Forest Policy and Economics 78 (2017) 98–106

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

# Big game hunter preferences for hunting club attributes: A choice experiment

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ARTICLE INFO

*Article history:*
Received 1 August 2016
Received in revised form 16 December 2016
Accepted 13 January 2017
Available online 20 January 2017

*Keywords:*
Hunting leases
Hunter preferences
Nonmarket valuation
Attribute based methods
Wildlife economics

ABSTRACT

Big game hunting on private leased forestland is popular in Georgia and other parts of the southern United States. Very often, the leasing arrangement takes the form of a club, wherein a specified number of members pay an annual fee to either a landowner or the club's manager to have a certain bundle of access rights in accordance with other club regulations or attributes. Currently, little is formally known about hunter preferences for club characteristics. The objective of this study was to identify hunter preferences for attributes related to big game hunting clubs and to derive measures of economic value for these attributes. This was accomplished by conducting a choice experiment (CE) via a mail survey in 2012 of licensed big game hunters in Georgia. The CE presented respondents with alternative hunting clubs representing different combinations of attributes including acreage, membership number, harvest regulations, recent forest management activity, and annual club dues. Responses were analyzed with conditional logit and multinomial probit regression models. Consistent with economic theory, hunters preferred more acreage and fewer members. The least preferred harvest regulation was a one buck limit without size restriction while recent clearcutting was the least preferred forest management activity. Results should provide a better understanding of big game hunters' preferences and trade-offs for club attributes and should help landowners and club managers make management decisions that enhance the value of their resources.



## 1. Introduction

Nationwide, hunting is a popular recreational activity with significant economic impacts and benefits. In 2011, there were an estimated 13.7 million hunters in the United States, up from 12.5 million in 2006 (United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, 2011). As population growth continues, the number of hunters is expected to increase despite a projected per capita participation rate decrease over the next 50 years (Bowker et al., 2012). Total expenditures related to hunting in the United States were estimated at $33.7 billion in 2011, a $8.2 billion increase from 2006 (United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, 2011). In Georgia, there were approximately 392,000 resident and nonresident hunters in 2011 (ranking among the top 12 states) who generated 965 million dollars in total expenditures (United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, 2011). Similar to surrounding southeastern states, nearly 90% of Georgia hunters hunted big game, and roughly 60% of all hunting expenditures were related to big game hunting. Big game hunters typically have various access options such as public land, private leased land, and private non-leased land. For example, most Georgia hunters (76%) exclusively hunted on private land in 2011, while 22% hunted on both private and public land (United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, 2011).

Purchasing a lease or joining a hunting club is a popular alternative for many hunters who lack their own hunting land or prefer an alternative to hunting on public land. In recent decades, the popularity of lease hunting has generally increased. For example, the percentage of forest industry firms in the southern United States that leased to hunting clubs or individuals was 64.5% in 1994 compared to 76% in 1999 (Marsinko et al., 1998; Morrison et al., 2001). In Georgia, the estimated farm gate value of hunting leases for white-tailed deer increased from approximately $72 million in 2002 to $96 million in 2012 (Boatwright and McKissick, 2013; Wolfe and Stubbs, 2013). The popularity of lease hunting demonstrates that hunters are willing to pay for a hunting experience on private land (Hussain et al., 2004). Similar to other purchasing decisions, hunters maximize utility by choosing leases that possess attributes important to them while considering money and time constraints. From the supply perspective, landowners provide fee access opportunities primarily to generate revenue. In addition, landowners

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http://dx.doi.org/10.1016/j.forpol.2017.01.013
1389-9341/

benefit from greater access control and reduced property damage due to trespassing (Marsinko et al., 1992).

Primary and secondary hunting lease markets exist in the United States. With leasing, private corporate and non-corporate landowners sell hunting rights to an individual, a group of people, or to a hunting club (Mozumder et al., 2007). Typically, landowners providing lease opportunities sell access to an entire tract. However, a secondary lease market is present when hunting clubs sell membership opportunities to hunters who are not necessarily interested in, or financially capable of, becoming independent leaseholders. Membership in a club can be more dynamic since hunters often have the opportunity to choose which club(s) to join or leave each season. Hunting club membership dues are typically paid before the beginning of the fall hunting season and are not expressed in dollars per acre. In addition, hunting club members are subject to club rules and bylaws that guide the behavior of club members. Thus, hunting clubs can be considered composite goods that can be broken down into specific attributes. Attribute-based modeling of hunting club choice can be used to assess whether and how hunters value alternative club attributes. The objective of this study was to determine Georgia big game hunters' preferences for various club attributes and to estimate the relative value, or willingness to pay (WTP), associated with each attribute.

While each state possesses unique demographic characteristics and laws governing big game hunting, Georgia is similar to most Southern states in terms of species hunted, hunter access, demographics, and alternatives. In addition, the hunting club membership market in Georgia is generally not centralized or formal and is fairly representative of the market in nearby states.

### 1.1. Factors affecting lease choice and willingness to pay

Attribute based methods have been widely used to examine outdoor recreation preferences. Adamowicz et al. (1994) studied angler site preferences with a choice experiment (CE) and found that attributes such as water quality and fishing success significantly affected site choice. Mackenzie (1990) used a conjoint analysis and found that Delaware deer hunters' site preferences were affected by factors such as travel time, site congestion, and type of hunting companions. In Canada, Boxall et al. (1996) found that hunter access, site congestion, and moose populations significantly affected moose hunter site preferences. Similarly, Boxall and Macnab (2000) found that distance to residence, hunter access, site congestion, and evidence of forestry activity affected wildlife recreationist preferences in Canadian boreal forests. In the southern United States, Hussain et al. (2003) used a conjoint analysis and found that Alabama deer lease hunter preferences were affected primarily by factors such as harvest success and accessibility. Similarly, Hussain et al. (2010) examined preferences for hunting lease choice in Mississippi and found that hunters preferred leases with greater game diversity, closer distance to residence, longer lease durations, and sizes between 500 and 1000 acres.

