Hunter Preferences and Willingness to Pay for Hunting Leases

Ian Munn, Anwar Hussain, Darren Hudson, and Ben C. West

Abstract: Previous analyses of hunting leases need to be refined by addressing the decision to lease, incremental willingness to pay (WTP) for those already leasing, and number of leases purchased. Requisite data for this study were generated on the basis of a survey of Mississippi resident and nonresident hunters. Results suggested that a hunter decision to purchase a lease was influenced by hunting avidity, availability of alternative hunting access options, perceived hunter crowding on public lands relative to private lands, and household income, whereas the number of leases purchased was influenced by alternative access options and hunter perception of congestion on public lands compared with that on private land. Thus, factors influencing the decision whether or not to purchase a lease and number of leases purchased were not the same. Incremental median WTP ranged from $0.56 to $6.40 per acre, depending on alternative hunting access options, hunter perception of crowding on public lands, availability of game species on leased lands, and duration of the lease agreement. This result suggested that Mississippi landowners who currently allow hunting access may be able to enhance lease-related total gross annual financial returns by $800 to $9,200 if they improved management of their lands or modified their lease agreements consistent with hunters' genuine concerns. FOR. SCI. 57(3): 189–200.

Keywords: hunting access, Mississippi, sample selection bias, willingness to pay

INTEREST IN UNDERSTANDING hunting lease markets continues as landowners and hunters across the United States increasingly engage in hunting lease transactions (Knoche and Lupi 2007, Rhyne et al. 2009). Knowledge of the market is still rudimentary; substantive and theoretical issues underlying hunter preferences and willingness to pay (WTP) for big game and waterfowl hunting access need to be refined if a more complete picture of this market is to be obtained. Past research on the subject is deficient in two respects. First, previous research did not fully account for the role of factors hunters consider important when purchasing a hunting lease (Messonnier and Luzar 1990, Buller et al. 2006). Factors such as lease duration, lease size, and internal access on the hunting site were not included in factors influencing hunters' WTP. Second, studies have taken a simplistic view of the hunting lease market by assuming that hunters purchase a single lease (Loomis and Fitzhugh 1989, Mackenzie 1990). The reality is that hunters may purchase, individually and/or as members of multiple hunt clubs, more than one hunting lease in a season. If the number of hunters who purchase multiple leases is not trivial, what influences hunters to purchase multiple leases becomes an interesting component of the hunting lease market. There are also implications for survey design and implementation of contingent valuation experiments. For which hunting lease is incremental WTP being elicited? How is the randomly assigned predetermined bid price set up to account for this complexity?

Private forest landowners (nonindustrial and forest industry) and public land managers (of state and federal lands) and other natural resource managers need information about hunter sociodemographics, hunting experiences, and preferences for game species to achieve management objectives. Insights from research findings that ignore these aspects may mislead landowners as to which management improvements would maximize hunting-related financial returns. They will not be able to make appropriate improvements to their management plans consistent with hunter expectations if they are uncertain as to which lease attributes hunters value most when evaluating lease opportunities. Extension professionals who provide guidance to landowners, state and federal agencies, and private consultants may be misled into designing programs that miss intended targets because of lack of information about genuine concerns of hunters.

The objective of this article was to address two questions: first, identify factors that influence a hunter's decision to purchase a hunting lease and, conditional on that decision, identify factors that influence the number of leases purchased; and second, analyze factors that influence incremental WTP for premium hunting leases conditional on the decision to purchase a hunting lease. The research is needed because understanding of the hunting lease market is still weak (Mozumder et al. 2007); additional studies are needed to establish the validity of earlier findings in other regions of the country, refine specifications of the leasing and WTP decisions, and address related natural resource management issues. This study contributes to and refines existing research on hunting leases by providing a better characterization of the hunting lease market and a fuller specification of WTP for hunting access. These considerations have implications for model specification, design of contingent valuation experiment, and data collection procedures.

Ian Munn, Department of Forestry, Mississippi State University, Box 9681, 39762-9681—Phone: (662) 325-4546; imunn@cfr.msstate.edu. Anwar Hussain, Mississippi State University—ahussain@cfr.msstate.edu. Darren Hudson, Texas Tech University—darren.hudson@ttu.edu. Ben C. West, Mississippi State University—bwest@cfr.msstate.edu.

Acknowledgments: Funding for this project was provided by the Natural Resources Enterprises Program, U.S. Fish and Wildlife Services.

