2000). The perceived low deer densities

in Pennsylvania (Diefenbach et al. 1997), especially on public lands, are unlikely the result of excessive hunter harvest.

ACKNOWLEDGMENTS

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Table 1. Density ($\hat{D}$) and abundance ($\hat{N}$) estimates, measures of precision (CV and 95% CI), and survey effort for black bear and white-tailed deer hunters on 460 km^2 of the Sproul State Forest in north-central Pennsylvania, 2002.

|					Density (hunters/1,000 ha)			Abundance		
Season	Date	Time	n[a]	L[b]	$\hat{D}$	CV	95% CI	$\hat{N}$	CV	95% CI
Bear	26 November	Afternoon	59	332.0	4.0	24.7	2.4 – 6.6	184	24.6	111 – 280
Deer	3 December	Morning	17	391.7	1.0	46.7	0.2 – 2.0	45	46.6	8 – 92
		Afternoon	16	413.5	0.9	31.0	0.4 – 1.4	40	31.0	19 – 66
	4 December	Afternoon	9	422.8	0.5	40.0	0.2 – 0.9	22	40.0	7 – 41
	7 December	Morning	33	384.6	1.9	39.9	0.7 – 3.8	89	39.8	30 – 174
		Afternoon	8	418.7	0.4	39.0	0.2 – 0.8	20	38.6	8 – 39

[a] No. hunters observed during survey.

[b] Total km of transects flown.

Table 2. Number of hunters ($\hat{N}$) and hunter density ($\hat{D}$; per 1,000 ha) ≤0.5 km and >0.5 km from roads open to vehicular travel. Fifty-six percent of the study area was ≤0.5 km from a road, Pennsylvania, 2002.

			Distance from nearest road				
			≤0.5 km			>0.5 km	
Season	Date	Time	$\hat{N}$	$\hat{D}$		$\hat{N}$	$\hat{D}$
Bear	26 November	Afternoon	136	5.3		48	1.9
Deer	3 December	Morning	33	1.3		12	0.5
		Afternoon	30	1.2		10	1.4
	4 December	Afternoon	16	0.6		6	0.2
	7 December	Morning	66	2.6		23	0.9
		Afternoon	15	0.6		5	0.2

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FIGURE LEGENDFigure 1. Relative use of areas by white-tailed deer and black bear hunters on the Sproul State Forest, Pennsylvania, 2002. Lightest colored areas indicate greatest use and darkest colored indicate least use; lines indicate roads
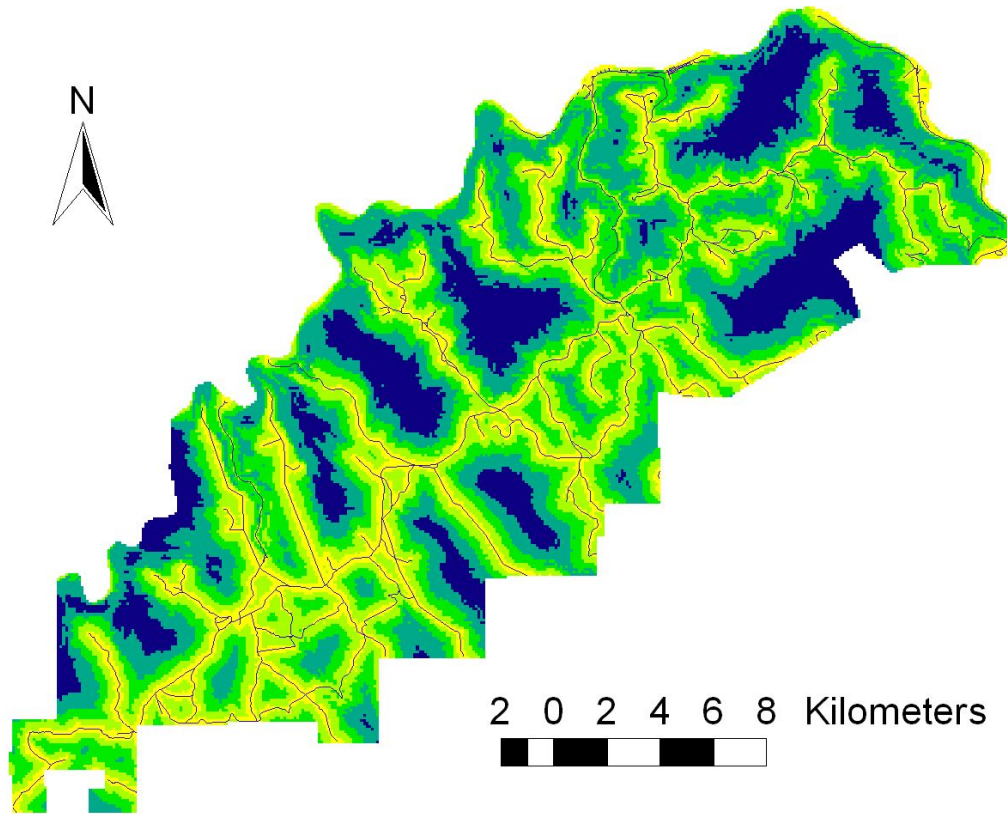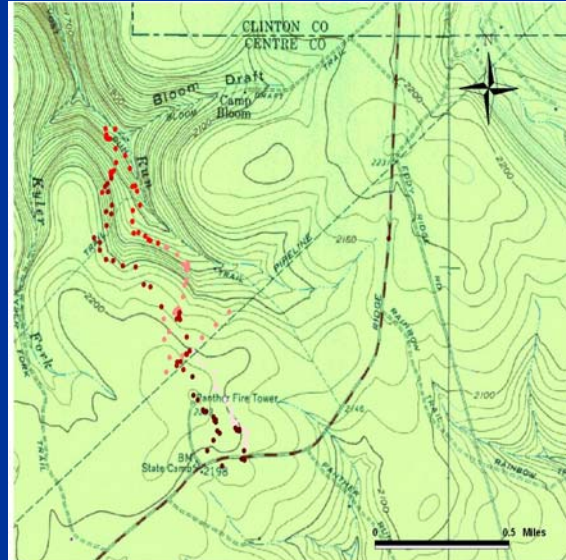
APPENDIX C

**EXAMPLES OF MAPS OF HUNTER MOVEMENTS
TRACKED BY GPS**

What can we do?