In addition to attribute based approaches, studies have used methods such as hedonic modeling and contingent valuation to examine hunting lease preferences. A hedonic study of hunting lease revenue in primary market by Hussain et al. (2007) found no significant relationship between lease price per acre and lease size, while Shrestha and Alavalapati (2004) and Rhyne et al. (2009) found that lease price per acre decreased with increasing acreage. Examining hunting club membership dues, Livengood (1983) and Pope and Stoll (1985) found that club dues paid by deer hunters increased with greater lease acreage. Researchers have also found that crowded conditions were not preferred by waterfowl hunters (Gan and Luzar, 1993) and increased the likelihood of Mississippi hunters choosing to opt for private leases over public sites (Munn et al., 2011). Similarly, Hussain et al. (2003) found that Alabama deer hunters preferred lease sites with a smaller likelihood of crowding. Using contingent valuation, Stribling et al. (1992) found that willingness to pay (WTP) for a lease in Alabama did not significantly increase with the opportunity to harvest more than two deer.

Purchasing a hunting lease and purchasing a hunting club membership is not the same decision. Though attribute based methods have been used to examine lease attributes (Hussain et al., 2010; Hussain et al., 2003), similar approaches are needed to analyze hunter preferences for club attributes specifically. Though previous studies identified significant lease site preferences related to factors such as site congestion and game diversity, the effect of different management approaches on lease or club choice has not been examined. It should be noted that the choice set (attributes and their levels) analyzed in our study are more relevant and realistic with the club or secondary lease market. For example, unlike 2 and 3 year durations considered by Hussain et al. (2010), lease duration is rarely over 1 year for most (if not all) of hunting lease markets in the region. Attributes in our choice experiment include more important factors in lease club joining decisions such as number of members, buck harvesting regulations, and forest management activities, none of which were considered in previous studies such as Hussain et al. (2010). The findings of this research should be useful for private landowners and timber companies interested in better understanding hunter preferences and adopting management approaches that can improve the marketability of their clubs or leases.

## 2. Methodology

### 2.1. Choice experiment background

A CE is an attribute based approach to valuation that treats an environmental amenity as a composite good with distinct attributes and attempts to estimate the marginal economic value associated with each attribute (Holmes and Adamowicz, 2003). An application of the characteristics theory of value (Lancaster, 1966), the CE approach assumes that consumer utility is derived from the attributes that a good or service possesses rather than from the good itself. This method can be especially useful in evaluating natural resource policy questions since the focus is often not the complete loss or preservation of an environmental good but rather the appropriate adjustment of relevant attributes that make up the good (Hussain et al., 2010).

There are a number of advantages associated with choosing a CE over other nonmarket approaches. For instance, welfare estimates obtained from contingent valuation approaches may be affected by respondents neglecting to take into account potential alternatives (Boxall et al., 1996). From an operational perspective, a CE can help to avoid the “explicit elicitation” of willingness to pay values and other issues typically associated with contingent valuation method like protest bids and strategic or social desirability bias (Hanley et al., 2001). A CE also provides advantages over revealed preference approaches such as hedonic modeling and the travel cost method. The revealed preference methods rely on examining observed market or consumer behavior, and therefore are relatively free from hypothetical market effects (Hanley et al., 2002). Nevertheless, a CE provides greater flexibility in framing the research question and controlling which attributes are included in the analysis (Ryan et al., 2007). In addition, attribute levels beyond the range of those currently observed in the marketplace can be examined using a CE (Hanley et al., 2002), making CE useful for ex ante policy analysis. However, it should be noted that potential concerns associated with conducting a CE include choice complexity, choice set length, and the potential for strictly dominated alternatives (Hanley et al., 2002).

### 2.2. Study area

This study was conducted in the state of Georgia, United States, where hunters have the opportunity to legally hunt three big game species: white-tailed deer (*Odocoileus virginianus*), eastern wild turkey (*Meleagris gallopavo*), and American black bear (*Ursus americanus*).

However, deer is the most popular game species as 89% of hunters in Georgia pursued deer in 2011, with the largest proportion (87%) of hunting occurring on some form of private land (United States Department of the Interior, Fish and Wildlife Service and United States Department of Commerce, 2011).

### 2.3. Survey and sampling design

A mail survey questionnaire was designed and implemented. A preliminary survey was pilot-tested among hunters, landowners, wildlife biologists, and private wildlife professionals knowledgeable of big game hunting and leasing in Georgia. One of the six sections in the survey asked respondents to indicate their preferred deer hunting club from six choice sets each containing two possible club scenarios. In addition, respondents were asked to provide details regarding their three most visited big game hunting sites in Georgia in 2012. Among the possibilities were hunting clubs, personally leased land, personally owned land, private land with permitted access, and public land such as state wildlife management areas (WMAs).

The sampling frame included all licensed hunters (resident and non-resident) who had big game hunting privileges in Georgia in 2012. A database of 422,663 big game license holders was obtained from the Georgia Department of Natural Resource's Wildlife Resource Division to create the big game hunter sample. Following Paudyal et al. (2015), a stratified random sampling approach was developed to ensure that the sample was representative of the Georgia big game hunter population. This sampling procedure first involved determining the percentage of each of the 16 different big game license types out of the total population. Next, individuals from each license type were randomly selected based on their respective license type's share of the total population. Overall, the allocation of hunters into the sample was very similar to the percentages based on license type. The mailing sample consisted of 3000 licensed Georgia hunters with big game privileges in 2012.

The survey instrument was administered following a modified version of Dillman's Tailored Design Method (Dillman, 2007). The initial mailing consisted of a survey packet containing a personalized cover letter, the questionnaire, and a business-reply prepaid return envelope. The initial mailing was followed with a postcard reminder approximately three weeks later. A final mail-out to non-respondents, including a packet with a follow-up cover letter and a copy of the questionnaire, was sent two weeks after the postcard reminder was mailed. No additional survey mailings or reminders were sent due to budget constraints.

