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Deer Hunting on Pennsylvania's Public and Private Lands: A Two-Tiered System of Hunters?

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Recreational hunting is crucial for controlling white-tailed deer populations. Public land is increasingly important as access to private lands declines. However, differences between public and private land hunters remain unknown. Our study of Pennsylvania hunters revealed differences between private and public land hunters that may pose problems for management. Hunters who only hunted public land had lower harvest rates, especially of antlerless deer, spent less time hunting, were less committed to hunting, were more likely to hunt alone, less likely to belong to a hunting camp, and more likely to live in urban areas. They were less likely to believe that high deer populations could damage forest ecosystems, and less willing to harvest antlerless deer. The implications of these findings, in the context of already-declining hunter capacity to keep deer populations in check, and concomitant declining access to private land, are discussed.

Keywords abundant wildlife, white-tailed deer, public land, private land, hunter access, wildlife management, Pennsylvania

Introduction

Deer abundance has become a major challenge for wildlife managers (Warren, 1997). High deer populations can alter forest biodiversity, damage field crops, and increase deer–vehicle collisions and disease transmission (Boyd & Palmer, 1992; Diefenbach, Palmer, & Shope, 1997; Witmer & deCalesta, 1992). Recreational hunting is a crucial factor in the control of deer populations. However, the ability to manage deer populations through recreational hunting is questionable. Riley et al. (2003) point out that the divergence between deer numbers (increasing) and deer hunter numbers (generally decreasing) suggests the implausibility of recreational hunter capacity to continue to effectively manage the deer

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herd (see also Curtis et al., 2000). A small number of hunters, at least under current regulatory frameworks, cannot control large herds of deer. Even the liberalization of seasons and tags issued cannot compensate for small hunter populations, as the vast majority of hunters do not wish to harvest more than two or three deer (Ward, Stedman, Luloff, Shortle, & Finley, 2008). Riley et al. (2003) found that hunters were willing, in the context of unlimited permit availability, to harvest an average of 1.13 antlerless deer each. Although agencies often respond to declining hunter numbers by increasing permit allocations, hunters must be willing to apply for and use the permits (Curtis et al., 2000).

We examined whether trends in hunter access to private lands may make these challenges more acute. Declining access to private land for hunting impedes management capacity in several crucial ways. Using aerial sampling techniques, Diefenbach et al. (2005) discovered large areas of public land with little hunting pressure that acted as deer refuges. Restricted public access through posting may exacerbate this problem, and drive some hunters out of the hunting population. Not having a place to hunt is a key factor mentioned in some hunters' reasons for ceasing participation. Per unit effort, public land may also have lower success rates. A higher proportion of hunters hunting public land may result in less deer being harvested. Public land hunts are generally considered to be lower quality and less satisfying. These factors may also contribute to hunter cessation. Public land hunters may be less committed to hunting, less tied to the place, and less socially rooted in hunting, making them more likely to stop hunting. Public land hunters may not invest the same amount of effort (i.e., time afield) as do private land hunters, which may further contribute to lower harvest rates. Finally, there may be different motivations between public lands and private lands hunters. Private lands hunters, because they have a connection to a particular landscape, may be more likely to view the landscape as a potential manager, and act accordingly. We focus on differences between public and private lands hunters on behaviors, beliefs, and motivations that underpin their effectiveness as managers.

Literature Review

Declines in hunting participation have been well-documented. Although some figures suggest recent stabilization in the big game hunting trends (Duda, Bissel, & Young, 1998), participation has been on a general downward trend (Heberlein & Thomson, 1992, 1997). These trends vary by region (Decker, Brown, & Siemer, 2001); the loss of hunters is especially steep in our study area, the mid Atlantic (Brown, Decker, Seimer, & Enck, 2000).