- Determine avg. speed
- Total distance
- Time spent hunting
- Habitat usage
- Hunting style
- Use of trails or old log roads
- Proximity to roads
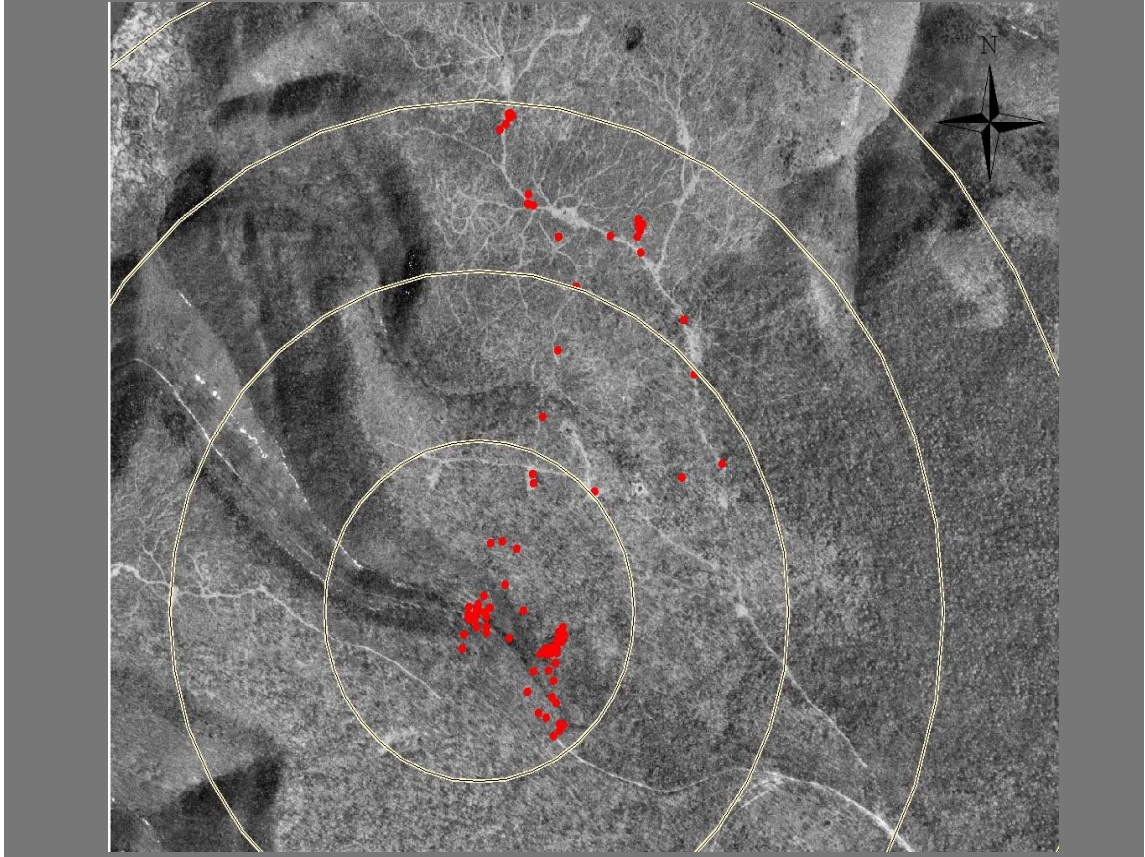
APPENDIX D

MAPS OF ESTIMATED MOVEMENTS PRESENTED BY HUNTERS

SPROUL STATE FOREST
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
BUREAU OF FORESTRY

N

SCALE: 1" = APPROX. 2 MILES

LEGEND
— · · — County Line
———— Hard Surface Road
———— Improved Dirt Road
■ ■ ■ ■ Drivable Trail
– – – – Trail
— · — Powerline R/W
Vistas
• Hunter Check Stations

404-53
(879M)
Project 2415

FOREST RESOURCES EXTENSION
HUNTER MOVEMENT STUDY
7 FERGUSON BUILDING
UNIVERSITY PARK PA 16802-9989

Hunter Movement Study
The Pennsylvania State University

• Please take a moment to review the map on the reverse side of this paper. The map corresponds to the southern portion of Sproul State Forest. On the map, mark an '✳' where you left your vehicle or camp to hunt, also indicate with an '✗' the farthest location you were from an open, non-gated road during the day's hunt. Please note the scale in the upper left-hand corner.

• Please also take a few minutes to complete the set of questions at the bottom of this page. After answering the questions, please fold this paper along the dotted lines so that the address shows on the outside. Affix a small piece of tape (**DO NOT STAPLE**) to keep the edges together and place in the mail. Postage is pre-paid by Penn State University. Your patience and cooperation with this study are greatly appreciated.

Contact Information:
Dr. James C. Finley
Penn State Forestry Extension
University Park, PA 16802
(814) 863-0401

Please take a few minutes to complete this small set of questions below and the mapping exercise on the reverse side.

1. Please check all the days you <u>have hunted and plan to hunt</u> during the 2002 rifle season in Sproul State Forest:

___ Mon. 12/02	___ Thurs. 12/05	___ Mon. 12/09	___ Thurs. 12/12
___ Tues. 12/03	___ Fri. 12/06	___ Tues. 12/10	___ Fri. 12/13
___ Wed. 12/04	___ Sat. 12/07	___ Wed. 12/11	___ Sat. 12/14

2. Did you kill a deer in **Sproul** State Forest during the 2002 rifle season? (check all that apply)
    ___ Antlered, Date: _____   ___ Antlerless, Date: _____

3. What was the maximum distance you hunted from an open, non-gated road in the **Sproul**?
    _____ miles (to the nearest tenth)

4. Do you own, belong to, or use a camp in **Sproul** State Forest?   ___ Yes ___ No

5. Did you agree to wear a GPS unit during the 2002 rifle season? ___ Yes ___ No
    • If YES, date worn _____
    • number on GPS unit issued _____

6. What is your age?   ___ 12-15 ___ 16-30 ___ 31-40 ___ 41-50 ___ 51-64 ___ 65 and older
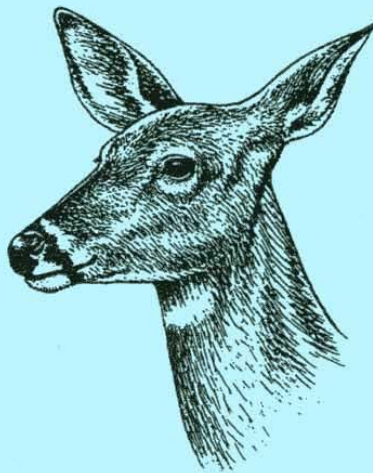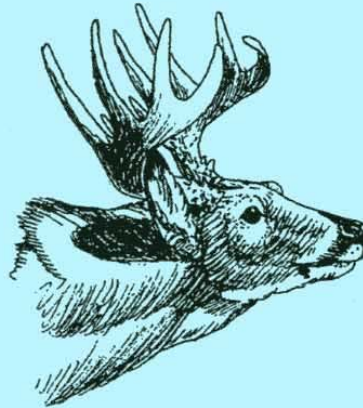
7. What is your name and address?
    Name: _____
    Street: _____
    Town: _____ State: _____ Zip: _____