### 2.4. Choice experiment design

A crucial step in designing a CE involves identifying relevant attributes and creating realistic choice scenarios. The present study expands on the previous work (e.g. Hussain et al., 2010) by examining hunting club preferences in Georgia using the following five attributes: club dues, lease size, membership number, recent forest management activity, and buck harvest regulation (Table 1). This list of salient lease attributes was chosen to reduce choice complexity and to make the CE more manageable for respondents (Hanley et al., 2002).

Overall, the levels for the club dues, lease size, and club membership attributes were chosen to reflect realistic dollar per acre lease rates for each lease scenario. Six levels were used for the club dues attribute while three levels were used for the lease size and club membership attributes. Similar to Boxall and Macnab (2000), three levels were established for the recent forest management activity attribute. Considering the current Georgia harvest restrictions and alternative management strategies such as Quality Deer Management (QDM), three levels involving buck harvesting regulations attributes were specified.

The experimental design of the CE was specified using SAS macros (Kuhfeld, 2010). First, given the CE's number of attributes and levels, the number of choice sets needed to obtain reliable parameter estimates was determined to be 18. From a set of candidate factorial designs, the design with the greatest *D-efficiency* was chosen.[1] The use of the *D-efficiency* criterion ensured that the most balanced and orthogonal design possible was specified (Kuhfeld, 2010). Since the computational burden associated with responding to 18 choice sets is fairly high, the 18 choice sets were broken up into three blocks of six. As a result, each respondent specified their club choice from six choice sets. Within each choice set, two hunting club alternatives were presented along with a status quo option (neither club alternative). The status quo option was included to prevent forced choices and to ensure that WTP estimates for each attribute could be estimated (Roe et al., 1996). A respondent may choose the status quo as a default "not to choose" option or may be a legitimate choice if the alternatives presented do not align well with the respondent's preferences (Boxall et al., 2009). The inclusion of a status quo option is common in the CE literature. However, studies do not typically have information from each respondent to determine each individual's actual status quo. If possible, each individual's actual status quo should be retrieved in order to remove any doubt regarding what constitutes each alternative (Pedersen and Gyrd-Hansen, 2013).

**Table 1**
Definitions of choice experiment attributes and hunter specific characteristics used to model the preferred deer hunting club choice of Georgia big game hunters in 2012.

| Variable | Definition<br>Levels |
|---|---|
| *Attributes* | |
| Annual club dues | $440, $480, $520, $560, $600, $640 |
| Lease size | 200 acres, 300 acres, 400 acres |
| Membership number | 6 members, 7 members, 8 members |
| Forest management activity | No management, 50% of lease clearcut, 50% of lease thinned |
| Buck harvest regulation | 1 buck limit with size restriction, 1 buck limit with no size restriction, 2 buck limit with size restriction |
| *Hunter specific characteristics* | |
| Age | Respondent's age (years) |
| Experience | Number of years respondent has hunted big game in Georgia |
| Household income | Respondent's household income ($1000s) |
| Leased land | 1 = hunted on leased land in 2012, 0 = otherwise |
| Own land | 1 = hunted on own property in 2012, 0 = otherwise |
| Public land | 1 = hunted on public land in 2012, 0 = otherwise |
| NLP land | 1 = hunted on non-leased private land in 2012, 0 = otherwise |

Similar to Hussain et al. (2010), hunter specific characteristics were considered to ascertain their correlation with club choice. Specific characteristics included *Age*, *Income*, *Experience*, *Leased land*, and a set of potential hunting access alternatives (*Own land*, *Public land*, and *NLP land*) (Table 1). In the survey, respondents were asked to specify their household income by checking one of seven categories containing different income ranges. For the analysis, *Income* was treated as a continuous variable by using the midpoints associated with each income category (Sun et al., 2015). Following Haab et al. (2001) and Kim et al. (2007), missing *Income* values were imputed using a log-linear ordinary least squares regression of household income on age, education, rural origin, and employment.[2]

In addition to modeling the club preferences of Georgia big game hunters in general, additional models were fit to a sample subset consisting of big game hunters who leased land or were club members in Georgia in 2012. Comparison of parameter estimates from full and reduced sample models could identify differences in preferences between

[1] A "small" variance matrix typifies an efficient design, and the eigenvalues of the parameter estimate variances provide measures of the "size" of the variance matrix. D-efficiency is one approach to quantify efficiency and is a function of the geometric mean of the eigenvalues (Kuhfeld, 2010).

[2] Regression results: ln(Household income) = 10.37 + 0.01(Age) + 0.45(Bachelor's degree) − 0.15(Rural background) + 0.53(Employed full-time); $R^2 = 0.26$

the general big game hunter population and big game hunters who already pay for hunting access rights.

### 2.5. Estimation technique

The theoretical framework associated with choice experiments derives from the Random Utility Model (Ryan et al., 2007). Based on this framework, the indirect utility function for each respondent ($U_i$) contains two components: a deterministic component and a stochastic component (Boxall and Macnab, 2000). The deterministic component ($V$) is specified as a linear index of the attributes ($X$) of the different alternatives ($j$) in the choice set (Hanley et al., 2001). The stochastic component ($e$) represents unobservable influences on choice behavior. Mathematically, the equation can be shown as (Hanley et al., 2002):

$$U_{ij} = V_{ij}(X_{ij}) + e_{ij} = bX_{ij} + e_{ij} \tag{1}$$

The probability of a respondent choosing option $g$ rather than alternative option $h$ can be expressed as the probability of the utility associated with option $g$ being greater than option $h$. This can be demonstrated by the following equation (Hanley et al., 2002):

$$P\left[(U_{ig} > U_{ih}) \forall h \neq g\right] = P\left[(V_{ig} - V_{ih}) > (e_{ih} - e_{ig})\right] \tag{2}$$

