Opinions and Preferences of Arkansas Deer Hunters Regarding Harvest Management

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Abstract: State wildlife management agencies use harvest regulations to manage white-tailed deer (*Odocoileus virginianus*) herds at sustainable levels while providing recreational opportunities for sportspersons. State agencies face increasing challenges when managing white-tailed deer because hunter expectations and satisfaction levels vary. Changes in harvest regulations that may influence hunter expectations and satisfaction should be evaluated by state agencies considering alternative management strategies. We conducted a mail survey of white-tailed deer hunters in Arkansas to evaluate opinions of what constituted a "quality deer" and to determine which factors contributed to hunter expectations for an enjoyable deer season. Sixty-six percent of respondents felt that the chance to harvest a mature buck was an extremely important component of an enjoyable hunting season. Forty-four percent of respondents thought the opportunity of seeing deer while hunting was important. We found that 51% of hunters surveyed believed the current antler restriction (i.e., three-point rule) would increase their opportunity to harvest a quality deer. Hunters considered a quality deer to be either a healthy buck with ≥8 points or a healthy doe. We found that hunter-harvest expectations and perceptions of a quality deer were less for those who hunted on public land compared to private land hunters. Expectations increased as respondent education level increased. Our results indicate that deer management strategies should focus on providing opportunity and allow for management flexibility in for hunters on private lands.

Key words: antler restriction, harvest, *Odocoileus virginianus*, regulations, white-tailed deer

Across the United States, hunting has been the fundamental mechanism used by state wildlife agencies (SWAs) for managing white-tailed deer (*Odocoileus virginianus*) populations (Carpenter 2000). In order to reach management goals, SWAs must plan, apply, and evaluate harvest practices that develop and sustain deer populations while maximizing hunter satisfaction. Conflicts arise because hunter satisfaction is often evaluated by SWAs in terms of harvest success (Holbrook and McSwain 1991, Miller and Graefe 2001). Hunter satisfaction may involve additional considerations such as harvest opportunity or hunting frequency, which are beyond the control of SWAs (McCullough and Carmen 1982). Because many white-tailed deer hunters today are inundated in a culture of "trophy harvest" (Green and Stowe 2000, Peterson 2004), expectations of harvest success can be dependent on antler size or other phenotypic characteristics (e.g., number of points, antler spread). However, SWAs typically focus state management more toward larger populations to provide high levels of opportunity. Thus, hunter expectations are often inconsistent with those strategies used by state wildlife agencies.

Recently, SWAs have adopted intensive management regulations to change the frequency and distribution of certain white-tailed deer population characteristics (e.g., age structure, sex ratio, antler structure) to increase hunter satisfaction (Collier and Krementz 2006). In Arkansas, statewide regulations attempt to limit harvest of young male deer by imposing an antler restriction (Carpenter and Gill 1987, Strickland et al. 2001), restricting buck harvest to individuals with ≥3 points on a single beam. The Arkansas Game and Fish Commission (AGFC) assumed that this regulation, when combined with increased harvest of antlerless deer, would cause (1) an increase in male age structure, (2) a decrease in deer density, and (3) an equalization of population sex ratios, thereby producing a higher quality deer herd with a balanced sex ratio and older age structure (Strategic Deer Management Plan 1999). However, the management strategy was not evaluated *a priori* to determine its ability to satisfy the demands of Arkansas deer hunters. The purpose of our research was to (1) determine hunter attitudes towards current white-tailed deer management practices in Arkansas and (2) evaluate which factors contribute to variation in hunter preferences towards type (i.e., buck versus doe) and quality of harvest (i.e., doe, small antlered buck, and large antlered buck).

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Methods

Survey Protocol

In cooperation with the AGFC we developed and tested a pilot survey that addressed various aspects of Arkansas's deer management program (Collier and Krementz 2006). In 2001, we tested the pilot survey by sending an eight-page, self-administered, mail-back questionnaire to a randomly-selected sample of individuals (n = 7,500) who had purchased an Arkansas hunting license during 2000. This pilot study was designed to test methodology and identify areas requiring modification, so we do not include these results.

