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Attribute-based analysis of hunters' lease preferences☆

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ABSTRACT

Understanding of hunter preferences for hunting lease attributes is important to landowners because such knowledge provides key information for managing and marketing fee-hunting in order to maximize revenues. Premised on this insight, we used attribute based modeling to investigate how hunter preferences for potential leases were influenced by lease and hunter-specific attributes. A mail survey of Mississippi licensed hunters provided the necessary data. Estimation results based on McFadden conditional logit regression suggested that lease attributes including game diversity, lease location relative to hunter residence, lease size, lease duration and lease rate influenced willingness to pay for additional units of lease attributes. Depending on the specific levels of these attributes, WTP could vary as much as $5.70 per acre. Of the hunter-specific attributes, age and income significantly influenced hunter decision to buy a lease or opt for status quo. Results of this study should assist landowners in increasing financial returns from fee-hunting endeavors through appropriate changes to their hunting access policies and wildlife management activities in response to hunter preferences regarding lease attributes.

1. Introduction

The contribution of hunting leases to forest landowner income is determined in large part by how well they manage and market their lands (Hussain et al., 2007; Munn and Hussain, 2010). A critical input in this regard is an understanding of hunter preferences. Many studies have focused on the determinants of hunter participation (Wallace, 1989; Rossi, 1998) and willingness to pay (WTP) for hunting leases (Pope and Stoll, 1985; Hussain et al., 2004). However, the value of these studies is limited because they determined hunters' willingness to pay for hunting leases as a composite whole but did not derive willingness to pay for various attributes that made up the leases. While these studies are helpful in describing the relative scarcity of hunting land at a broad geographic level, they are not an effective guide for landowners in their wildlife management or marketing decisions.

Attribute based methods, such as choice experiments (Hanley et al., 1998), can be used to determine hunter willingness to pay for lease attributes. These methods are consistent with Lancaster's (1966) consumer demand theory which states that consumers derive utility not from goods themselves but rather from attributes or characteristics that the goods possess. Economists and other researchers have started to realize that for valuation purposes environmental goods (e.g., forest landscapes, open spaces, wetlands, hunting leases, etc.) are best viewed as composite goods with distinct attributes. In natural resource policy settings, the focus is often on appropriate adjustments to specific attributes of interest, rather than the complete loss or preservation of an environmental resource.

The realization that environmental goods may be treated as composites has led to attention on appropriate non-market valuation tools such as attribute based methods (ABMs) which allow estimation of the contribution of each distinct attribute to the total valuation of a good (Holmes and Adamowicz, 2003; Stevens et al., 1997). Unlike the dichotomous choice contingent valuation (DCCV) valuation technique, which treats goods holistically without regards to the contribution of individual attributes, ABMs decomposes the overall judgment of an individual into its basic elements, and make inferences about the importance of each attribute and the psychological tradeoffs performed by the individual during the decision making process. The underlying premise of ABMs is that by providing individuals with a set of stimuli to choose from, it is possible to make inferences about their preference ordering. As the technique treats the price of a good as just another attribute of the good, many

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potential biases that can arise in valuation are minimized (Haab and McConnell, 2002). From an operational point of view, ABMs involve decomposing a composite good into its constituent attributes, surveying respondents regarding their relative preferences for alternative attribute levels, estimating parameters of the utility function via discrete choice methods and quantifying how much an extra unit of a particular attribute is worth to them.

Applications of ABMs have long been routine in marketing (Wittink and Cattin, 1989). During the past decade, they have been used increasingly in agriculture (livestock, horticulture, and fisheries), forestry and wildlife-related fields as well.[1] For instance, using ABMs, Stevens et al. (2000) estimated non-industrial private forest landowner willingness to pay for activities that are compatible with ecosystem management. Employing four different econometric models, including a DCCV logit model, two attribute based analysis models, and a ratings difference attribute based analysis model, they found that attribute based analysis offered several conceptual advantages relative to open-ended contingent valuation, but was sensitive to model specification. Characterizing deer hunting trips as a multi-attribute recreation good, Mackenzie (1990) derived willingness to pay for various attributes associated with deer hunting trips and estimated implied marginal valuation for increased probability of harvesting a deer and the marginal valuation of reduction in travel time. Reddy and Bush (1996) examined buyer perceptions of softwood lumber value for preservation treatment and determined tradeoffs between lumber attributes and price. Zinkhan et al. (1997) analyzed user utility for alternative nature and recreational park designs within a southern pine forest using ABMs. Adamowicz et al. (1998) elicited passive use values relating to caribou preservation by presenting alternative forest management strategies in a multi-attribute setting. Boyle et al. (2001) used various response formats to generate preferences for timber harvesting practices and examined the implied compensating variation of moving from the status quo forest practices to more environmentally benign timber harvesting based on a survey of residents in Maine.