Parameter estimation requires that the distribution of the error terms be specified. A typical assumption is that the errors are independently and identically distributed with an extreme value (Weibull) distribution (Hanley et al., 2002). This distribution can be illustrated with the following formula (Hanley et al., 2001):

$$P(e_{ij} \leq t) = F(t) = \exp(-\exp(-t)) \tag{3}$$

As a result, the probability of any alternative $g$ being preferred can be expressed using the logistic distribution (McFadden, 1973). This specification known as the conditional logit model is illustrated as (Hanley et al., 2001):

$$P\left[(U_{ig} > U_{ih}), \forall h \neq g\right] = \frac{\exp(\mu V_{ig})}{\sum_j \exp(\mu V_{ij})} \tag{4}$$

where $\mu$ is a scale parameter. The model can then be estimated using maximum likelihood. As a result, the associated log-likelihood function (Hanley et al., 2001) is described below where $y_{ij}$ is an indicator variable which becomes one if respondent $i$ chooses option $j$ and $N$ is the total number of observations.

$$\log L = \sum_{i=1}^{N} \sum_{j=1}^{J} y_{ij} \log \left\{ \frac{\exp(V_{ij})}{\sum_{j=1}^{J} \exp(V_{ij})} \right\} \tag{5}$$

A concise description of the indirect utility function can be expressed as the linear function of the attributes vector (i.e. $X_1, X_2, X_3, X_4, X_5$) which represent club dues, lease acreage, membership number, recent forest management activity, and buck harvest regulation, respectively. This utility function also includes an alternative specific constant (ASC) dummy variable associated with the status quo option in the choice set (Yoo et al., 2008). The ASC captures the utility of a club alternative that the attributes do not capture (Adamowicz et al., 1994). To incorporate hunter specific characteristics into the model and to determine each characteristic's effect on club choice, the ASC can be interacted with each hunter specific characteristic (Hussain et al., 2010).

Similar to Pedersen and Gyrd-Hansen (2013), different assumptions regarding the status quo option were considered. One approach used the common treatment in the literature where the status quo option was interpreted simply as a preference for neither lease option. The second approach, which incorporated information already in the survey, specified the status quo as each respondent's actual lease choice in 2012. Lease size, membership number, and individual club dues was specified from each hunter's actual lease choice in 2012. For the forest management activity and buck harvest restriction attributes, each hunter's status quo could not be specified since this information was unknown.

Parameter estimates from the estimated CE model can be used to calculate marginal WTP for each attribute in the utility function. Marginal WTP is estimated as (Hanley et al., 2001):

$$WTP = \frac{-b_c}{b_y} \tag{6}$$

where $b_c$ is the coefficient associated with any of the non-price attributes and $b_y$ is the coefficient of the price attribute (i.e. *Club dues*). Confidence intervals associated with marginal willingness to pay estimates can be obtained using methods such as Monte Carlo simulation, the delta method, or the Krinsky and Robb method (Hole, 2007).

An important caveat involving estimation of the choice experiment model is that responses to choice sets must adhere to the Independence of Irrelevant Alternatives (IIA) assumption. This assumption states that "the relative probabilities of two options being selected must be unaffected by the introduction or removal of other alternatives" and comes from the conditional logit's assumed independence of the Weibull error terms across different choice set options (Hanley et al., 2002; Hanley et al., 2001). If the IIA assumption is violated, the conditional logit regression model is incorrectly specified leading to biased and inconsistent coefficient estimates (Kropko, 2007). The IIA assumption can be tested by conducting likelihood ratio tests comparing the full model's results with results obtained when one of the choice alternatives is left out. Hausman tests (Hausman and McFadden, 1984) and a robust method that relies on seemingly unrelated estimation can be used to test the IIA assumption (White, 1996). If the null hypothesis of the assumption is rejected, errors associated with the choice set alternatives are correlated, and the independence assumption underlying the multinomial logit is violated (Ryan et al., 2007). Statistical models that do not assume IIA such as multinomial probit (Hausman and Wise, 1978), nested logit (McFadden, 1980), or random parameters logit (Train, 1998) regression are used when such a violation is apparent. While the mixed logit model is another desirable alternative for analyzing our data, it also suffers from subjectivity in assignment of randomness among variables. For our analysis, multinomial probit was chosen over logit for its ability to allow different degrees of randomness of utility assigned to choice alternatives, and accounting for interdependence among choices (Namakura, 1989, pp. 253).

## 3. Results

### 3.1. Survey responses

Of the 3000 surveys mailed out, 663 were completed and returned, while 280 were undeliverable, netting an adjusted response rate of 24%. This response rate is consistent with several recent surveys that utilized license holders as the sampling frame (e.g., Kyle et al., 2007: 20% in South Carolina; Paudyal et al., 2015: 24% in Georgia; Shideler et al., 2015: 18% in Florida). Since the population of interest was individuals who hunted big game in Georgia in 2012, respondents (100) who did not hunt big game in 2012 were removed from the sample.

Consistent with the general hunter population in Georgia, the resulting sample was overwhelmingly male (94%), white (98%), and non-Hispanic (99%) (Table 2). Most came from a rural background (65%) while nearly a third (32%) possessed at least a Bachelor's degree. Respondents' average age was 51 years while nearly a quarter of the sample (23%) indicated they were retired. The average household income of respondents was just under $80 thousand. On average, hunters had almost 27 years of experience hunting big game. Nearly all

**Table 2**
General sample characteristics collected from a mail questionnaire that targeted licensed big game hunters who hunted big game in Georgia in 2012 (n = 563).