Based on feedback provided by the pilot survey, we revised several questions, which included adding response options or categories suggested by hunters. In 2002, we sent a revised eight-page, self-administered, mail-back questionnaire to a randomly-selected sample of individuals (n = 15,000) who had purchased a hunting license in 2001. We determined minimum sample size for our 2002 survey using variance estimates from the pilot study and a target coefficient of variation of 0.20 (Zar 1999). Each mailing contained a cover letter describing the study, the questionnaire, and a postage-paid business reply envelope. We sent two follow-up mailings to non-respondents at three-week intervals. In September 2002, we evaluated non-response bias using a two-page, self administered, mail-back questionnaire containing a subset of questions from the original survey instrument (n = 200, approximately 2% of non-respondents).

Question Format

Our questionnaire initially addressed whether an individual hunted white-tailed deer in Arkansas. Individuals who did not hunt deer in Arkansas were requested to return the survey without responding to subsequent survey questions. Because previous work (Collier and Krementz 2006) had shown that deer management intensity varies by property type, respondents that hunted white-tailed deer in Arkansas were classified based on property type they hunted most frequently: deer camp program property (DCP), private lands receiving additional wildlife management assistance from the AGFC, private land, or public land. Respondents were asked to provide general information on the length of time and where they hunted (county and zone) in Arkansas. In addition, respondents were asked to provide opinions regarding public land availability, state white-tailed deer management goals, and basic demographic information.

Using an ordinal scale from one to eight (one = extremely important, eight = not important), we asked respondents to rank their opinions regarding what constituted a quality deer (e.g., buck or doe, buck with big versus small antlers). Using a scale from five to one (five = extremely important, one = not important), respondents were asked to rank the importance of different harvest levels for an enjoyable deer season. For definitions of quality deer, we used the generic term "healthy" combined with an antler structure and sex assignment (e.g., a healthy buck with ≥6 points).

Analyses

We used a single set of predictors (property type hunted, deer management unit (DMU), frequency of hunting) for proportional odds modeling of responses regarding harvest levels necessary for an enjoyable deer season. Because harvest level data were ordinal, we conducted cumulative logit (proportional odds) modeling (SAS 2000) to predict the probability of a respondent providing a rank in one specific category versus another category (e.g., giving a ranking of 1 to harvest a limit of mature bucks and then giving a ranking of 2 to harvest a single mature buck; Agresti 1996, Allison 1999). We checked model goodness-of-fit for the proportional odds assumption by evaluating the χ^2 test statistic, where a non-significant test statistic indicated that the proportional odds model adequately fit the data (Allison 1999).

When evaluating what constituted a quality deer, we used an information-theoretic approach based on Akaike Information Criterion to model selection and inference (Anderson et al. 2000, Burnham and Anderson 2002). We hypothesized five sources of variation could influence hunter opinions on what constituted a quality deer and constructed a set of candidate models to evaluate these sources (Table 1). This candidate model list was created after discussions with AGFC biologists on on biological and social factors likely to influence deer hunter opinions in Arkansas.

We evaluated fit of the global model by evaluating predicted model residuals (Draper and Smith 1998). Due to quasi-complete separation (Agresti 1996) in nearly all response variables, we ranked all scores ≤3 as a success (one) and all scores ≥4 as a failure (zero) and estimated the odds of a respondent providing a rank of one. We predicted what factors caused a hunter to rank a buck with >8 points higher than a doe as a quality deer, and then by comparing in the opposite direction, we predicted what factors cause hunters to rank a doe higher than a buck with >8 points. Rather than present a large set of models having limited plausibility (Flanders-Wanner et al. 2004, Guthery et al. 2005), we present estimated odds for between category comparisons where the 95% CI did not include one (Agresti 1996) from those models with Δ_i <2, and provide model weights ($AIC_{c\,wt}$) to facilitate interpretation of model plausibility (Burnham and Anderson 2002). Because hunters most frequently classified a quality deer in three categories (healthy doe, healthy buck >8 points, healthy buck >10 points), we present model selection comparisons for these three categories.

Table 1. Model number, notation, and description of logistic candidate model with additive main effects used to estimate log-odds between response categories for hunter responses to question on what constitutes a quality deer.