Understanding how incremental changes in hunting lease attributes affect total utility (and hence hunter WTP) is important. This understanding could guide interested landowners and wildlife outfitters to make needed adjustments in their managerial and marketing plans and maximize hunting lease related financial returns. For wildlife outfitters and many landowners, the management decision does not involve whether or not to sell a hunting lease; rather it concerns determining the optimal lease package: which game species to encourage on their lands, whether or not to invest in onsite access roads, how many acres of land to devote to hunting leases, how long the duration of a lease should be, and how much to charge per acre. From a hunter's perspective, the issues are similar: when in the market for a hunting lease, hunters think in terms of the attributes of the lease rather than simply access to the land.

Both from supply and demand side perspectives, the issue at the individual agent level (e.g., landowner, outfitter, hunter, etc.,) is about the optimal mix of lease attributes rather than a lease in itself. To advance our understanding of the hunting lease market in Mississippi, this study focuses on the demand side of the hunting lease market by identifying combinations of lease attributes that hunters prefer. The objectives of this research are to analyze hunter preferences for specific attributes of hunting leases, identify hunters' characteristics that significantly influence the hunting lease decision, and estimate how much a typical hunter is willing to trade off one attribute of a hunting lease for an additional unit of another attribute.

[1] See for instance, Boxall et al. (2003), Gan and Luzar (1993), Gineo (1990), Mackenzie (1990, 1992), Manalo (1990), Reddy and Bush (1996), Teisl et al. (1996), Zinkhan et al. (1997).

2. Methods

2.1. Random utility theory

Random utility theory (McFadden, 1973) provides the theoretical basis for attribute based methods and consistency with utility maximization. Random utility theory assumes that economic agents (n=1,…..N) compare J distinct alternatives (j = 1,…, J) in choice set C on tth occasion and choose the one that provides the greatest level of satisfaction or utility. Formally, let U_{njt} be the nth agent utility index corresponding to alternative j ($j \in C$) on tth occasion. Furthermore, assume the utility index can be partitioned into a systematic component V_{njt} and a random component ε_{njt} reflecting the agent's unobservable tastes. Assuming that the two components of the utility are independent, we can add them up to get (Holmes and Adamowicz, 2003)

$$U_{njt} = V_{njt} + \varepsilon_{njt} \tag{1}$$

While complex functional forms are available, the systematic part of the utility is commonly defined to be linear in taste weights ($\gamma_1, \ldots, \gamma_k$) and additive in attributes (Z_1,…, Z_k)

$$V_{njt} = \gamma_{0j} + \gamma_1 Z_{1njt} + \cdots + \gamma_{k-1} Z_{k-1njt} + \gamma_K Z_{Knjt} \tag{2}$$

Of these attributes, Z_1, …, Z_{k-1} are the non-cost attributes whereas Z_k is the cost attribute of alternative j; γ_{0j} is a constant reflecting the mean impact of unobservable components on utility associated with alternative j; $\gamma_1, \ldots, \gamma_{K-1}$ are coefficients for Z_1, …, Z_{K-1} non-cost attributes and γ_k is the coefficient of the cost attribute. The attributes are assumed to vary by alternative; the taste weights are assumed to be constant across individuals but can vary across alternatives. The key assumption is that individual n will choose alternative i if and only if

$$U_{nit} > U_{njt}, \quad j \neq i \in C \tag{3}$$

2.2. Analyzing discrete choice using standard conditional logit

The stochastic term in Eq. (1) allows probabilistic statements to be made about actual choices. Assuming the choice set C contains $J > 2$ alternatives, the probability that individual n will choose alternative i on occasion t from choice set C (Holmes and Boyle, 2003) is

$$P(i) = P(U_{nit} > U_{njt}) = P[V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt}], \quad \forall j \in C \tag{4}$$