| Variable | Min | Max | Mean | SD |
|---|---|---|---|---|
| *Demographics* | | | | |
| Age | 20.00 | 83.00 | 50.96 | 13.69 |
| Male (%) | – | – | 94.35 | 23.10 |
| Hispanic (%) | – | – | 0.56 | 7.48 |
| White (%) | – | – | 98.36 | 12.72 |
| Bachelor's degree (%) | – | – | 32.36 | 46.83 |
| Rural background (%) | – | – | 64.77 | 47.81 |
| Retired (%) | – | – | 23.13 | 42.21 |
| Employed full-time (%) | – | – | 66.48 | 47.25 |
| NRA member (%) | – | – | 36.91 | 48.30 |
| QDMA member (%) | – | – | 6.92 | 25.41 |
| Household income ($1000s) | 12.50 | 162.00 | 79.73 | 43.33 |
| *General hunting experience* | | | | |
| Years hunted big game | 1.00 | 65.00 | 26.93 | 14.25 |
| Hunt deer (%) | – | – | 99.29 | 8.41 |
| Hunt turkey (%) | – | – | 64.83 | 47.79 |
| Hunt bear (%) | – | – | 10.48 | 30.66 |
| *Hunting site selection in 2012* | | | | |
| Hunted on own land (%) | – | – | 38.37 | 48.67 |
| Hunted on non-leased private land (%) | – | – | 52.40 | 49.99 |
| Hunted on leased land (%) | – | – | 47.32 | 49.97 |
| Hunted on public land (%) | – | – | 33.93 | 47.39 |

respondents (99%) indicated they hunt deer, while 65% indicated they hunt turkey, and 11% indicated they hunt bear. Concerning land access, 38% of respondents hunted on their own land, 47% hunted on leased land, 54% hunted on non-leased private land such as family or friend's land, and 34% hunted on public land.

### 3.2. Choice experiment data and model selection

From the sample of 563 respondents who hunted big game in Georgia in 2012, 497 respondents (88%) fully completed the choice experiment component of the questionnaire. Of three choice set options (A, B, None) presented, Option A was preferred 32% of the time while choice set B was preferred 29% of the time. The status quo option (neither choice set A or B) was preferred 39% of the time. For respondents who hunted on multiple leases, the most frequently visited lease site was considered when specifying each lease hunter's individual status quo option.

Club choice was first analyzed using a conditional logit regression model with alternative assumptions regarding the status quo option. Categorical attributes were effects-coded to ensure that the effect of each attribute level could be estimated (Bech and Gyrd-Hansen, 2005). Effects coding is dissimilar to dummy coding in that the reference category is coded as a −1 rather than a zero. Similar to Boxall and Macnab (2000), attributes related to lease size and membership number were treated as continuous variables for the statistical models. Results from Hausman tests and robust tests indicated that the IIA assumption was consistently violated especially when either club option B or the status quo option was omitted.[3] As a result, multinomial probit regression was used to model club choice and to relax the conditional logit's IIA assumption. Overall, model results were not sensitive to different specifications or samples. Alternative specifications involved removing insignificant variables related to hunter specific characteristics such as hunting experience and household income, or removing each hunter specific characteristic variable altogether. Models were also re-estimated using samples that omitted tails for continuous hunter specific characteristics available (i.e., hunting experience and household income). Each alternative specification produced similar results[4] in terms of the sign and significance of the estimated coefficients.

### 3.3. Choice experiment parameter estimates

For the estimated multinomial probit models, standard errors were adjusted to account for potential intragroup correlation (Hussain et al., 2010). Estimates obtained from all specifications are similar in terms of sign and significance indicating robustness across both treatments of the status quo option (Table 3). Overall, all five club attributes significantly affected the club choice of Georgia big game hunters. Hunters preferred greater lease sizes and fewer club members. The clearcut level of 50% was not preferred by hunters, while the thinned level of 50% had a positive relationship with club choice. The one buck limit with no size restriction level was not preferred by hunters while the two buck limit with size restriction level was preferred. *Club dues* was negative and significant indicating that the likelihood of choosing a club option decreased as hunting club dues increased.

The alternative specific constant associated with the status quo option ($ASC_{SQ}$) was negative and significant indicating that choosing the status quo was preferred significantly less than choosing one of the club options. In addition, the hunter age interaction term was negative and significant suggesting that older respondents were more likely to choose the status quo rather than a club option. The household income interaction term was insignificant suggesting that household income had no effect on choosing the status quo. The hunter experience interaction term was also insignificant indicating that big game hunting experience had no effect on choosing the status quo. The leased land interaction term was insignificant suggesting that being a lease hunter did not significantly influence the decision to choose a club option or the status quo. The interaction terms associated with alternative hunting site types were all insignificant indicating that the availability of lease site substitutes did not influence the decision to choose a club option or the status quo.

### 3.4. Willingness to pay estimates from choice experiment model

Models assuming each individual's actual lease status quo produced WTP estimates of higher absolute value and wider confidence intervals (Table 3). Confidence intervals, at the 95% level, were obtained using the delta method (Hole, 2007). Depending upon the selection of the status quo specification, an average hunter was willing to pay $2.08 to $2.45 more in club dues for each additional acre of lease size. In addition, an average hunter was willing to pay $96.66 to $119.95 less in club dues for each additional club member. The 50% of lease clearcut level had a greater effect on WTP than the 50% of lease thinned level, albeit in opposite directions. An average hunter was willing to pay $83.56 to $99.70 less in club dues if the site recently had 50% of its acreage clearcut. Conversely, an average hunter was willing to pay $50.07 to $54.31 more in club dues if the site recently had 50% of its acreage thinned. Hunters were also willing to pay $107.60 to $130.87 less in club dues if the buck rule was a one buck without a size restriction. In contrast, hunters, on average, were willing to pay $47.82 to $58.97 more in club dues if the buck rule was two bucks with a size restriction.

The club scenario that produced the highest welfare estimate had 400 acres, 6 members, a recent thinning of 50% of the lease's acreage, and a buck harvest regulation consisting of a two buck limit with size restriction. The club scenario that produced the lowest welfare estimate had 200 acres, 8 members, a recent clearcut of 50% of the lease's acreage, and a buck harvest regulation of a one buck limit without size restriction.

[3] For example, when the status quo option was specified as a preference for neither club option, Hausman ($\chi^2 = 39.64$; p-value < 0.001) and robust ($\chi^2 = 41.11$; p-value < 0.001) tests were significant when choice set option B was omitted. Similarly, when the status quo option was omitted, a robust test was significant ($\chi^2 = 97.23$; p-value < 0.001) while the assumptions of the Hausman test could not be met.