N̊   3302

APPENDIX E

HOUSEHOLD/HUNTER SURVEY INSTRUMENTS

Hunter Movement Survey
2002

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Dear Hunter,

This survey is part of a study by the Pennsylvania Department of Conservation and Natural Resources and the Human Dimensions Unit in the School of Forest Resources at Penn State. The intent of the study is to better understand how hunters use "big woods" habitat like that encountered on the Sproul State Forest. We hope to learn more about hunter movement, success, and use of the cover they encounter while hunting on the Sproul.

The tracking number on the front cover of the questionnaire is used so that we can check responses against our mailing list and avoid sending duplicate mailings to those who have already returned a completed survey. Please try to complete and return the survey within two weeks. When you have competed the questionnaire, please mail it back to us using the pre-addressed return envelope: no postage is necessary. If you have questions, feel free to call the number listed below.

Thank you in advance for your participation in this part of the study. And, we wish to thank you for your cooperation earlier this year when we met you on the Sproul during the 2001-hunting season. We have had excellent cooperation and we are indebted to you for your help.

Sincerely,

James C. Finley
Project Director
7 Ferguson Building
University Park, PA 16802

814 863-0401

Hunter Movement Study
2002

The first set of questions is designed to tell us a little about your hunting experience. Please fill in the appropriate space or circle the best answer for each question.

1. a. How many years have you been hunting deer? _____ years

    b. How many years have you hunted deer in Pennsylvania? _____ years

    c. How many years have you hunted deer in the Sproul State Forest (Sproul)? _____ years

    d. How many years have you hunted **antlerless** deer in the Sproul? _____ years

    e. Compared to other years, how much time did you spend hunting deer on the **Sproul** in the **2001** season? (Circle <u>one</u>)

    > 1 - More time
    > 2 - About the same amount of time
    > 3 - Less time

2. a. In addition to the general hunting license, which other licenses or stamps did you have for the **2001** season for hunting deer in Pennsylvania? (Check all that apply)

    > 1. Archery License _____
    >
    > 2. Flintlock/Muzzleloader License _____
    >
    > 3. Combination (Archery/Muzzleloader) _____
    >
    > 4. Antlerless License _____

    b. In what counties did you purchase **antlerless** licenses in **2001**?

    _____ _____ _____ _____

3. Do you consider yourself to be *primarily* an: (Circle <u>one</u>)

    > 1 - Archery hunter
    > 2 - Firearm (Rifle/Pistol/Shotgun) hunter
    > 3 - Flintlock/Muzzleloader hunter

1

For the next series of questions, we are interested in learning about your hunting success for the last three seasons (2001, 2000, and 1999). The first few questions focus on __antlered__ deer.

4. a. Did you kill an **antlered** deer in **2001**? (Circle <u>one</u>)

   1 - YES   2 - NO

   b. If YES, in what season did you kill this **antlered** deer? (Circle <u>one</u>)

   1 - Early Archery
   2 - Early Flintlock/Muzzleloader
   3 - Firearm (Rifle/Pistol/Shotgun)
   4 - Late Archery
   5 - Late Flintlock/Muzzleloader

   c. If you harvested an **antlered** deer on the **Sproul** in **2001**, what was the date of the kill? _____ (date)

5. a. Did you kill an **antlered** deer in **2000**? (Circle <u>one</u>)

   1 - YES   2 - NO

   b. If YES, in what season did you kill this **antlered** deer? (Circle <u>one</u>)

   1 - Early Archery
   2 - Firearm (Rifle/Pistol/Shotgun)
   3 - Flintlock/Muzzleloader
   4 - Late Archery

6. a. Did you kill an **antlered** deer in **1999**? (Circle <u>one</u>)

   1 - YES   2 - NO

   b. If YES, in what season did you kill this **antlered** deer? (Circle <u>one</u>)

   1 - Early Archery
   2 - Firearm (Rifle/Pistol/Shotgun)
   3 - Flintlock/Muzzleloader
   4 - Late Archery

2

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Again, we are interested in learning about your hunting success for the last three seasons (2001, 2000, and 1999), but here our focus is on <u>antlerless</u> hunting.

7. a. Did you kill an **antlerless** deer in **2001**? (Circle <u>one</u>)

        1 – YES   2 – NO

    b. If YES, in what season did you kill this **antlerless** deer? (Circle <u>one</u>)

        1 - Early Archery
        2 - Firearm (Rifle/Pistol/Shotgun)
        3 - October Firearm Season (Junior/Senior)
        4 - Early Flintlock/Muzzleloader
        5 - Late Flintlock/Muzzleloader
        6 - Late Archery

    c. If you harvested an **antlerless** deer on the **Sproul** in **2001**, what was the date of the kill? _____ (date)

8. a. Did you kill an **antlerless** deer in **2000**? (Circle <u>one</u>)

        1 – YES   2 – NO

    b. If YES, in what season did you kill this **antlerless** deer? (Circle <u>one</u>)

        1 - Early Archery
        2 - Firearm (Rifle/Pistol/Shotgun)
        3 – Flintlock/Muzzleloader
        4 - Late Archery

9. a. Did you kill an **antlerless** deer in **1999**? (Circle <u>one</u>)

        1 – YES   2 – NO

    b. If YES, in what season did you kill this **antlerless** deer? (Circle <u>one</u>)

        1 - Early Archery
        2 - Firearm (Rifle/Pistol/Shotgun)
        3 - Flintlock/Muzzleloader
        4 - Late Archery

10. a. What is the furthest you are willing to travel from your home to hunt **antlered** deer in a concurrent season? _____ (number of miles)

    b. What is the furthest you are willing from your home to hunt **antlerless** deer in a concurrent season? _____ (number of miles)

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The next series of questions ask about your deer hunting experiences in Pennsylvania. We are also interested in knowing how long you spend afield.

11. How many days did you spend afield in each of the following **2001** hunting seasons? (If less than one complete day, please indicate this by writing in 1 day.)