Assuming the stochastic term follows an extreme value type 1 distribution (also known as Gumble distribution) the probability that agent n will choose alternative i from the choice set C is given as,

$$P_n(i) = \frac{\exp(\mu \gamma z_{in})}{\sum_{j \in C} \exp(\mu \gamma z_{jn})} \tag{5}$$

where μ is scale parameter. Letting N represent the sample of individuals, the likelihood function for the standard conditional logit model is

$$L = \prod_{n=1}^{N} \prod_{i \in C} P_n(i)^{y_{in}} \tag{6}$$

where $y_{in} = 1$ if individual n chooses alternative i, else 0. Substituting Eq. (5) in (6) and taking the natural logarithm, the choice model is estimated by finding values of γ_s that maximize

$$\ln L = \sum_{n=1}^{N} \sum_{i \in C} y_{in} \left(\mu \gamma z_{in} - \ln \sum_{j \in C} \exp(\mu \gamma z_{jn}) \right) \quad (7)$$

2.3. Quantitative measures of tradeoffs between attributes

Parameter estimates based on ABMs can be used to calculate willingness to pay measures for improvements or decrements in utility. The total derivative of Eq. (2) with respect to changes in a non-cost attribute Z_{k-1} and cost attribute Z_k is given as $dV_{njt} = \gamma_{K-1}\, dZ_{K-1} + \gamma_k\, dZ_k$. Setting this expression equal to zero and solving for dZ_k/dZ_{K-1} yields the expression for willingness to pay (WTP), i.e., the change in cost that keeps utility unchanged given a change in Z_{K-1}:

$$\frac{dZ_k}{d\bar{Z}_{K-1}} = WTP_{K-1} = -\frac{\gamma_{K-1}}{\gamma_k} \quad (8)$$

As the standard conditional logit model is estimated using maximum likelihood, the coefficients in the model are asymptotically normally distributed. This implies that the distribution of willingness to pay (being a ratio of two normally distributed variables) is approximately normal when the coefficient of variation of the denominator variable is negligible, and provides the rationale for constructing confidence intervals for willingness to pay (Hole, 2007).

2.4. Analyzing discrete choice using general conditional logit

The standard conditional logit cannot include person-specific attributes because any attribute which does not vary across choices (e.g., age, income, etc.,) fall out of the expression for probability (Greene, 2007, pp. N11.9–N11.11). The general conditional logit model adds person-specific attributes (x_n) by interacting them with dummies for J-1 alternative-specific constants (ASC) and entering the resulting interaction variables (ASC*person-specific attributes) as explanatory variables along with alternative-specific attributes. The predicted probability of choosing alternative m is then written as (Long and Freese, 2006, p. 307):

$$\Pr(y_i = m || x_n, z_i) = \frac{\exp(z_{im}\gamma + x_n\beta_m)}{\sum_{j=1}^{J} \exp(z_{ij}\gamma + x_n\beta_j)}, \text{ where } \beta_1 = 0 \quad (9)$$

3. Data sources and variable definitions

3.1. Attributes, levels and hunting lease scenarios

Based on available literature about hunter preferences and a focus group discussion with hunting clubs, landowners, and wildlife professionals, six hunting lease attributes that could be examined in a questionnaire survey were identified as important. These attributes were game diversity, lease location relative to hunter's residence, onsite access, lease size, lease duration, and lease rate per acre (see Table 1 for details). Three levels were specified for each variable.

Of these attributes, game diversity was hypothesized to positively impact a hunter choice of a lease alternative; for instance, hunting leases that had "deer and turkey" were expected to be favored over leases that had only "deer" as a game species, and leases with "deer, turkey and waterfowl" were expected to be favored over leases with "deer and turkey" as game species. Leases located closer to a hunter residence were expected to be favored over leases located farther away; all else equal, hunters would be willing to pay less for a lease located farther away than an otherwise similar lease located closer to hunter residence. Lease rate was expected to impact a hunter choice of a lease alternative negatively. Based on focus group input, onsite access consisting of all-weather roads was expected to positively impact hunter choice. No *a priori* hypotheses were established regarding lease size and lease duration because previous research findings on the subject are mixed at best.