Model No.	Model notation	Model description
1	Π, Contact, DMU, Freqhunt, Education, Local	Log-odds differ by property type[a], deer management unit[b], hunting frequency[c] education level[d] and location lived[e]
2	Π, DMU, Education, Local	Log-odds differ by deer management unit, education level, and location lived
3	Π, DMU, Contact	Log-odds differ by deer management unit and property type
4	Π, DMU, Education	Log-odds differ by deer management unit and education level
5	Π, Education, Local	Log-odds differ by education level and location lived
6	Π, Contact, Education	Log-odds differ by property type and education level
7	Π, Contact, Freqhunt	Log-odds differ by property type and hunting frequency
8	Π, DMU	Log-odds differ by deer management unit
9	Π, Education	Log-odds differ by education level
10	Π, Contact	Log-odds differ by property type
11	Π, Freqhunt	Log-odds differ by hunting frequency
12	Π, Local	Log-odds differ by location lived

a. Property ownership categories—hunting camp property, private property, and public land.
b. Deer management unit categories—Ozarks, Ouachitas, Mississippi Alluvial Plain, and Gulf Coastal Plain.
c. Frequency of hunting—infrequent, active, avid.
d. Education level—low, moderate, high.
e. Location lived—rural, suburban, urban

Results

Response Rates and Respondent Profile

We received 5,496 of 15,000 questionnaires (36%) yielding an adjusted response rate of 37%. Because only seven individuals responded to the non-response bias survey, we were unable to accurately assess non-response bias to our survey. Survey respondents were primarily middle-aged ($\bar{X}$ = 43; SE = 0.20), male (93%), with at least some college education (48%), and most (48%) lived on farms or in rural areas, consistent with data about the Arkansas hunting population (D. Harris, AGFC, pers. commun.), thus we believe that our results were representative of hunters in Arkansas. Respondents to our survey were older (43) than the median age of the Arkansas population (36) and were more likely to be male (i.e., 50% statewide versus 93% in our survey, U.S. Census Bureau 2000). Eighty-two percent of survey respondents hunted white-tailed deer in Arkansas, most of whom hunted private lands (70%).

Harvest Level and Season Enjoyment

Respondents who hunted deer in Arkansas ranked "knowing that the opportunity exists to harvest a buck" as an extremely important aspect of an enjoyable deer season. Seeing deer and harvesting a single mature buck also were important aspects of an enjoyable deer season (Table 2). Few hunters felt that harvesting

Table 2. Respondent frequencies for harvest level necessary for an enjoyable deer season in Arkansas. Ranking levels are from 1 (not important) to 5 (extremely important).

	Ranking levels—n (%)				
Harvest level	**Not important 1**	**2**	**3**	**4**	**Extremely important 5**
Harvest limit of antlered bucks	2,095 (48)	650 (15)	843 (20)	407 (9)	350 (8)
Harvest single mature buck and antlerless deer	1,184 (27)	664 (15)	1,098 (25)	796 (19)	584 (14)
Harvest single mature buck and young bucks	2,426 (57)	799 (19)	621 (14)	253 (6)	181 (4)
Harvest single mature buck	489 (11)	373 (9)	962 (22)	1,075 (25)	1,444 (33)
Harvest single antlered buck	2,046 (48)	719 (17)	859 (20)	352 (8)	304 (7)
Harvest any deer	1,484 (35)	585 (14)	840 (19)	541 (13)	838 (19)
See deer, regardless of size/sex/quality	311 (7)	299 (7)	752 (17)	1,065 (25)	1,923 (44)
Know opportunity exists to harvest a buck	99 (2)	77 (2)	354 (8)	941 (22)	2,904 (66)

a limit of antlered bucks, a single antlered buck, or several young bucks were important aspects of an enjoyable deer season.