        1 - Early Archery   _____ (number of days)
        2 - Early Flintlock/Muzzleloader   _____ (number of days)
        3 - October **Antlerless** Firearm   _____ (number of days)
        4 – Firearm (Rifle/Pistol/Shotgun)   _____ (number of days)
        5 - Late Flintlock/Muzzleloader   _____ (number of days)
        6 - Late Archery   _____ (number of days)

12. How many days, in total, did you spend visiting your hunting *areas*, in the **2001** hunting season, when you **were not** hunting deer? (If less than one complete day, please indicate this by writing in 1 day. _____ (number of days)

13. For each of the following **2001** hunting seasons, where did you **primarily** hunt? ("X" out the appropriate cell[s].)

SEASONS	PUBLIC LANDS				PRIVATE LANDS		
	Bureau of Forestry	PA Game Comm	Allegheny National Forest	Other Public	Hunting Club Lands*	Posted Lands	Not Posted Lands
a. Archery	1	2	3	4	5	6	7
b. Early Flintlock	1	2	3	4	5	6	7
c. October **Antlerless** Firearm	1	2	3	4	5	6	7
d. Firearm	1	2	3	4	5	6	7
e. Late Flintlock	1	2	3	4	5	6	7
f. Late Archery	1	2	3	4	5	6	7

* Owned or Leased Lands

4

14.   a.   How far do you travel from your home to hunt deer in the **Sproul**?

             _____ (number of miles)

    b.   In what county do you live? _____ (name of county)

    c.   When hunting deer in the **Sproul**, do you normally stay away from home? (Circle one)

           1 – YES   2 - NO

    d.   Do you own, belong to, or use a camp in the **Sproul**? (Circle <u>one</u>)

           1 - Own camp
           2 - Belong to camp
           3 - Use camp
           4 - None of the above

15.   When hunting deer in the **Sproul**, how would you best describe the **topography** where you most often hunt? (Circle <u>one</u>)

           1 - Upper plateau flats
           2 - Side hills
           3 - Valley bottoms
           4 - Mixed topography

16.   We are interested in learning about the deer habitat you hunt on the Sproul. Using a **1** (one) to indicate the *most frequently* hunted habitat type and a **2** (two) to indicate the *next most frequently* hunted habitat type, please rank the following habitat types. We are only interested in the **two most frequently hunted** habitat types.

Rank the **two most frequently hunted** habitats:

    ____ Oak dominated area, open wooded
    ____ Maple and other hardwood dominated area, open wooded
    ____ Pine and hemlock dominated area, open wooded
    ____ Wooded area with dense stands of Mt. Laurel or rhododendron
    ____ Dense wooded area, limited visibility
    ____ Large areas with no undergrowth and patchy trees
    ____ Forest with mixed ages, open area
    ____ Mixed low vegetation, open area

There are many ways to manage deer in Pennsylvania. One approach is to allow yearling bucks to mature and develop larger racks. Accomplishing this goal would protect small <u>antlered</u> deer from harvest.

17. How supportive would you be of a **statewide** antler restriction that requires bucks to have at least three points on one side? (Circle <u>one</u>)

Strongly Support	Support	Slightly Support	Neither Support, Nor Oppose	Slightly Oppose	Oppose	Strongly Oppose
1	2	3	4	5	6	7

18. How supportive would you be of an antler restriction in the **Sproul** that requires bucks to have at least three points on one side? (Circle <u>one</u>)

Strongly Support	Support	Slightly Support	Neither Support, Nor Oppose	Slightly Oppose	Oppose	Strongly Oppose
1	2	3	4	5	6	7

In the next series of questions, we are interested in learning more about your hunting style, experiences, and general opinions.

19. While in the field, do you typically hunt alone? (Circle <u>one</u>)

   1 – YES   2 – NO

20. a. During the **2001** rifle season, how did you typically hunt? (Circle <u>one</u>)

      1 – Drives with nine or less hunters
      2 – Drives with ten or more hunters
      3 – In ground stand
      4 – In tree stand
      5 – Stalking
      6 – Small, quiet, pushes
      7 – Other (please specify) _____

   b. Compared to other years, how much time did you spend driving deer on the **Sproul** in the **2001** rifle season? (Circle <u>one</u>)

      1 – More time
      2 – About the same amount of time
      3 – Less time
      4 – Did not drive deer

6

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21. With the change to concurrent seasons (**antlered** and **antlerless** deer together), are you now more likely to buy an **antlerless** license to hunt on the **Sproul**? (Circle <u>one</u>)

    1 – YES   2 – NO

22. a. Did the new concurrent season change the way you hunted deer? (Circle <u>one</u>)

    1 – YES   2 – NO

    b. If YES, how did your hunting style change? _____
_____

23. a. Did the new concurrent season change the way your group or camp hunted deer? (Circle <u>one</u>)

    1 – YES   2 – NO

    b. If YES, how did your hunting style change? _____
_____

24. a. Were you responsible for monitoring the activities of a youth hunter in the **2001** deer hunting seasons? (Circle <u>one</u>)

    1 – YES   2 – NO

    b. If YES, how did this responsibility change your hunting activity during the **2001** deer hunting seasons? _____
_____

    c. What percent of your deer hunting time afield in the **2001** season was spent monitoring the activities of a youth hunter? _____ percent

25. a. In total, during the **2001** hunting season, how many people purchased hunting licenses in your household? _____ (number)

    b. How many were Junior license holders? _____ (number)

26. In the **2001** hunting season, what was the maximum distance you hunted from a **paved road** in the **Sproul**? _____ number of miles (to the nearest tenth)

27. In the **2001** hunting season, what was the maximum distance you hunted from an "open" or non-gated **dirt road** in the **Sproul**? _____ number of miles (to the nearest tenth)

28. Do you walk gated roads to access your hunting area? (Circle <u>one</u>)

    1 - YES   2 - NO

29. For each of the following statements, please indicate whether or not you agree, using the scale: (Circle <u>one</u> ranking per statement)

1 = <u>S</u>TRONGLY <u>D</u>ISAGREE (**SD**)
2 = <u>D</u>ISAGREE (**D**)
3 = <u>N</u>EITHER <u>A</u>GREE <u>N</u>OR <u>D</u>ISAGREE (**N**)
4 = <u>A</u>GREE (**A**)
5 = <u>S</u>TRONGLY <u>A</u>GREE (**SA**)