Table 1
Attributes and levels of deer hunting lease sites.

Attribute	Unit	Levels	Hypothesized impact
Game diversity	Number of species	Deer Deer & turkey Deer, turkey & waterfowl	As the number of species increases, hunter valuation of a site increases
Location from residence	Mile	30 60 90	As distance from residence increases, site valuation decreases
Onsite access	Type	ATV trails only Dry weather only roads All weather roads	No a priori expectation about the desirability of a particular lease size
Lease size	Acre	500 500–1000 >1000	No a priori expectation about the desirability of a particular lease size
Lease duration	Year	One Two Three	No a priori expectation about the desirability of a particular lease duration
Lease rate	$/ acre	3 6 9	As lease rate increases, hunter willingness to pay decreases

The insights and information about lease attributes and their levels formed the basis for the creation of orthogonal choice sets. Orthogonal choice sets provide an efficient way of determining the right number of combinations of attribute levels and help avoid inter-correlation of variables. Using SAS OPTEX procedure, the six attributes with three levels each were used to create 50 hunting lease alternatives. Considering the enormous task it would be for respondents to cognitively process this information, the 50 alternatives were randomly divided into 5 blocks of 10 alternatives each. The 10 alternatives were posed to respondents as 5 choice sets, with each choice set containing 2 alternatives, and the option of choosing none of the hunting lease alternatives (see Table 2 for a sample choice set posed to respondents). In effect, each respondent had to make 5 repeated choices, and select the "most preferred option" from each of the 5 choice sets. The alternative "none of the hunting lease alternative" or status quo option was included in each choice set in order to be able to derive measures of willingness to pay for particular attributes (Roe et al., 1996). Operationally, the inclusion of a status quo alternative allows

Table 2
A sample choice set showing a pair of hunting lease alternatives and the option to choose none.

Attribute	Lease A	Lease B	Neither A nor B
Game diversity (species present)	Deer, turkey	Deer	Status Quo
Location (miles from residence)	30	60	
Onsite access roads	ATV passable	Dry weather (dirt roads)	
Lease size (acres)	>1000	500–1000	
Lease duration (years)	1	3	
Lease rate ($/acre)	9	6	
CHOICE (please check one)			

respondents to reject any pair of hunting lease alternatives for whatever reason. For estimation purposes, the attributes were effect coded to avoid confounding of included attribute effect in the model with unobservable effect not accounted for (Bech and Gyrd-Hansen, 2005). Effect coding is similar to dummy coding except that the reference level is assigned −1.

3.2. Sample frame, sample size and survey administration

The sample frame for this study consisted of hunters (resident and non-resident) that purchased Mississippi state hunting licenses during 2006 hunting seasons. A random sample of 2000 hunters was obtained from the list of licensees maintained by the Mississippi Wildlife and Fish Department (MWFD), with the relative shares of the resident versus non-resident set in proportion to their shares (i.e., 9:1) in all licensee sales in 2006. To ensure that the survey instrument would realistically elicit data of interest from hunters, a pre-test was carried out and appropriate adjustments made.

The survey instrument had four sections. Section I began with a set of warm up questions relating to hunters' hunting experience, attitudes towards the quality of hunting on public and private lands (in terms of game diversity and abundance, and hunter congestion), how often they hunted last season, and alternative hunting access options (i.e., if they hunted family land, friends' land, private lease land, and/or public land last season). The remainder of Section I specifically focused on lessee hunters, club membership, number of leases purchased (individually and through hunting club membership), and attributes of leases (i.e., game diversity, location relative to hunter residence, onsite access, lease size, lease duration, and rate per acre). Section II was devoted to the choice experiment: each respondent was asked to choose the most preferred option from each of the 5 choice sets. The last section of the survey asked questions about hunter socioeconomic characteristics (age, education, residence, employment status, number of dependents, and income). Following the pre-test, hunters were mailed the self-administered questionnaire. The survey procedure included three survey mailings and a reminder post card for a total of four mailings if hunters did not respond to the first or second mailed survey. The 1st mailing was sent on Feb 26, 2007 followed by the post card a week later. The 2nd mailing was sent on March 19, 2007 and the 3rd mailing on April 16, 2007. Each mailing included a cover letter, the questionnaire, and a postage-paid reply envelope.