Property Type Comparisons

Respondents who hunted on DCP property were on average 1.4 (95% CI = 1.14 – 1.65) and 1.2 (1.06 – 1.31) times more likely to rank harvesting a limit of antlered bucks higher than respondents on public or other private property, respectively. Respondents on DCP property also were more likely to rank harvesting a single mature buck or several small bucks higher than respondents on public property (1.7; 1.4 – 2.1) and private property (1.3; 1.2 – 1.5). Respondents on private property were 1.3 (1.1 – 1.4) times more likely to rank harvesting a single antlered buck higher than those on public property. Deer camp program respondents tended to rank harvesting a single antlered buck higher than respondents on public property (1.8; 1.5 – 2.1) and private property (1.4; 1.2 – 1.5). This group also was 1.7 (1.5 – 2.1) and 1.3 (1.3 – 1.5) times more likely to rank harvesting any deer higher than respondents on public and private property. Respondents from private property were 1.2 (1.1 – 1.4) times more likely to rank harvesting any deer higher than respondents on public property. Respondents on DCP property also were 1.3 (1.1 – 1.5) times more likely to rank seeing deer (regardless of size, quality or sex) higher than respondents hunting public property.

Opinions on Deer Quality

Respondents most frequently defined a quality deer as a healthy buck with >10 points, followed by a healthy doe, and a healthy buck with >8 points (Table 3). Fifty-one percent of respondents felt that it was very likely that the three-point rule would increase

Table 3. Respondent frequencies for opinions on what constitutes a quality deer in Arkansas. Ranking levels are from 1 (most important) to 8 (least important).

	Rank levels—n (%)							
	Most important							Least important
What is a quality deer?	1	2	3	4	5	6	7	8
Healthy doe	1,148 (30)	831 (22)	360 (9)	332 (9)	266 (7)	167 (4)	673 (17)	89 (2)
Healthy buck	778 (21)	363 (10)	286 (8)	246 (6)	321 (9)	862 (23)	734 (20)	108 (3)
Healthy buck (symmetric)	407 (11)	252 (7)	502 (14)	521 (15)	854 (24)	632 (18)	332 (9)	87 (2)
Healthy buck (>3 points)	385 (11)	171 (5)	47 (7)	1,015 (28)	739 (20)	520 (14)	440 (12)	96 (3)
Healthy buck (>6 points)	714 (19)	295 (8)	1,154 (31)	632 (17)	562 (15)	241 (6)	61 (2)	72 (2)
Healthy buck (>8 points)	972 (26)	1,233 (33)	433 (12)	268 (7)	239 (6)	407 (11)	87 (2)	97 (3)
Healthy buck (>10 points)	1,628 (45)	418 (11)	344 (9)	262 (7)	175 (5)	145 (4)	513 (14)	173 (5)
No opinion	316 (24)	7 (0.5)	11 (1)	8 (0.5)	13 (1)	9 (1)	19 (1)	941 (71)

their opportunity to harvest a quality deer. Respondents on public and private property were 1.5 (1.1 – 1.9) and 1.3 (1.1 – 1.7) times more likely than those on DCP property to rank a healthy doe higher than a healthy buck with >8 points as a quality deer (AIC_c $_{wt}$ = 0.79, model seven). Respondents who hunted infrequently were 1.8 (1.2 – 2.7) and 2.1 (1.4 – 3.3) times more likely than respondents who were active or avid hunters to rank a healthy doe higher than a healthy buck with >8 points as a quality deer. Active hunters were 1.3 (1.1 – 1.6) times more likely than avid hunters to rank a healthy doe higher than a healthy buck with >10 points ($AIC_{c\ wt}$ = 0.72, model 11).

Respondents on DCP property were 1.3 (1.1 – 1.7) times more likely than those on public property to rank a healthy buck with >8 points higher than a healthy doe ($AIC_{c\ wt}$ = 0.52; model six), while respondents with a high education were 2.3 (1.8 – 3.0) and 2.0 (1.5 – 2.6) times more likely than those with a low or moderate education to rank a healthy buck with >8 points higher than a healthy doe. Respondents with a high education were 3.1 (2.4 – 4.2) and 2.1 (1.6 – 2.8) times more likely than hunters with a low or moderate education to rank a healthy buck with >10 points as a quality deer ($AIC_{c\ wt}$ = 0.56; model 9). We found no differences in the odds of a hunter ranking a healthy buck with >8 points higher than a healthy buck with >10 points. Respondents from private property were 1.4 (1.1 – 1.7) times more likely than those from public property to rank a quality deer as being a healthy buck with >10 points (model six, $AIC_{c\ wt}$ = 0.80), whereas those with a high education were 1.6 (1.3 – 2.1) and 1.6 (1.2 – 2.0) times more likely than respondents with a low or moderate education to rank a healthy buck with >10 points as higher quality than a healthy buck with >8 points.