		SD	D	N	A	SA
a.	Public lands are more heavily hunted than private lands.	1	2	3	4	5
b.	Public lands have higher deer densities than private lands.	1	2	3	4	5
c.	Public lands have higher hunter success rates than private lands.	1	2	3	4	5
d.	I hunt with the goal of harvesting an **antlered** deer only.	1	2	3	4	5
e.	The number of deer has no effect on plant and animal communities.	1	2	3	4	5
f.	There is enough public hunting land in PA to provide access to anyone who wants to hunt.	1	2	3	4	5
g.	The quality of the hunting experience is higher on private lands than it is on public lands.	1	2	3	4	5
h.	Posting of private land has made it more difficult for me to find a place to hunt.	1	2	3	4	5
i.	Over time, deer hunting pressure has decreased in the places I hunt.	1	2	3	4	5
j.	It has become increasingly difficult for me to find a good place to hunt deer.	1	2	3	4	5
k.	Deer damage to forests in Pennsylvania is a problem.	1	2	3	4	5
l.	Keeping deer populations in balance with natural food supplies is necessary.	1	2	3	4	5
m.	I don't really care if I shoot an **antlered** or **antlerless** deer as long as I get a deer.	1	2	3	4	5
n.	Posting has restricted my access to hunting on private lands.	1	2	3	4	5
o.	Deer cause serious conflicts with other land uses, such as forestry, farming, highways, and other development.	1	2	3	4	5

8

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For each of the following statements, please indicate whether or not you agree, using the scale: (Circle one ranking per statement)

1 = STRONGLY DISAGREE (SD)
2 = DISAGREE (D)
3 = NEITHER AGREE NOR DISAGREE (N)
4 = AGREE (A)
5 = STRONGLY AGREE (SA)

	SD	D	N	A	SA
p. I would rather harvest a doe than no deer at all.	1	2	3	4	5
q. The higher the deer population, the better my hunting experience.	1	2	3	4	5
r. I hunt to harvest a trophy **antlered** deer.	1	2	3	4	5
s. I can have a satisfying **day** of hunting without harvesting a deer.	1	2	3	4	5
t. I can have a successful **season** of hunting without harvesting a deer.	1	2	3	4	5
u. The number of deer has no effect on forest regeneration.	1	2	3	4	5

30. How important, would you say hunting is to you: (Circle one)

Very Important	Important	Slightly Important	Neither Important, Nor Unimportant	Slightly Unimportant	Unimportant	Very Unimportant
1	2	3	4	5	6	7

31. Using a scale ranging from 1 *(not at all crowded)* to 9 *(extremely crowded)* on an average hunt in the Sproul, how crowded do you usually feel? (Circle one)

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded			Moderately Crowded			Extremely Crowded

32. How important are each of the following reasons for your participation in hunting – is each very important, important, neither important nor unimportant, unimportant, or very unimportant? (Circle one ranking per statement)

1 = VERY IMPORTANT (VI)
2 = UNIMPORTANT (U)
3 = NEITHER IMPORTANT NOR UNIMPORTANT (N)
4 = IMPORTANT (I)
5 = VERY UNIMPORTANT (VU)

	VI	U	N	I	VU
a. To get outdoors.	1	2	3	4	5
b. To get away from my everyday routine.	1	2	3	4	5

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How important are each of the following reasons for your participation in hunting – is each very important, important, neither important nor unimportant, unimportant, or very unimportant? (Circle one ranking per statement)

1 = <u>V</u>ERY <u>I</u>MPORTANT (**VI**)
2 = <u>U</u>NIMPORTANT (**U**)
3 = <u>N</u>EITHER IMPORTANT NOR UNIMPORTANT (**N**)
4 = <u>I</u>MPORTANT (**I**)
5 = <u>V</u>ERY <u>U</u>NIMPORTANT (**VU**

	VI	U	N	I	VU
c. To obtain venison.	1	2	3	4	5
d. To get a large **antlered** deer.	1	2	3	4	5
e. The challenge of hunting deer.	1	2	3	4	5
f. To test my outdoor skills.	1	2	3	4	5
g. To be with my friends.	1	2	3	4	5
h. To be with my family.	1	2	3	4	5
i. To return to traditional hunting spots.	1	2	3	4	5
j. To help manage the deer population.	1	2	3	4	5

33.   Who was **primarily** responsible for teaching you how to hunt deer? (Circle one)

1 - Parent
2 - Other relative
3 - Peers
4 - PGC hunting education course
5 - Hunting camp companion
6 - Friend
7 - Learned on my own
8 - Media sources

34. a.   Which sources do you most often rely upon to get your news/information about Pennsylvania hunting-related issues? (Circle all that apply)

1 - Television
2 - Radio
3 - Newspapers
4 - Organization newsletters
5 - Hunting magazines
6 - Internet
7 - Talking to others
8 - PGC Website
9 - The hunting regulation booklet
10 - Other (please specify) _____

b.   Of those you identified above as relying upon **most often**, which is the most important source? _____

For the next few questions, we are interested in learning about what you do with the deer you harvest.

35. Who uses most of the venison from the deer you harvest? (Circle <u>one</u>)

    1 - Your household
    2 - Other family members
    3 - Other hunters
    4 - Friends
    5 - Charities
    6 - Whoever will take it

36. If you could purchase additional **antlerless** permits, how many **antlerless** deer would you seek to harvest in a year? _____ (number of deer)

Finally, we need to ask a few questions about you and your household. This information, as with all information provided in this survey, will be used for statistical analysis only and will remain strictly confidential.

37. In what year were you born?   19____

38. What is the highest level of formal education that you completed? (Circle <u>one</u>)

    1 - Did not complete high school
    2 - Completed high school or equivalent
    3 - Some college or vocational training
    4 - Completed college degree
    5 - Graduate or professional training beyond college degree

39. a. How many people, including yourself, live in your household? _____ (number)

    b. How many are under 18 years of age?   _____ (number)

    c. How many are over 65 years of age?   _____ (number)

40. Would you say your health is: (Circle <u>one</u>)

    1 – Excellent   2 – Good   3 – Fair   4 - Poor

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41. How much difficulty do you have doing the following? Do you have a "great deal of difficulty," "some difficulty," or "no difficulty"? Circle **one** answer for each question.

How much difficulty do you have:	Great deal of Difficulty	Some Difficulty	No Difficulty
a. Going up and down stairs	1	2	3
b. Kneeling or stopping	1	2	3
c. Lifting or carrying objects less than 10 pounds, like a bag of groceries.	1	2	3
d. Using your hands or fingers	1	2	3
e. Seeing, even with glasses	1	2	3
f. Hearing	1	2	3
g. Walking	1	2	3

42. Do you use any of the following while you hunt the **Sproul**? (Circle all that apply)

1 – Maps   2 – Compass   3 - Walkie-talkie   4 - GPS unit

43. Remembering that your answers are confidential, could you please tell me if your total household income from all sources before taxes in **2000** was more or less than $30,000? (Circle one)

a.   LESS ? Was it more or less than $15,000?