4. Results

A total of 811 hunters responded suggesting a response rate of 41%. However, not all of the surveys were usable; only 643 hunters (or 32%) provided all the requested information in the survey. Descriptive statistics of hunter-specific attributes are reported in Table 3. Sample respondents had average age of 43 years. Sixty-seven percent identified their residence location as rural. Average annual household income was $74,000, well above the Mississippi state average. A majority of hunters (i.e., 86%) had access to public lands or free access to private lands, and 70% perceived public lands to be crowded compared to private lands. On average, hunters made 25 hunting trips during the 2006 hunting season.

In terms of the choice decision, 81.5% of respondents chose one of the two lease options, alternative A or B. As the attributes of the choices were randomly assigned, we would expect the preference for A and B to be similar. This was indeed the case; 39.4% chose alternative A and 42.1% chose alternative B. Only 18.5% opted for status quo; these hunters would rather do other things (or stay with their current hunting access options) than choose the alternative leases provided in the choice experiment. Given that only 37% of respondents actually purchased leases, the number of respondents who chose alternative A or B (i.e., 81.5%) suggests that there might be potential for additional leasing provided the appropriate mix of attributes is made available to them.

Table 3
Descriptive statistics of hunter-specific attributes used in the analysis.

Variable	Mean	Std. dev	Min	Max
Age (years)	43.32	12.55	16.00	78.00
Residence (Rural = 1)	0.67	0.47	0.00	1.00
Income ($000)	74.03	34.14	35.00	147.50
Access options (Yes = 1)	0.86	0.35	0.00	1.00
Opinion about Crowding (Yes = 1)	0.70	0.46	0.00	1.00
Avidity (# of trips in previous season)	25.04	21.86	1.00	150.00
Lessees	0.37	0.48	0.00	1.00
Percent choosing hunting lease alternative A	39.41			
Percent choosing hunting lease alternative B	42.08			
Percent choosing status quo option	18.51			

4.1. Estimation results

Results of the standard and general conditional logit are reported in Tables 4 and 5. Estimates of willingness to pay and associated 95% Krinsky–Robb confidence intervals for both models are reported in Table 6. The Wald chi-square statistics for the standard and general conditional logit suggest that all of the included attributes significantly influence hunter preferences. However, the *R*-squared statistic of 0.15 for the general conditional logit (Table 5) compared to the 0.14 for the standard conditional logit (Table 4)

Table 4
Parameter estimates of hunters preferences for lease attributes based on a standard conditional logit model.

	Coef.	Std. err.	P>|z|	Odds[a] ratio	%Chg	WTP
Design variables						
Game diversity						
Deer & turkey	0.23	0.05	0.00	1.25	25.48	1.10
Deer, turkey & waterfowl	0.17	0.05	0.00	1.18	18.15	0.81
Location from residence (miles)						
60	−0.03	0.04	0.45	0.97	−3.08	−0.15
90	−0.57	0.05	0.00	0.57	−43.28	−2.76
Onsite access						
Dry weather (dirt)	−0.05	0.05	0.30	0.95	−4.64	−0.23
All weather (gravel)	0.01	0.04	0.74	1.01	1.28	0.06
Lease size (acres)						
500–1000	0.20	0.05	0.00	1.22	22.35	0.98
>1000	−0.03	0.04	0.53	0.98	−2.49	−0.12
Lease duration (years)						
2	−0.04	0.04	0.32	0.96	−4.18	−0.21
3	0.18	0.04	0.00	1.19	19.21	0.86
Lease rate ($/acre)	−0.21	0.01	0.00	0.81		
ASC_{sq}[b]	−137.03	98.63	0.17			
Summary statistics						
Log-likelihood	−3016.16					
Wald $\chi^2(12)$	489.71					
R-squared	0.14					
Number of observations	9645					
Sample size	643					

[a] Deer is the omitted level for game diversity and 30 miles, ATV, 500 acres, and 1 year are the omitted levels for location, onsite access, lease size, and lease duration respectively.
[b] ASC_{sq}, Alternative-Specific Constant corresponding to the status quo option.