Explanations for this decline include urbanization; an aging hunter population coupled with poor recruitment and retention of new hunters; an increasing proportion of single parent-headed households; increasing racial and ethnic diversity; and increased posting of private lands that increases the pressure on public lands. Decker et al. (2001) asserted that the "factors most related to hunting desertion are generally social or psychological" (p. 300), noting that structural barriers are not strongly associated with strong potential for hunting desertion (see also Enck, Swift, & Decker 1993). However, much of the decline may be attributable to changes in traditional socialization patterns that occur in rural areas (Stedman & Heberlein 2001). Traditional hunting initiation via primary family, especially in rural areas, is strongly associated with continued participation (Decker, Provencher, & Brown, 1984; Purdy, Decker, & Brown, 1989).

One often overlooked aspect of hunter socialization is the availability of land as the setting for the transmission of beliefs and values. Over 60% of Pennsylvania hunters

reported that posting had restricted their access to private lands (Bhandari, Stedman, Luloff, Finley, & Diefenbach, 2006). Multiple studies demonstrate that access to private lands for hunting is declining (Brown, Messmer, & Decker, 2001; Jagnow et al., 2006; Lauber & Brown, 2000; Responsive Management, 2004a). Nationally, a large proportion of forested land is controlled by private forest landowners, and much of it is non-accessible for hunting. For example, of the 16 million acres of Pennsylvania's forested land, over 12 million acres is privately owned (Pennsylvania Game Commission, 2005). Jagnow et al. (2006) reported that nearly 70% of private landowners in Greene, Pike, and York counties posted their lands and restricted trespassing, hunting, and fishing. These figures mirror other states in the Northeast: in Dutchess County, New York, Lauber and Brown (2000) reported that 63% of the private landowners posted at least part of their property during the 1991–92 hunting seasons. Access is reduced through population growth and land parcelization, which limits access both through cultural change and by parcelizing the landscape to render hunting illegal and/or impractical (Brown et al., 2001). Posting is thus especially common in rapidly growing rural–urban interface areas (Conover & Messmer, 2001; Jagnow et al., 2006).

Despite declining access, the majority (82%) of American hunters hunted on private land at least once during the 2001 hunting seasons (Responsive Management, 2004a). About half (47%) of Pennsylvania 2000–2001 hunting license holders primarily hunted private land over the past five years (Responsive Management, 2004b). Furthermore, hunting continues to occur on many posted lands: in Pennsylvania, Jagnow et al. (2006) reported that hunting occurred on 68% of posted lands. In Dutchess County, New York, Lauber and Brown, (2000) reported that although only 15% of landowners were willing grant deer hunting permission to strangers, most allowed friends, neighbors, and family members to hunt.

It is clear, however, that hunting access is declining, and that social trends suggest a continued decline. This raises several issues crucial to management. Hunters believe that success and satisfaction are lower on public lands than private lands (Luloff et al., 2004). This set of beliefs, however, may not be accurate. Recent studies of Pennsylvania's Sproul State Forest reported that large tracts of this public forest received little or no hunting pressure. Instead, hunters relied on areas accessible to nearby roads (Diefenbach et al., 2005), reducing their success and fueling perceptions of poor hunting. Regardless, "perception is reality," and hunters often prefer hunting on private lands. Brown et al. (2001) revealed that about two thirds of New York hunters would prefer to hunt private lands, based on perceived convenience, quality of habitat, and hunter density. The loss of access to private lands may thus contribute to a decline in hunting participation, further reducing management capacity. The National Shooting Sports Federation (NSSF, 2000) identified loss of access to land as a potentially strong factor in ceasing participation. Responsive Management (2004b) found that a perceived lack of game and perceived lack of access to hunting lands contributed to the decline in the number of hunters in Pennsylvania.

Hypotheses

Access to private lands may be crucial to effective management of abundant species such as white-tailed deer. This study compared two groups of deer hunters: those who hunt public land only and those who also hunt private land. We examined six hypotheses that reflect the ability of hunters to serve management ends. Specifically, compared to private land hunters, public land hunters:

H_1 Have lower harvest rates overall;
H_2 Have lower harvest rates of antlerless deer;
H_3 Are less committed and connected to hunting, (are more likely to hunt alone, less likely to belong to a hunting camp, and more likely to reside in urban areas);
H_4 Have lower overall hunting effort (fewer days spent afield);
H_5 Have beliefs that are less in line with managers' goals of reducing deer populations;
H_6 Have hunting motivations that align with these beliefs: are less willing to harvest antlerless deer and are more motivated by hunting antlered deer only.