      1 – LESS   2 - MORE

b.   MORE ? Was it more or less than $45,000?

      1 – LESS   2 - MORE

44. Are you: 1 - Male   2 - Female

That is all the questions that we have. Thank you for your cooperation.

Please use the remainder of this survey and the inside back cover
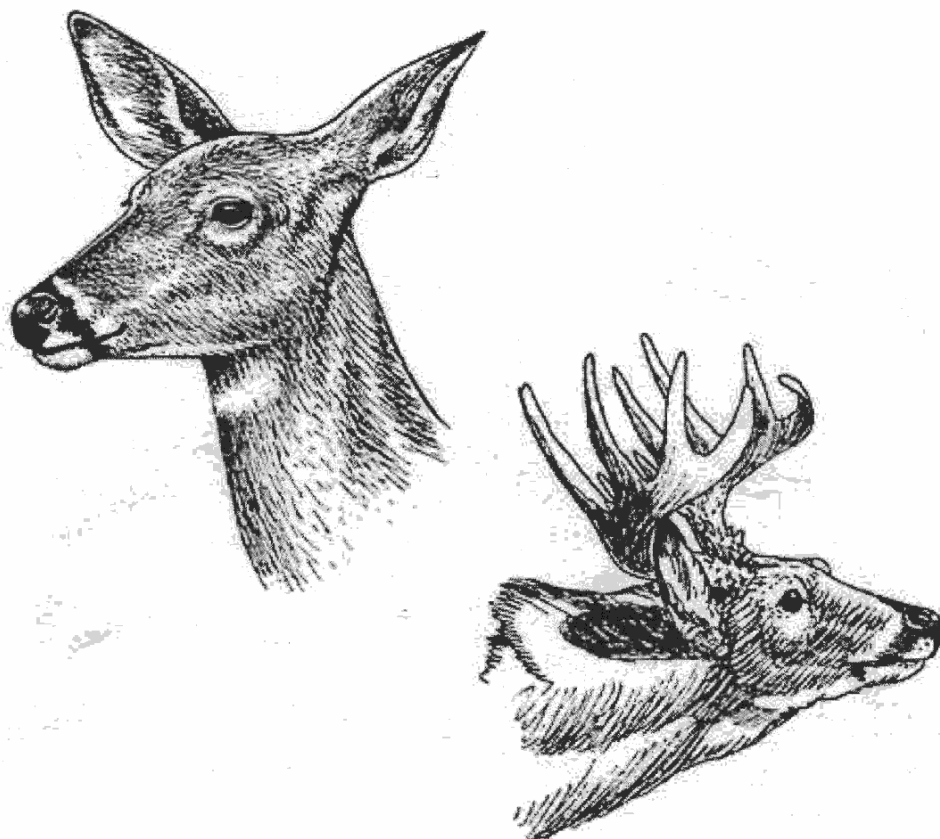for any comments you would care to share

_____

_____

_____

_____

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PENNSTATE

DCNR

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PENNSTATE
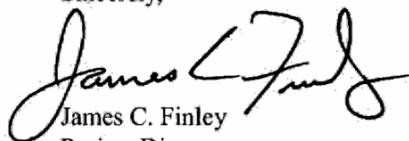
**Hunter Movement Survey
2003**

Dear Hunter,

This survey is part of a two-year long study by the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry and the Human Dimensions Unit in the School of Forest Resources at Penn State. The intent of the study is to better understand how hunters use "big woods" habitat like that encountered on the Sproul State Forest. We hope to learn more about hunter movement, success, and use of the cover they encounter while hunting on the Sproul.

The tracking number on the front cover of the questionnaire is used so that we can check responses against our mailing lists and avoid sending duplicate mailings to those who have already returned a completed survey. Please try to complete and return the survey within two weeks. When you have completed the questionnaire, please mail it back to us using the pre-addressed return envelope: no postage is necessary. If you have questions, feel free to call the number listed below.

Thank you in advance for your participation in this part of the study. And, we wish to than you for your cooperation this past deer hunting season when we met you on the Sproul State Forest. We have had excellent cooperation and we are indebted to you for your help.

Sincerely,

James C. Finley
Project Director
7 Ferguson Building
University Park, PA 16802

814 863-0401

The first set of questions is designed to tell us a little about your hunting experience during the 2002 hunting season. Please fill in the appropriate space or circle the best answer for each question.

1. a. How many years have you been hunting deer?   _____ years

    b. How many years have you hunted deer in Pennsylvania?   _____ years

    c. How many years have you hunted deer in the Sproul State Forest? _____ years

    d. How many years have you hunted **antlerless** deer in the Sproul? _____ years

    e. Compared to other years, how much time did you spend hunting deer on the **Sproul** in the **2002** season? (Circle one)

        1 - More time
        2 - About the same amount of time
        3 - Less time

2. a. In addition to the general hunting license, which other licenses or stamps did you have for the **2002** season for hunting deer in Pennsylvania? (Check all that apply)

        1. Archery License   _____

        2. Antlerless License   _____

    b. In which Pennsylvania counties did you purchase antlerless licenses in 2002? (List counties)

        _____   _____   _____   _____

For the next series of questions, we are interested in learning about your hunting success during the last season, 2002.

3. a. Did you kill an **antlered** deer in **2002**? (Circle one)

        1 - YES   2 – NO

    b. If YES, in what season did you kill this **antlered** deer? (Circle one)

        1 - Early (Archery, Flintlock/Muzzleloader)
        2 - Firearm (Rifle/Pistol/Shotgun)
        3 - Late (Archery, Flintlock/Muzzleloader)

4. a. Did you kill an **antlerless** deer in **2002**? (Circle one)

        1 – YES 2 – NO

    b. If YES, in what season did you kill this **antlerless** deer? (Circle one)

        1 - Early (Archery, Flintlock/Muzzleloader)
        2 - Early Junior/Senior (Archery, October Firearm, Flintlock/Muzzleloader)
        3 - Firearm (Rifle/Pistol/Shotgun)
        4 - Late (Archery, Flintlock/Muzzleloader)

5. a. What is the furthest you are willing to travel from your home to hunt antlered deer in a concurrent season?   _____ (number of miles)

    b. What is the furthest you are willing to travel from your home to hunt antlerless deer in a concurrent season?   _____ (number of miles)

1

98

The next series of questions ask about your deer hunting experiences in Pennsylvania. We are also interested in knowing how long you spend afield.