Table 5
Parameter estimates of hunters preferences for lease attributes based on a general conditional logit model.

	Coef.	Std. err.	$P>\|z\|$	Odds[a] ratio	% Change	WTP
Design variables						
Game diversity						
Deer & turkey	0.24	0.05	0.00	1.27	26.54	1.14
Deer, turkey & waterfowl	0.16	0.05	0.00	1.17	17.06	0.76
Location from residence (miles)						
60	−0.02	0.04	0.56	0.98	−2.39	−0.12
90	−0.58	0.05	0.00	0.56	−44.12	−2.82
Onsite access						
Dry weather (dirt)	−0.05	0.05	0.29	0.95	−4.78	−0.24
All weather (gravel)	0.02	0.04	0.68	1.02	1.60	0.08
Lease size(acres)						
500–1000	0.20	0.05	0.00	1.22	22.15	0.97
>1000	−0.02	0.04	0.61	0.98	−2.07	−0.10
Lease duration (years)						
2	−0.04	0.04	0.33	0.96	−4.08	−0.20
3	0.17	0.04	0.00	1.19	18.58	0.83
Lease rate ($/acre)	−0.21	0.01	0.00	0.81		
ASC_{sq}[b]	−147.40	98.86	0.14			
Socioeconomic variables						
Age*ASC_{sq}	0.02	0.01	0.00	1.02		
Income*ASC_{sq}	−0.01	0.00	0.01	0.99		
Crowding*ASC_{sq}	−0.09	0.18	0.63	0.91		
Options*ASC_{sq}	0.46	0.25	0.07	1.59		
Avidity*ASC_{sq}	0.00	0.00	0.76	1.00		
Summary statistics						
Log-likelihood	−2989.17					
Wald $\chi^2(17)$	525.37					
R-squared	0.15					
Number of observations	9645					
Sample size	643					

[a] Deer is the omitted level for game diversity and 30 miles, ATV, 500 acres, and 1 year are the omitted levels for location, onsite access, lease size, and lease duration respectively.
[b] ASC_{sq}, alternative-specific constant corresponding to the status quo option.

Table 6
Implied willingness to pay estimates and Krinsky–Robb 95% confidence intervals.

Attribute	Standard conditional logit			General conditional logit		
	WTP	Lower limit	Upper limit	WTP	Lower limit	Upper limit
Game diversity						
Deer & turkey	1.10	0.60	1.61	1.14	0.64	1.64
Deer, turkey & waterfowl	0.81	0.36	1.26	0.76	0.31	1.21
Location from residence (miles)						
60	−0.15	−0.54	0.24	−0.12	−0.51	0.27
90	−2.76	−3.36	−2.16	−2.82	−3.43	−2.21
Onsite access roads						
Dry weather (dirt)	−0.23	−0.67	0.21	−0.24	−0.68	0.20
All weather (gravel)	0.06	−0.30	0.42	0.08	−0.28	0.44
Lease size (acres)						
500–1000	0.98	0.54	1.42	0.97	0.53	1.41
>1000	−0.12	−0.50	0.26	−0.10	−0.48	0.28
Lease duration (years)						
2	−0.21	−0.62	0.20	−0.20	−0.61	0.21
3	0.86	0.46	1.25	0.83	0.43	1.23

suggests that the inclusion of hunter-specific attributes does not make much difference in improving the log-likelihood. The negative sign on the alternative-specific constant for status quo (ASC_{sq}) suggests that "hunting lease alternatives A and B in the experiment" are preferred over the status quo.

4.1.1. Alternative-specific attributes

All the hunting lease attributes except onsite access are significant, and the attributes game diversity, location relative to residence, and lease rate have *a priori* hypothesized signs. The reported standard errors are adjusted for intra-respondent correlation across choice sets. Given the panel nature of respondent-specific data and the potential for correlations across choice sets, standard errors needed to be adjusted. Unadjusted standard errors are generally biased downwards and provide misleading signals about parameters statistical significance (Baum, 2006, pp. 138–139; Hardin and Hilbe, 2007, p. 319).