Methods

We surveyed hunters in 2003 after the 2002 deer season, and included questions about a range of issues such as hunters' experiences, attitudes, beliefs, field behaviors, and socio-demographic characteristics. The sample was based on names and addresses of hunters who hunted in North Central Pennsylvania, in an area primarily consisting of public land. Our study area encompassed approximately 45,000 ha, and included portions of the Sproul State Forest (Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry [BoF]), and State Game Lands 100, managed by the Pennsylvania Game Commission (PGC). Drive-in hunters were contacted by intercepting vehicles at three access points in the study area on the opening Monday–Wednesday of the rifle deer season (November 26–28) and the following two Saturdays (December 1 and 8). At each station, beginning at 0430 h, uniformed personnel from the DCNR or PGC stopped vehicles entering the study area, and asked the driver whether they were willing to participate in the study. Approximately 50% of those stopped agreed to participate.

The study area has numerous camps on public land leased from the state. We selected camps by randomly choosing a camp on four pre-determined routes and visiting every third camp. If a camp refused to participate, or was vacant, we went to the second camp on the right. All camp hunters agreed to participate in the study. Each hunter was asked to complete a short field survey that included contact information for the follow-up survey (see Stedman et al., 2004) for more detail on the study area and methodology. In total, 427 hunters were contacted via mail and 287 were contacted via phone. The mailed survey yielded 208 responses (response rate = 50%); 170 surveys were completed by phone (response rate = 59%). We used these survey techniques in tandem primarily to gain response from hunters who provided no mailing addresses. Because the results obtained from the mail and telephone surveys did not differ (Luloff et al., 2004) the data sets were merged for analysis.

Our analysis profiled differences between hunters who used *only* public land during at least one of the 2002 deer hunting seasons (i.e., "public land hunters"). Public land categories included Bureau of Forestry lands, Pennsylvania Game Commission lands, the Allegheny National Forest (ANF), and other municipally owned lands. A hunter was considered a "private land hunter" if he or she used private land in any of the four deer seasons (early archery; early muzzleloader; regular firearm; late archery/muzzleloader). Hunting club lands and other posted and non-posted private lands were treated as the private lands. Because the sample of hunters was drawn from a public lands hunt, we therefore cannot describe hunters who *only* hunted on private land. Our comparisons are between two types of public lands hunters: those who hunted exclusively on public land, and those who also hunted on private land.

Our comparison variables included: (a) deer harvest in the previous hunting season (dichotomous measures for whether the hunter harvested an antlered deer, antlerless deer,

both, or neither); (b) hunter effort (measured by number of days afield in each of three seasons); (c) beliefs about the role of deer in forest health; (d) commitment to hunting; and (e) willingness to harvest antlerless deer. Questions about hunting support included several dichotomous items: whether the respondent (f) typically hunted alone; and (g) belonged to or regularly used a hunting camp; and (h) size of place of current residence (rural country, rural town or village, suburban, or city).

Results

Harvest Success

As hypothesized, harvest rates differed between public and private land hunters (Table 1). Nearly two thirds of private land hunters (64%) harvested a deer, compared to 41% of public land hunters ($p < .001$). These differences were primarily associated with the harvest of *antlerless* deer; only for the harvest of an antlered deer only were the groups the same: 14% of public land and 15% of private lands hunters *only* harvested an antlered deer. In contrast, 29% of private land hunters *only* harvested an antlerless deer, compared to 19% of public land hunters ($p < .05$). One fifth (20%) of private land hunters harvested *both* an antlerless and antlered deer, compared to 8% of public land hunters ($p < .001$).