[4] Results from alternative specification are not reported here for brevity but are available from authors upon request.

**Table 3**
Georgia big game hunter choice experiment parameter estimates obtained from multinomial probit models based on alternative specifications of the status quo option for lease hunters.

| | Neither option SQ | | Individual SQ | |
|---|---|---|---|---|
| Variable | Coef. (SE) | WTP (95% CI) | Coef. (SE) | WTP (95% CI) |
| Lease size | 0.0046*** (0.0006) | 2.08 (1.40, 2.76) | 0.0002** (0.0001) | 2.45 (1.18, 3.71) |
| Membership number | −0.2121*** (0.0314) | −96.66 (−132.88, −60.44) | −0.0084** (0.0040) | −119.95 (−192.06, −47.83) |
| *Forest management* | | | | |
| 50% of lease clearcut | −0.1834*** (0.0432) | −83.56 (−126.64, −40.49) | −0.0070** (0.0032) | −99.70 (−166.40, −32.99) |
| 50% of lease thinned | 0.1099*** (0.0380) | 50.07 (17.23, 82.92) | 0.0038* (0.0021) | 54.31 (7.53, 101.09) |
| *Buck harvest regulation* | | | | |
| 1 buck without size restriction | −0.2361*** (0.0429) | −107.60 (−155.12, −60.08) | −0.0091** (0.0044) | −130.87 (−215.79, −45.96) |
| 2 buck with size restriction | 0.1049*** (0.0386) | 47.82 (14.36, 81.28) | 0.0041* (0.0023) | 58.97 (6.87, 111.07) |
| Club dues | −0.0022*** (0.0004) | – | −0.0001** (<0.0001) | – |
| $ASC_{SQ}$ | −1.5057*** (0.4107) | – | −0.9521*** (0.3320) | – |
| $ASC_{SQ}$*Age ($\bar{x} = 50.43$) | 0.0176*** (0.0051) | – | 0.0196*** (0.0054) | – |
| $ASC_{SQ}$*Income ($\bar{x} = 79.35$) | −0.0004 (0.0015) | – | −0.0006 (0.0016) | – |
| $ASC_{SQ}$*Experience ($\bar{x} = 26.99$) | −0.0072 (0.0053) | – | −0.0075 (0.0057) | – |
| $ASC_{SQ}$*Leased land ($\bar{x} = 0.47$) | −0.0345 (0.1316) | – | −0.0709 (0.1438) | – |
| $ASC_{SQ}$*Public land ($\bar{x} = 0.34$) | −0.0770 (0.1274) | – | −0.0865 (0.1367) | – |
| $ASC_{SQ}$*Own land ($\bar{x} = 0.39$) | −0.1504 (0.1352) | – | −0.1756 (0.1468) | – |
| $ASC_{SQ}$*NLP land ($\bar{x} = 0.53$) | −0.2176 (0.1324) | – | −0.2258 (0.1426) | – |
| Model fit | | | | |
| Number of observations | 8820 | | 8820 | |
| Sample size | 490 | | 490 | |
| Log-likelihood | −2952.375 | | −2970.206 | |
| Wald chi-squared | 155.760 | | 75.730 | |
| Probability > chi-squared | <0.001 | | <0.001 | |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively. Standard errors are adjusted for intragroup correlation. NLP refers to non-leased private land. Reference levels for categorical variables were no timber management and 1 buck limit with size restriction respectively. $ASC_{SQ}$ indicates the alternative specific constant for the status quo option. WTP confidence intervals were estimated using the delta method. 7 observations were removed from the original sample due to missing data.

### 3.5. Lease hunter subset choice experiment parameter estimates

A lease hunter only dataset was constructed to compare the lease attribute preferences of the general big game hunting population with the preferences of lease hunters. Overall, this subset of data contained a sample of 236 hunters. Three observations were omitted from regression analysis due to missing data. Based on results from Hausman tests and robust tests, the IIA assumption was also violated for the lease hunter only models. As a result, multinomial probit regression was used to relax the conditional logit's IIA assumption. Parameter estimates obtained using different status quo specifications were fairly comparable suggesting robustness across specification type (Table 4). Overall, estimates from the lease hunter model were qualitatively similar to those from the general hunter population model. This result suggests that, in general, big game hunter club preferences were similar to those of existing lease hunters. However, it should be noted that the 50% of lease thinned attribute level was insignificant for lease hunters and the two buck limit with size restriction level was insignificant for lease hunters for one model specification. Similar to the larger sample, lease hunters preferred greater lease sizes and smaller membership sizes. The 50% of lease clearcut level was significant and not preferred by lease hunters. The one buck limit with no size restriction level was not preferred by lease hunters and the two buck limit with size restriction level was preferred but only for one specification. Similar to the larger sample models, the alternative specific constant associated with the status quo option ($ASC_{SQ}$) was negative and significant while the hunter age interaction term was also negative and significant. All of the remaining hunter specific interaction terms were insignificant.

### 3.6. Willingness to pay estimates from lease hunter sample models

Lease attribute WTP estimates from the lease hunter subset choice experiment models were calculated (Table 4). Similar to Hussain et al. (2010) and Juutinen et al. (2011), WTP estimates for insignificant attributes were made and should thus be viewed cautiously. Similar to results involving the general sample models, the lease hunter subset models assuming each individual's actual lease status quo produced WTP estimates of higher absolute value and wider confidence intervals. In addition, compared with WTP estimates from the general population models, estimates from the lease hunter models were of higher absolute value for each significant club attribute. Depending upon the selection of status quo specification, an average lease hunter was willing to pay $2.91 to $3.94 more in club dues for each additional acre. An average lease hunter was also willing to pay $132.85 to $196.11 less in club dues for each additional club member. In addition, an average lease hunter was willing to pay $131.81 to $172.54 less in club dues if the site had a recent 50% clearcut. Hunters were willing to pay $170.61 to $249.86 less in club dues with the size-restricted one buck limit. Alternatively, the average lease hunter was willing to pay $73.53 to $104.50 more in club dues if the two buck limit with size restriction was in place. However, the two buck limit attribute level was insignificant for one model specification for lease hunters.