6. How many days did you spend afield in each of the following **2002** hunting seasons? (If less than one complete day, please indicate this by writing in 1 day.)

    1 -Early (Archery, Flintlock/Muzzleloader, _____ (number of days)
    2 - Early Junior/Senior (Archery, _____ (number of days)
        October Firearm, Flintlock/Muzzleloader)
    3 -Firearm (Rifle/Pistol/Shotgun) _____ (number of days)
    4 -Late (Archery, Flintlock/Muzzleloader) _____ (number of days)

7. How many days, in total, did you spend visiting your hunting *areas*, in the **2002** hunting season, when you **were not** hunting deer? (If less than one complete day, please indicate this by writing in 1 day. _____ (number of days)

8. For each of the following **2002** hunting seasons, where did you **primarily** hunt? ("X" out the appropriate cell[s].)

SEASONS	PUBLIC LANDS	PRIVATE LANDS
a. Early (Archery, Flintlock/Muzzleloader)	1	2
b. October **Anterless** Firearm	1	2
c. Firearm	1	2
d. Late (Archery, Flintlock/Muzzleloader)	1	2

9. a. How far do you travel from your home to hunt deer in the **Sproul**?

        _____ (number of miles)

    b. In what Pennsylvania county do you live? _____
                                                (name of county)
        Do not live in Pennsylvania _____

    c. When hunting deer in the **Sproul**, do you normally stay away from home? (Circle <u>one</u>)

        1 – YES   2 – NO

    d. Do you own, belong to, or use a camp in the **Sproul**? (Circle <u>one</u>)

        1 - Own camp
        2 - Belong to camp
        3 - Use camp
        4 - None of the above

10. When hunting deer in the **Sproul**, how would you best describe the **topography** where you most often hunt? (Circle <u>one</u>)

    1 - Upper plateau flats
    2 - Side hills
    3 - Valley bottoms
    4 - Mixed topography

2

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11. a. We are interested in learning about the deer habitat you hunt on the Sproul.
Using a **1** (one) to indicate the most frequently hunted habitat type and a **2** (two) to indicate the next most frequently hunted habitat type, please rank the following habitat types. We are only interested in the two most frequently hunted habitat types.

Rank the **two most frequently hunted** habitats:
____ Oak dominated area, open wooded
____ Maple and other hardwood dominated area, open wooded
____ Pine and hemlock dominated area, open wooded
____ Wooded area with dense stands of Mt. Laurel or rhododendron
____ Dense wooded area, limited visibility
____ Large areas with no undergrowth and patchy trees
____ Forest with mixed ages, open area
____ Mixed low vegetation, open area

b. Approximately what percent of the time do you hunt in each habitat?

Most Frequent _____ %
Next Most Frequent _____ %

(Note: Does not have to sum to 100%.)

There are many ways to manage deer in Pennsylvania. Several ideas have been advanced by various parties. How supportive are you of each of the following strategies for managing deer in Pennsylvania?

12. First, how supportive are you of continuing the *statewide* antler restriction? Choose one.

Strongly Support	Support	Slightly Support	Neither Support, Nor Oppose	Slightly Oppose	Oppose	Strongly Oppose
1	2	3	4	5	6	7

13. Group permits that allow parties to hunt together to harvest deer, regardless of who actually takes the animal, is one suggestion for managing deer in remote areas or where specific reductions are desired. How supportive would you be of a proposal to allow group permits? Choose one.

Strongly Support	Support	Slightly Support	Neither Support, Nor Oppose	Slightly Oppose	Oppose	Strongly Oppose
1	2	3	4	5	6	7

14. This spring the Game Commission established 22 deer management areas. How supportive are you of the proposed deer management area approach for allocating **anterless** licenses? Choose one.

Strongly Support	Support	Slightly Support	Neither Support, Nor Oppose	Slightly Oppose	Oppose	Strongly Oppose
1	2	3	4	5	6	7

3

100

In the next series of questions, we are interested in learning more about your hunting style, experiences, and general opinions.

15. While in the field, do you typically hunt alone? (Circle <u>one</u>)

     1 – YES   2 – NO

16. Do you use any of the following while you hunt the **Sproul**? (Circle all that apply)

     1 – Maps   2 – Compass   3 - Walkie-talkie   4 - GPS unit

17a. During the **2002** rifle season, how did you typically hunt? (Circle <u>one</u>)

     1 – Drives with nine or less hunters
     2 – Drives with ten or more hunters
     3 – In ground stand
     4 – In tree stand
     5 – Stalking
     6 – Small, quiet, pushes
     7 – Other (please specify) _____

   b. Compared to other years, how much time did you spend driving deer on the **Sproul** in the **2002** rifle season? (Circle <u>one</u>)

       1 – More time
       2 – About the same amount of time
       3 – Less time
       4 – Did not drive deer·

18. With the change to concurrent seasons (antlered and antlerless deer together), are you now more likely to buy an antlerless license to hunt on the Sproul? (Circle one)

     1 – YES   2 – NO

19. a. Did the concurrent season change the way you hunted deer? (Circle one)

     1 – YES   2 – NO

   b. If YES, how did your hunting style change? _____

20. a. Did the concurrent season change the way your group or camp hunted deer? (Circle one)

     1 – YES   2 – NO

   b. If YES, how did your hunting style change?

21. a. In total, during the 2002 hunting season, how many people purchased hunting licenses in your household? _____ (number)

   b. How many were Junior license holders?   _____ (number)

22. In the 2002 hunting season, what was the maximum distance you hunted from a paved road in the Sproul?   _____ number of miles (to the nearest tenth)

23. In the 2002 hunting season, what was the maximum distance you hunted from an "open" or non-gated dirt road in the Sproul?   _____ number of miles (to the nearest tenth)

4

101

24. Do you walk gated roads to access your hunting area? (Circle one)

         1 – YES   2 – NO

25. For each of the following statements, please indicate whether or not you agree, using the scale:
(Circle one ranking per statement)

         1 = STRONGLY DISAGREE (SD)
         2 = DISAGREE (D)
         3 = NEITHER AGREE NOR DISAGREE (N)
         4 = AGREE (A)
         5 = STRONGLY AGREE (SA)