Hunter Effort

The differences in hunter success may be tied to effort. Private land hunters spent more days afield than public land hunters, but only in seasons other than the traditional firearm season. There were no differences in hunter effort between public and private lands hunters during the traditional firearm season (6.0 vs. 5.9 days on average). In contrast, private land hunters spent more days afield than public land hunters in the early (5.8 vs. 3.4) and late (3.4 vs. 1.3) seasons. Past research (Bhandari et al., 2006) demonstrated that hunting effort in seasons *other* than the traditional firearm season is particularly associated with hunter success. From this perspective and that of managers, public land hunters focus their efforts at the "wrong" time.

Hunting Commitment and Social Support

Private lands hunters reported higher levels of hunting commitment. Slightly over half (58%) of public land hunters reported hunting as "very important" ("5" on a 5-point scale*). In contrast, 78% of private land hunters expressed the same level of commitment. Public land hunters' connections to other people and to place (each of which is thought to foster commitment and continued participation) were lower for public land hunters, who were more likely than private land hunters to "typically hunt alone" (59% vs. 40%, $p < .01$). Public land hunters were slightly less likely to belong to or regularly use a hunting camp (79% vs. 87%, $p < .10$).

Urban Versus Rural Residence

The linkage between rural backgrounds and hunting participation suggests that rural people, especially those who come to hunting through traditional rural socialization, are more connected to hunting. Rural residents may have better access to private land resources through their social networks and/or spatial proximity to potential hunting lands.

Table 1
Comparisons of public and private lands hunters

	Public (n = 249)		Private (n = 92)				
	Mean	SD	Mean	SD	t	p-value	Cohen's d
Harvest Success: % harvesting							
% Antlered only	0.14	0.35	0.15	0.36	0.18	ns	—
% Antlerless only	0.19	0.39	0.29	0.46	2.09	<.05	.153
% Antlered and antlerless	0.08	0.27	0.20	0.40	3.18	<.01	.207
% Any deer	0.41	0.49	0.64	0.48	3.86	<.001	.330
Hunting Commitment/Support							
% saying hunting "very important"	0.58	0.49	0.78	0.41	3.46	<.001	.298
% that typically hunt alone	0.59	0.49	0.40	0.50	−3.13	<.01	.128
% used hunting camp	0.79	0.41	0.87	0.34	1.72	<.10	.195
Hunting Effort: n days afield							
Regular firearm	6.01	3.23	5.86	2.96	−0.57	ns	—
Early archery/flintlock/muzzleloader	3.43	6.09	5.79	6.71	3.09	<.01	.933
Late archery/flintlock/muzzleloader	1.34	1.99	3.37	3.63	6.57	<.001	1.21

(*Continued*)

Table 1
(*Continued*)

	Public (n = 249)		Private (n = 92)				
	Mean	SD	Mean	SD	t	p-value	Cohen's d
Place of Residence							
% Rural (Open Country)	0.23	0.42	0.30	0.46	1.35	<.10	.106
% Suburban area/Small town	0.54	0.50	0.57	0.50	0.38	ns	—
% Central City	0.22	0.42	0.13	0.34	−1.94	<.10	146
Hunter Beliefs (1 = sd, 5 = sa)							
Deer numbers have no effect on plant and animal communities	2.12	1.04	1.80	0.95	−2.52	<.01	.425
Deer damage to forests in Pennsylvania is a problem	3.02	1.17	3.43	1.08	2.99	<.01	.387
Keeping deer populations in balance with natural food supply is necessary	4.07	0.77	4.12	0.72	0.55	ns	—
Deer cause serious conflicts with other land uses	3.34	1.06	3.53	1.07	1.49	ns	—
The number of deer has no effect on forest regeneration	2.23	0.93	1.97	0.85	−2.36	<.01	.276
Hunter Motivations (1 = sd, 5 = sa)							
Hunt with the goal of harvesting an antlered deer only	3.09	1.33	2.62	1.17	−2.99	<.001	.420
I don't really care if I shoot an antlered/antlerless deer	2.64	1.20	3.09	1.18	3.08	<.01	.413
I would rather harvest a doe rather no deer at all	2.89	1.29	3.52	1.14	4.14	<.001	.572

Common anecdotes characterize public land hunters as "city folk" who lack access and have little knowledge of the local landscape. This relationship was supported, albeit only modestly. Public land hunters were more likely to live in central cities (22% vs. 13%, $p < .10$) and less likely to live in the open countryside (23% vs. 30%, $p < .10$).