Discussion

If the purpose of harvest management strategies is to increase hunter opportunity and satisfaction, then hunter opinions regarding regulations should be incorporated into the decision-making processes. Based on our results, the most frequent definition of deer quality given by respondents relied on antler characteristics. Antler characteristics, however, were not the only criteria used to define deer quality; sometimes harvesting healthy doe was the goal. As noted by Green and Stowe (2000), deer management programs used by SWAs have focused a majority of the promotion on the male segment of deer populations, which could partially explain the pattern suggested by our results of deer quality being related to antler characteristics. However, we acknowledge that because support for game regulations is influenced by hunter harvests (Miller and Graefe 2001), differences in opinions on the antler restriction may be due to factors limiting harvest that are largely independent of antler restriction regulations, such as perceived deer density, available hunting area, habitat characteristics, and hunter densities (Diefenbach and Palmer 1997, Miller and Graefe 2001).

We found that harvest expectations and definitions of quality changed across classification of property. Respondents from DCP properties had higher expectations of quality (e.g., larger antlers) than did hunters on private and public lands, while expectations and opinions of respondents from private lands were higher than those on public lands. Respondents on DCP lands were considerably invested in deer management through the involvement with AGFC personnel (Collier and Krementz 2006), while respondents on public lands have little direct influence on deer management. Investments in hunting locations, such as capital (hunting lodges) or habitat (food plots, native seeding), have been shown to influence harvest expectations (Pope and Stoll 1985, Busch and Guynn 1987, Johnson 1989, Messmer et al. 1998). Thus, it seems likely that being invested in deer management, such as hunters involved with the DCP (Collier and Krementz 2006) would increase harvest expectations, as shown by our results.

Higher levels of education were associated with hunter expectations. We hypothesize this result was tied to the amount money and time hunters could afford to invest in their primary hunting location. Typically, individuals with higher education are invested

in management for white-tailed deer (Woods et al. 1996), and are likely to have a strong utilitarian wildlife values (Zinn 2003). Respondents to our survey were likely to have more college education than the Arkansas population (48% versus 40%, U.S. Census Bureau 2000). Because education is frequently tied to income, respondents with more education were more likely to hunt on private lands involved in the DCP, thus expected a higher return on their investment, which was opportunity to harvest older deer with larger antlers.

A majority of hunters stated that harvest opportunity was the most important factor determining whether they had an enjoyable hunting season. Harvest opportunity is rarely evaluated in hunter satisfaction models, which typically focus on characteristics such as regulations, number of days hunting, management involvement, harvest success, and knowledge (Beattie 1981, Rollins and Romano 1989, Woods et al. 1996, Miller and Graefe 2001). Stankey et al. (1973) and Miller and Graefe (2001) also suggested that harvest opportunity was an important component of hunter satisfaction, where deer seen per unit effort (e.g., Giles and Findlay 2004) could also be used as a measure of opportunity.

Management Implications

State wildlife agencies face increasing challenges when managing white-tailed deer because hunter expectations and satisfaction levels vary, and statewide or even regional management may not meet the expectations of all hunters. As a result, intensive harvest management programs designed to alter deer population size and structure at localized scales have increased (Woods et al. 1996, Collier and Krementz 2006). In Arkansas, deer management on private lands exceeds minimum regulations set by the state agency on nearly 60% of white-tailed deer hunting camps (Collier and Krementz 2006). We suggest that broad-scale harvest management currently in use in Arkansas may not be providing the level and type of white-tailed deer harvest at local scales needed to meet expectations of most Arkansas hunters. Further research into hunter opinions towards quality deer is necessary to assist SWAs with management planning. We recognize that SWAs do not have the ability to manipulate harvest management programs so that expectations of all hunters are reached, but we recommend considering potential impacts on satisfaction and participation when structuring harvest management programs (Fulton and Manfredo 2004). Based on our results, we suggest that managers develop strategies that provide ample opportunity, defined as more available deer, for individuals who hunt public lands yet also provide flexibility in regulations for landowners who are actively managing populations on private lands to ensure that opportunity to harvest higher-quality individuals is available.

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