		SD	D	N	A	SA
a.	Public lands are more heavily hunted than private lands.	1	2	3	4	5
b.	Public lands have higher deer densities than private lands.	1	2	3	4	5
c.	Public lands have higher hunter success rates than private lands.	1	2	3	4	5
d.	I hunt with the goal of harvesting an antlered deer only.	1	2	3	4	5
e.	The number of deer has no effect on plant and animal communities.	1	2	3	4	5
f.	There is enough public hunting land in PA to provide access to anyone who wants to hunt.	1	2	3	4	5
g.	The quality of the hunting experience is higher on private lands than it is on public lands.	1	2	3	4	5
h.	Posting of private land has made it more difficult for me to find a place to hunt.	1	2	3	4	5
i.	Over time, deer hunting pressure has decreased in the places I hunt.	1	2	3	4	5
j.	It has become increasingly difficult for me to find a good place to hunt deer.	1	2	3	4	5
k.	Deer damage to forests in Pennsylvania is a problem.	1	2	3	4	5
l.	Keeping deer populations in balance with natural food supplies is necessary.	1	2	3	4	5
m.	I don't really care if I shoot an antlered or antlerless deer as long as I get a deer.	1	2	3	4	5
n.	Posting has restricted my access to hunting on private lands.	1	2	3	4	5
o.	Deer cause serious conflicts with other land uses, such as forestry, farming, highways, and other development.	1	2	3	4	5
p.	I would rather harvest a doe than no deer at all.	1	2	3	4	5
q.	The higher the deer population, the better my hunting experience.	1	2	3	4	5
r.	I hunt to harvest a trophy antlered deer.	1	2	3	4	5
s.	I can have a satisfying day of hunting without harvesting a deer.	1	2	3	4	5
t.	I can have a successful season of hunting without harvesting a deer.	1	2	3	4	5
u.	The number of deer has no effect on forest regeneration.	1	2	3	4	5

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26. How important, would you say hunting is to you: (Circle one)

Very Important	Important	Slightly Important	Neither Important, Nor Unimportant	Slightly Unimportant	Unimportant	Very Unimportant
1	2	3	4	5	6	7

27. Using a scale ranging from 1 *(not at all crowded)* to 9 *(extremely crowded)* on an average hunt in the Sproul, how crowded do you usually feel? (Circle one)

```
  1        2       3       4       5       6        7       8        9
Not at all        Slightly              Moderately                Extremely
Crowded           Crowded               Crowded                   Crowded
```

28. How important are each of the following reasons for your participation in hunting – is each very important, important, neither important nor unimportant, unimportant, or very unimportant? (Circle one ranking per statement)

```
1 = VERY IMPORTANT (VI)
2 = UNIMPORTANT (U)
3 = NEITHER IMPORTANT NOR UNIMPORTANT (N)
4 = IMPORTANT (I)
5 = VERY UNIMPORTANT (VU)
```

		VI	U	N	I	VU
a.	To get outdoors.	1	2	3	4	5
b.	To get away from my everyday routine.	1	2	3	4	5
c.	To obtain venison.	1	2	3	4	5
d.	To get a large antlered deer.	1	2	3	4	5
e.	The challenge of hunting deer.	1	2	3	4	5
f.	To test my outdoor skills.	1	2	3	4	5
g.	To be with my friends.	1	2	3	4	5
h.	To be with my family.	1	2	3	4	5
i.	To return to traditional hunting spots.	1	2	3	4	5
j.	To help manage the deer population.	1	2	3	4	5

29. Who was **primarily** responsible for teaching you how to hunt deer? (Circle one)

```
1 - Parent
2 - Other relative
3 - Peers
4 - PGC hunting education course
5 - Hunting camp companion
6 - Friend
7 - Learned on my own
8 - Media sources
```

30. a. Which sources do you most often rely upon to get your news/information about Pennsylvania hunting-related issues? (Circle all that apply)

```
1 - Television
2 - Radio
3 - Newspapers
4 - Organization newsletters
5 - Hunting magazines
6 - Internet
7 - Talking to others
8 - PGC Website
9 - The hunting regulation booklet
10 - Other (please specify) _____
```

b. Of those you identified above as relying upon **most often**, which is the most important source?

_____

6

103

For the next few questions, we are interested in learning about what you do with the deer you harvest.

31. Who uses most of the venison from the deer you harvest? (Circle <u>one</u>)

1 - Your household
2 - Other family members
3 - Other hunters
4 - Friends
5 - Charities
6 - Whoever will take it

32. a. If you could purchase additional **antlerless** permits, how many **antlerless** deer would you seek to harvest in a year? _____ (number of deer)

b. How many antlerless permits would you purchase to hunt on the Sproul? _____ (number of permits)

Finally, we need to ask a few questions about you and your household. This information, as with all information provided in this survey, will be used for statistical analysis only and will remain strictly confidential.

33. In what year were you born?   19___

34. What is the highest level of formal education that you completed? (Circle <u>one</u>)

1 - Did not complete high school
2 - Completed high school or equivalent
3 - Some college or vocational training
4 - Completed college degree
5 - Graduate or professional training beyond college degree

35. a. How many people, including yourself, live in your household? _____ (number)

b. How many are under 18 years of age? _____ (number)

c. How many are over 65 years of age? _____ (number)

36. Would you say your health is: (Circle <u>one</u>)

1 – Excellent   2 – Good   3 – Fair   4 – Poor

37. How much difficulty do you have doing the following? Do you have a "great deal of difficulty," "some difficulty," or "no difficulty"? Circle **one** answer for each question.

How much difficulty do you have:	Great deal of Difficulty	Some Difficulty	No Difficulty
a. Going up and down stairs	1	2	3
b. Kneeling or stooping	1	2	3
c. Lifting or carrying objects less than 10 pounds, like a bag of groceries.	1	2	3
d. Using your hands or fingers	1	2	3
e. Seeing, even with glasses	1	2	3
f. Hearing	1	2	3
g. Walking	1	2	3

38. What is your zip code? _____

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39. How would you describe your current place of residence?

      1. Large city

      2. Medium-sized city
      3. Small city
      4. Suburban
      5. Rural town or village
      6. In the country

40. Remembering that your answers are confidential, could you please tell me if your total household income from all sources before taxes in **2000** was more or less than $30,000? (Circle one)

    a.   LESS ? Was it more or less than $15,000?

        1 – LESS   2 - MORE

    b.   MORE ? Was it more or less than $45,000?

        1 – LESS   2 - MORE

41. What is our gender?

        1 - Male   2 - Female

That is all the questions that we have. Thank you for your cooperation.

If you have comments you would like to share about hunting on the Sproul State Forest, or about hunting in Pennsylvania, please use the space below to share them with us.

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PENNSTATE
1855

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