Hunting Motivations and Beliefs

A factor affecting the capacity to keep deer numbers in check is hunters' willingness to adopt the mantle of deer "managers." We explored two interrelated phenomena: (a) hunter beliefs that high density deer populations may potentially result in damage to forest health and (b) hunter willingness to harvest antlerless deer. Among a wider set of belief statements, five addressed the relationship between deer numbers, forest health, and ecological well being. For three of these five statements, private land hunters were more likely to align themselves with the frame of abundance by agreeing that high deer numbers can be problematic. Private lands hunters were less likely than public lands hunters to agree that deer numbers have no effect on plant and animal communities ($p < .01$); more likely to agree that deer damage to forests in Pennsylvania is a problem ($p < .01$), and less likely to agree that the number of deer has no effect on forest regeneration ($p < .01$).

Hunter motivations also differed between the groups. Private land hunters were more willing to shoot antlerless deer and less likely to hunt with the goal of harvesting an antlered deer only ($p < .001$). They were less likely to care whether they shot an antlered/antlerless deer ($p < .01$). Finally, they were more likely to report that they would rather harvest a doe rather than no deer at all ($p < .001$). In summary, not only do private lands hunters have beliefs consistent with that of managers struggling with managing abundance, their expressed willingness to *act* as managers appears stronger as well.

Statistics such as *p* values only communicate the probability that an observed effect is "real," rather than attributable to chance (Vaske, Gliner, & Morgan, 2002). Therefore, for our significant relationships, we use *Cohen's d* (calculated as the difference between group means divided by the standard deviation) to represent effect size. Cohen (1988) suggested rough cutoffs for small (.20) medium (.50), and large (.80) values of *d.* Based on these guidelines, most of our observed differences entail relatively small effects: in the area of harvest success, the percent of hunters harvesting both antlered and antlerless deer ($d = .207$) and the percent of hunters harvesting any deer ($d = .330$) meet the minimally important cutoff. Our questions about hunting commitment and support show similar magnitude. In contrast, the largest differences between public and private lands hunters are seen in hunter *effort*: during early ($d = .933$), and late ($d = 1.21$) archery, flintlock, and muzzleloader seasons. Relatively substantial differences are also seen for some of the hunter beliefs, with *d* ranging from .387 to .572. The effect size analysis thus shows that the largest differences between public and private lands hunters are in hunter effort, followed by beliefs and motivations.

Conclusion and Implications

Hunters' willingness to harvest antlerless deer at needed rates under current regulations is a precondition for keeping the white-tailed deer population under control. Declining hunter access to private lands may be a crucial bottleneck facing wildlife agencies charged with controlling abundant deer populations. The prospects of public lands hunters being able to effectively manage deer populations at levels desired by managers appear fairly bleak. Our study demonstrated that public lands hunters do not harvest as many deer,

especially antlerless deer that are crucial to management. This may be a matter of less hunting effort, negative attitudes toward harvesting antlerless deer, or both. Public lands hunters spent less time hunting, were less supportive of harvesting antlerless deer, and held beliefs not aligned with population control. Based on previous research, they also seem more at risk of dropping out of the hunting population altogether, as they are more likely to come from urban areas and to hunt alone (each of which is associated with the risk of desertion). They express less commitment to hunting, further suggesting this risk. By implication, decreasing access to private lands may exacerbate already-recognized deficiencies in hunter capacity to manage deer.