Regarding hunter preferences for lease attributes, results indicate that lease alternatives that include turkey in addition to deer are preferred over otherwise similar alternatives that have only deer as a species to hunt. Likewise, alternatives having deer, turkey and waterfowl are preferred over alternatives with only deer. The associated odds ratios provide a better sense of the strength of preference for game diversity; hunting lease alternatives that have deer and turkey are 25% more likely to be preferred over alternatives that have only deer to hunt; likewise, hunting lease alternatives that have deer, turkey and waterfowl are 18% more likely to be preferred over alternatives that have only deer as a species to hunt. Expressed in monetary terms, hunters would be willing to pay $1.10 more per acre for lease alternatives that have deer and turkey compared to alternatives with only deer to hunt, and $0.81 more per acre for alternatives that have deer, turkey and waterfowl compared to alternatives with only deer to hunt.

The negative coefficients associated with the location attribute suggests that hunting lease alternatives located closer to hunter residence are preferred over alternatives farther away. In particular, hunters have a strong preference against traveling to hunting sites that are located 90 miles away from their residence. All else equal, hunters are 43% less likely to choose these sites compared to similar sites that are 30 miles away from their residence; in monetary terms, they would be willing to pay $2.76 less per acre for these sites. The lack of significance of the onsite accessibility attribute suggests that hunters might be indifferent to the type of onsite access because estimation results do not reveal any systematic patterns about the relative desirability of ATV access only, dry weather or all weather roads. Yet, it is possible that onsite access is a complex variable and difficult to measure than the way the current research visualized.

Results concerning hunter preferences about lease size indicate that 500–1000 acre tracts are preferred over 500 acre tracts. Hunters are 22% more likely to choose these lease alternatives over leases with 500 acre tracts, and would be willing to pay an additional $0.98 per acre for them. However, hunters do not seem to be eager to assign any premium to sites that are larger than 1000 acres. Of the three lease classes differentiated by duration, hunters prefer lease alternatives with 3 years duration compared to one year duration. As suggested by the odds ratio, hunters are about 19% more likely to prefer these over leases with one year duration, and would be willing to pay an additional 0.86 dollar per acre for them. This is understandable given the substantial fixed cost of preliminary scouting activities that hunters incur when they purchase a given lease for the first time.

The WTP amounts expressed above are not trivial. Depending on the specific combination of lease attributes, WTP vary greatly. For example, the marginal WTP for a lease with deer and turkey,

30 miles from the hunter's residence, 500–100 acres in size, and three years contract duration would be $5.70/acre greater than a lease with only deer, 90 miles from the hunter's residence, 500 acres in size, and only one year contract duration.

4.1.2. Hunter-specific attributes

To determine how hunter-specific attributes influenced hunter preferences towards potential lease alternatives versus the status quo option, the standard conditional logit model was expanded to include hunter-specific attributes. Hunter demographic characteristics (e.g., age and income), and other attributes such as hunter perception of crowding on public lands relative to private lands, hunter hunting avidity, alternative hunting access options, and whether or not a hunter was a lessee were also included in the model along with alternative-specific attributes discussed above. Operationally, the procedure involved interacting hunter-specific attributes with alternative-specific constants and including the set of interactions with status quo (ASC_{sq}) as additional variables in the standard conditional logit.

Estimation results reported in Table 5 indicate that an increase in income significantly ($p < 0.00$) decreases the likelihood that a hunter would opt for status quo relative to buying a lease; equivalently, greater income is associated with increased likelihood of buying a lease. In contrast, increase in age has a positive ($p < 0.00$) influence on a hunter's likelihood to opt for the status quo; older hunters are less likely to opt for either of the lease options posed in the survey in favor of the status quo than are younger hunters, all else equal. Having other hunting access options also positively impacts a hunter's decision to opt for the status quo. The other hunter-specific characteristics included in the model (i.e., perceived crowding on public lands, and hunting avidity) were not statistically significant.