The club scenario that produced the highest welfare estimate for lease hunters had 400 acres, 6 members, no forest management, and a two buck limit with size restriction. This combination is similar to the best scenario for larger sample of big game hunters. The one exception involves the recent forest management activity attribute. For lease

**Table 4**
Lease hunter subset choice experiment parameter estimates obtained from multinomial probit models based on alternative specifications of the status quo option for lease hunters.

| | Neither option SQ | | Individual SQ | |
|---|---|---|---|---|
| Variable | Coef. (SE) | WTP (95% CI) | Coef. (SE) | WTP (95% CI) |
| Lease size | 0.0052*** (0.0009) | 2.91 (1.09, 4.74) | 0.0002** (0.0001) | 3.94 (−0.79, 8.67) |
| Membership number | −0.2365*** (0.0470) | −132.85 (−221.29, −44.41) | −0.0089** (0.0044) | −196.11 (−451.72, 59.50) |
| *Forest management* | | | | |
| 50% of lease clearcut | −0.2347*** (0.0694) | −131.81 (−235.97, −27.65) | −0.0079** (0.0039) | −172.54 (−406.22, 61.14) |
| 50% of lease thinned | 0.0911 (0.0557) | 51.17 | 0.0026 (0.0023) | 57.33 |
| *Buck harvest regulation* | | | | |
| 1 buck without size restriction | −0.3038*** (0.0659) | −170.61 (−284.79, −56.43) | −0.0114** (0.0055) | −249.86 (−567.43, 67.71) |
| 2 buck with size restriction | 0.1309** (0.0585) | 73.53 (5.53, 141.53) | 0.0048 (0.0030) | 104.50 |
| Club dues | −0.0018*** (0.0006) | – | −0.0001* (<0.0001) | – |
| $ASC_{SQ}$ | −1.3710*** (0.6163) | – | −1.2321*** (0.4457) | – |
| $ASC_{SQ}$*Age ($\bar{x} = 50.76$) | 0.0197** (0.0079) | – | 0.0237*** (0.0085) | – |
| $ASC_{SQ}$*Income ($\bar{x} = 83.12$) | −0.0014 (0.0021) | – | −0.0005 (0.0023) | – |
| $ASC_{SQ}$*Experience ($\bar{x} = 27.28$) | −0.0117 (0.0082) | – | −0.0134 (0.0089) | – |
| $ASC_{SQ}$*Multiple leases ($\bar{x} = 0.11$) | 0.3190 (0.2804) | – | 0.4083 (0.3011) | – |
| $ASC_{SQ}$*Public land ($\bar{x} = 0.26$) | −0.0948 (0.1899) | – | −0.1194 (0.2070) | – |
| $ASC_{SQ}$*Own land ($\bar{x} = 0.27$) | 0.1360 (0.1999) | – | 0.1541 (0.2188) | – |
| $ASC_{SQ}$*NLP land ($\bar{x} = 0.38$) | −0.2051 (0.1844) | – | −0.1884 (0.2029) | – |
| Model fit | | | | |
| Number of observations | 4194 | – | 4194 | – |
| Sample size | 233 | | 233 | |
| Log-likelihood | −1380.518 | – | −1387.288 | – |
| Wald chi-squared | 76.440 | | 39.200 | |
| Probability > chi-squared | <0.001 | – | <0.001 | – |

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively. Standard errors are adjusted for intragroup correlation. NLP refers to non-leased private land. Reference levels for categorical variables were no timber management and 1 buck limit with size restriction respectively. $ASC_{SQ}$ indicates the alternative specific constant for the status quo option. WTP confidence intervals were estimated using the delta method. Three observations were removed due to missing data.

hunters, no forest management was preferred over having 50% of the lease being thinned. The club scenario that produced the lowest welfare estimate had 200 acres, 8 members, a recent clearcut of 50% of the lease's acreage, and a one buck limit without size restriction. This is similar to the lowest welfare producing alternative for the general population of big game hunters.

## 4. Discussion and conclusion

A number of attributes significantly affected club choice. In addition, the club preferences of the larger sample of big game hunters were similar to the preferences of existing lease hunters. However, marginal WTP estimates for lease hunters were consistently higher than estimates for big game hunters in general. Consistent with intuition, and economic theory, hunters preferred clubs with more acreage and fewer members. In addition, the least preferred harvest regulation was a one buck without size restriction, suggesting little or no trophy quality management, while the most preferred regulation was a two buck limit with size restriction. Preferences regarding forest management were mixed. The least preferred forest management option consistently involved a clearcut of half of the lease's acreage. For the general big game hunter population, thinning of half of the lease's acreage was preferred over no forest management. In contrast, lease hunters preferred no forest management over thinning.

Although the number of attributes was limited, the results provide a number of insights regarding hunter preferences for lease attributes. Georgia big game hunters preferred clubs with larger acreage. However, considering this attribute's upper (400 acres) and lower (200 acres) limits, it is not possible to make broad generalizations regarding the effect of lease size on lease choice. One previous lease CE study, Hussain et al. (2010), found that the marginal utility obtained from added lease size likely diminished for larger leases. Within this attribute's relatively narrow limits in this study, hunters were willing to pay approximately $2 to $4 more in club dues for each additional lease acre. This finding indicates that the effect of lease size on hunter WTP for a hunting club is substantial and has implications for landowners. Thus, an average club with 400 acres and 6 members should be willing to pay between $12 and $18 in aggregate for each additional acre it could acquire. To provide context, survey responses showed that the median amount Georgia lease hunters paid in club dues in 2012 was $600. In addition, the median size of club leases was approximately 500 acres, and the median number of club members was seven. The WTP estimates could be useful to industrial and non-industrial landowners who are interested in determining lease sizes that maximize profit for the company's entire land base. Moreover, for smaller landowners, this information could prove useful to the decision of purchasing adjacent land should it become available.