We recognize that we are using comparative cross-sectional profile data to discuss a potential shift over time (i.e., our research compares current "public land only" hunters with public land hunters who also hunt private land). As such, the differences we see between public land and private land hunters may not mirror what may happen if current private land hunters are displaced to public land (i.e., they may or may not actually change their attitudes and behaviors to reflect current public land hunters). There is likely a strong self selection bias at work as well, as more committed and more successful hunters may exert the additional effort to seek out private land hunting opportunities. It seems ill-advised, however, to discount the possibility that losing a favorite place to hunt may lead to alienation, loss of interest, lack of effort, and eventual desertion from hunting. There may be important implications of our sampling methodology. Our "private lands" hunters spent at least some of their hunting season on public land. While this introduces uncertainty, it is reasonable to assume that because these "private land" hunters also hunt on public land, they may be more similar to public land hunters than hunters who never hunt on public land. It is reasonable to suggest, therefore, that the differences between hunters who only hunt public land and those who only hunt private land might be more dramatic than those we encountered in our study.

Our findings carry strong implications for resource management capacity. Private land hunters appear to be "better" hunters: their harvest rates are higher, and they express greater commitment. This commitment is fostered by their ties to the *land* (Ericsson & Stedman, 2005). Hunters come to care deeply about the places they return to, season after season. Related to this is a second source of commitment: private lands hunters are more *socially* tied to the activity, as reflected in their hunting with others, and as part of hunting camps. Camps in particular conjoin social ties and ties to the land. Hunters with stronger ties to people and place are less likely to cease participation. In contrast, public land hunters seem to be at greater potential risk of desertion. Although they *may* return to the same public lands areas year after year, their use is non-exclusionary, and as a result, they may not feel as rooted.

The management implications of differences between public and private lands hunters identified in this study are not limited to the risk of participation cessation. These two groups are not equal when it comes to their effectiveness as "managers" from the standpoint of trying to control over-abundant deer herds. Private land hunters not only kill more deer, but they also are disproportionately likely to harvest antlerless deer. Their willingness to harvest antlerless deer is based in part on their recognition of the damage that deer can inflict. These findings may also reflect ties to the land. Private land hunters' concerns about deer damage on the lands they hunt may be based in greater familiarity with the land, greater caring about its ecological health, and the belief that their actions may affect its health. Public land hunters do not seem to share these views, perhaps because they cannot exclude other hunters, and hence have less control over the landscapes they hunt.

These findings suggest that increased posting of private lands may be a more serious threat to hunter capacity to manage wildlife than previously considered. Strategies to mitigate the effects of posting often focus on public lands as potential outlets for displaced hunters. Resource managers emphasize land acquisition to offset the loss of private lands opportunities. While we do not wish to undermine those who seek to expand the public domain, our results suggest that this approach may have distinct drawbacks, given the differences we observed. We cannot say for certain that hunters displaced from private land would, over time, take on the characteristics of public lands hunters. Answering this question would require longitudinal panel data. The cross-sectional differences, however, between the two groups are striking.

If public lands hunters are in some danger of ceasing participation, a greater management burden may fall on remaining hunters, or management agencies will need to use strategies other than recreational hunting to control wildlife populations. These findings suggest several potential policy strategies. Foremost are efforts to ensure continued access to private lands, although Jagnow et al. (2006) noted that those seeking to influence landowner posting behavior have relatively few public policy options available. We are somewhat skeptical of conventional calls for educating hunters about how to behave responsibly and about the potential negative impacts of abundant deer populations on forests. There are broad social forces at work that have displaced and may continue to displace hunters from private lands that they know well, care about, and hunt on with friends and family. Although education and hunter incentive programs to harvest additional antlerless deer may be helpful, we believe that the focus should be on understanding broader trends, their impacts on managers' ability to manage deer populations through traditional means such as recreational hunting, and generating potential alternatives to these approaches.

Note

* Because such a high proportion (well over half) of our sample responded with the highest level of commitment, this item was collapsed into two categories: those who indicated the highest level of commitment and those who did not.

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