Table 6 reports willingness to pay estimates and 95% Krinsky–Robb confidence intervals for the standard and general conditional logit models. The two sets of confidence interval estimates closely resemble each other, suggesting that inclusion of hunter-specific characteristics in the general conditional logit model does not have appreciable impact on willingness to pay estimates. Moreover, confidence intervals for coefficients associated with game diversity levels 'deer and turkey', and 'deer, turkey and waterfowl' overlap according to both models. This suggests that hunters are not willing to pay more for hunting lease options that have waterfowl as a game species in addition to deer and turkey.

5. Discussion and conclusions

The idea that specific attributes of environmental resources are usually of policy interest, not just the resources as a whole, has generated interest in attribute based methods. These methods allow researchers to determine willingness to pay (or accept) for attributes of interest. Based on a choice experiment (a specific attribute based valuation method), this study analyzed hunting lease attributes in Mississippi based on a sample survey of resident and non-resident hunters. The findings of the study confirm certain results reported in previous research, and suggest issues that need additional work.

While hunting lease alternatives that include "deer, turkey and waterfowl" were expected to command a premium over alternatives that have only "deer and turkey," the estimated coefficients suggest the opposite. The coefficients, however, are not significantly different from each other. A potential reason for this unexpected result might be that most areas of Mississippi do not have appreciable waterfowl numbers and areas of the state that have appreciable waterfowl numbers are simply too far away for most hunters. Sample respondents from those areas were probably unwilling to pay a premium for the option of having such low levels of waterfowl included in the lease rights despite survey instructions that hunter valuations were sought for hypothetical hunting possibilities rather than actual conditions on specific hunting sites.

Of the two accessibility attributes, location relative to hunter residence is in agreement with previous findings: the further the hunting site, the lower a hunter willingness to pay (Mackenzie, 1990). An implication of this finding is that landowners located away from population centers would do well by advertising their leases to attract hunters, encouraging game diversity, offering longer term leases, and/or providing larger blocks of land, if available, to offset the comparative advantage of landowners with lands close to population centers. The sign and lack of statistical significance of the 'onsite access' attribute raise questions because the expectation, based on focus group interviews, was that hunters would assign a premium to all-weather roads. A potential reason for this unexpected result may be that hunters confused all weather roads with public roads. Public roads running through the leased property would permit non-lessee related traffic and associated disturbances and possibly even poaching. Such traffic could negatively impact hunting quality. It may also simply reflect the possibility that hunters can typically access most parts of their leases with ATVs so having all weather onsite access does not command a premium.

The idea that lease prices may vary with lease length has only been discussed by Buller et al. (2006). While not directly comparable to findings by Buller et al. (2006), because the objective in that study concerned whether WTP changed as lease length increased from one day to a three day hunting package trip whereas lease duration in the current study is in years, this finding does point to a strong link with willingness to pay. Hunters may prefer longer duration leases to reduce the fixed cost of scouting new leases and reduce uncertainty about their future hunting opportunities.

The issue of appropriate lease size has been under discussion in many studies (Shrestha and Alavalapati, 2004; Zhang et al., 2006; Rhyne et al., 2008). While not directly comparable again because all these studies looked at the issue from a supply side whereas the current study concerns the demand side of the hunting lease market, the finding shows that lease returns are sensitive to lease size. The results here, that leases 500–1000 acres in size are preferred to 500 acre leases, confirm the sensitivity of willingness to pay to lease size. The lack of significance of the coefficient on '>1000 acres' level could be due to ambiguity in this level in our choice experiment. Greater than 1000 acres is essentially unlimited. For a hunter, willingness to pay a specific per acre price depends in large part on the number of acres included in the lease. That is, while a hunter might be willing to pay an additional $1/acre for a 1,001 acre lease, he may be very hesitant to do so for a 10,000 acre lease.

Finally, an important insight of the choice experiment conducted in this study is that there might be a potential for more leasing provided the right mix of lease packages are made available. This result follows because while the actual number of lessees was about 37%, the number of hunters who opted for lease alternative A and B over the status quo was over 80%. To refine this finding, and resolve concerns about game diversity, lease size and onsite accessibility, future research (e.g., using random parameter logit or latent class models) would need to address hunter heterogeneity and its determinants.

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