Consistent with previous studies (Gan and Luzar, 1993; Hussain et al., 2003), Georgia hunters preferred clubs with fewer members. Considering the limits specified for this attribute herein, it cannot be concluded that increasing membership at all levels decreases hunter WTP for a club. Similar to the size attribute, the effect of increasing membership on WTP may not be linear. The results of this study showed that the number of club members can have a significant effect on hunter WTP. For instance, hunters were willing to pay roughly $100 to $190 less in club dues for each additional club member. For club managers, an increase in membership can increase revenue but would likely result in diminished hunter satisfaction, all else being the same. It could also be a factor inducing current members to look for substitute clubs or consider hunting public land.

Results also demonstrated that club choice was significantly affected by different forest and wildlife management actions. Hunters preferred

club choices that were not recently managed with large clearcuts. In addition, the less intensive practice of thinning significantly affected lease choice and hunter WTP for the larger sample of hunters, but for existing lease hunters, this attribute was insignificant. Hussain et al. (2007) used hedonic modeling and found that a lease's percentage of cutover forest land negatively influenced lease revenue per acre in Mississippi. Similarly, Boxall and Macnab (2000) found that moose hunters in Canada preferred small, irregular shaped cutovers rather than more intensive forest management activities such as large scale clearcutting. For landowners, the results of this study indicate that harvesting a lease's timber can have a significant effect on hunter WTP for a club. While owners of forestland may obtain the majority of their income from the sale of standing timber, revenue from hunting leases can offset some timberland management expenses (Corriero, 2005). In addition, hunting leases can have a significant effect on forestland values. Hussain et al. (2013) found that the overall capitalization rate of hunting lease income into forestland value was 7.55%. These studies suggest that private forest landowners can use revenue generated from leasing to offset costs associated with management or property taxes. However, for forest landowners who lease to clubs and harvest timber, this study's results indicate that harvesting a site's timber can have a significant effect on hunter WTP for a club.

Results also indicated that hunters preferred more restrictive antler restrictions when a one buck limit was in place. Specifically, hunters preferred a one buck limit with size restriction over a one buck limit with no size restriction. However, in terms of WTP, hunters preferred a two buck limit with size restriction over a one buck limit with size restriction. Overall, these results demonstrate that hunters are likely willing to pay more for deer management approaches that emphasize harvesting mature bucks rather than younger ones. This is consistent with the growing popularity of Quality Deer Management (QDM) and other nontraditional deer management approaches. For instance, from 2010 to 2013, Georgia's percentage of 3.5 year old antlered deer harvested out of the total number of bucks harvested increased from 20% to 31% (Adams and Ross, 2015). In addition, the number of antlerless deer harvested in Georgia increased by 14% from 2011 to 2013 (Adams and Ross, 2015). Results also indicate that hunters may be willing to consider more restrictive statewide harvesting regulations, at least on leased land. Though wildlife policy changes are dictated by many factors other than hunter preferences, the results could be useful for wildlife officials in Georgia and other states or regions.

Preferences for club attributes were qualitatively similar between big game hunters in general and those who already lease. While the two samples had similar club attribute preferences, lease hunters attached greater value to each club attribute. Hunter characteristics had little effect on club choices. The choices of hunters were not influenced by alternative hunting sites with the lone exception involving non-leased private land such as land owned by friends or relatives. For big game hunters in general, respondents were less likely to choose the status quo option if they hunted on non-leased private land. Conversely, Hussain et al. (2010), found that possessing hunting site alternatives had a positive effect on choosing the status quo option. Similar to Hussain et al. (2010), younger hunters were more likely to choose the status quo. However, in contrast to Hussain et al. (2010), household income had no significant effect on club choice. Focusing on hunting site trip demand, travel cost studies have also found negative coefficients involving income (Balkan and Kahn, 1988; Creel and Loomis, 1990). The effect of income is likely complex and could potentially be related to a two-step process first involving participation (Bowker et al., 2012). For instance, Rockel and Kealy (1991) found that income positively influenced wildlife watching participation, but did not affect wildlife watching trip demand.

In addition to identifying hunter preferences for club attributes, this study makes a methodological contribution by accounting for each lease hunter's actual individual status quo in the choice experiment. Though the inclusion of a status quo option is common in the CE literature, information from each respondent is often unavailable to determine the actual status quo for each individual. This information can be useful in removing any doubt regarding what constitutes each alternative. Pedersen and Gyrd-Hansen (2013) examined this aspect of the status quo option, but more applications involving various treatments of the status quo option could be beneficial. Results from this study for both status quo specifications were similar suggesting robustness. However, it should be noted that WTP estimates obtained using the traditional treatment of the status quo option common in the literature were more conservative. If possible, future studies should consider the effect of different specifications of the status quo option.

Despite the contributions made by the current analysis, a few limitations should be noted. First, private landowners who hunt only on their land are not required to possess a hunting license and were thus omitted from the sample. This limitation likely impacted the study's sample but could not be realistically avoided. Second, the levels for both the lease size and membership number attributes may not precisely reflect the wide range of lease options available to most lease hunters in Georgia. Summary statistics from a separate portion of the same survey indicated that the median club size in Georgia was approximately 500 acres while the median membership size was seven members. As a result, it would be imprudent to make far reaching inferences regarding the results of the lease size and membership number attributes. Similar to previous studies, the choice experiment contained a small number of attributes to ensure that the choice sets were manageable for survey respondents. Despite the small number of attributes used, the study identified management specific preferences with practical implications for landowners and club managers.

## Acknowledgment

Authors would like to acknowledge funding support from USDA Forest Service, Southern Research Station, and University of Georgia's Office of the Vice President for Research. Authors like to thank Brian Murphy (Quality Deer Management) and Forest Kellog (North American Timberlands, Inc.) for their constructive comments and suggestions during the survey development phase.

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