Manuscript received October 7, 2009, accepted September 10, 2010

Theoretical Framework

Factors That Influence Hunter Decision to Purchase a Lease

Big game and waterfowl hunting continue to remain favorite consumptive recreation activities of a significant number of American hunters. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, 12.5 million hunters spent more than $22.9 billion in 2006 (U.S. Department of the Interior, Fish, and Wildlife Service 2007, p. 4). However, not all hunters have good access to public land for hunting, and public lands that are accessible are perceived to be crowded and to offer inferior wildlife populations (Benson 2001, Brown et al. 2001). With this scarcity, market forces are responding by inducing a certain segment of hunters and landowners to engage in hunting lease transactions.

Many factors have been identified that influence the reason that a hunter may be willing to purchase a lease. Among these, particularly important items include hunter household income, availability of alternative hunting site options, and stock of hunting equipment (Loomis and Fitzhugh 1989, Hussain et al. 2004). Hunters often opt to purchase a lease if their overall hunting experience on alternative lands available without leasing (e.g., personal, friends', or public lands) is not acceptable to them. For instance, considerations such as game abundance and quality and crowding of hunters may be important. Demographic characteristics such as age and residence may also be important. For instance, young hunters may be willing to compete with other hunters for sites at a public waterfowl hunting area, but hunters in their 50s and older may not consider it worthwhile to do so; as a result, these older hunters may be more willing to purchase a lease (trade off money for convenience). Likewise, urban residents may be more likely to purchase a lease than rural residents because they are less likely to have comparable contacts or available nonleased lands as their rural counterparts.

Determinants of the Number of Leases Purchased

Although the demand for hunting access has been a focus of analysis, the number of leases ultimately purchased and the factors that motivate hunters to do so have never been researched to the best of our knowledge. Conceptualizing the issue, economic theory suggests that economic agents first allocate their budget across broad commodity groups (e.g., food, clothing, health care, and recreation) to maximize utility. Budgets for commodities within subgroups are, then, subject to the same calculus: maximization of utility subject to budgets intended for the subgroup (Deaton and Muellbauer 1980, p. 122–123). It is, thus, reasonable to assume that hunters allocate the recreation budget such that utility is maximized. They purchase their most desirable lease first followed by their second, and so on; they look for available sites within a certain period of time and distance and look at a limited supply of land. This two-stage budget allocation suggests that factors influencing demand for a hunting lease and number of leases need not be the same. The former may be sensitive to factors bearing on budget allocations across broad commodity groups; the latter may be sensitive to intragroup influences such as the ability of a given lease to satisfy a hunter need for a given species. Consequently, a hunter may purchase a lease to hunt deer, another lease to harvest turkey, and a third lease to hunt waterfowl if the recreation budget allows.

We implement the above hunter-specific economic and behavioral insights by including the same set of factors in a two-equation model, whereby the first equation explains the decision whether to purchase a hunting lease and the second equation explains the number of leases purchased. The two equations differ only with regard to the dependent variables. The a priori expectation is that the same set of explanatory variables affects the dependent variables differently. The two equations are jointly estimated to account for selection bias, whereas the same set of explanatory variables are included in both equations because of lack of specific knowledge about the determinants of each response variable.

Determinants of Incremental Willingness to Pay for a Hunting Lease

Table 1 lists the set of variables hypothesized to influence a hunter's decision to purchase a hunting lease and incremental WTP for hunting access over and above the rate currently paid for the most expensive lease (consumer surplus). The hunter's decision to purchase a lease is expected to be positively related to perceived greater game abundance and quality and lesser crowding on private lands (relative to that on public lands). The decision is also expected to be positively related to age, urban residency, hunting avidity, lack of access options, and household income.

Of the list of explanatory variables in the incremental WTP model, game diversity (availability of deer, turkey, or waterfowl) and hunter crowding are expected to positively influence incremental WTP, whereas distance from residence, access to alternative hunting options, and number of leases are expected to influence it negatively. It is not clear, a priori, how the rest of the variables might influence incremental WTP. In light of these insights, one- and two-tailed tests are used accordingly.

Estimation Methods

The U.S. hunting lease market is still thin and fragmented. As of 1998 (the latest available data), only about one-third of big game hunters and less than 15% of nonindustrial private landowners engaged in leasing (Cordell et al. 1998). From a modeling perspective, these characteristics of hunting lease markets pose estimation challenges, suggesting the use of sample selection models. The decision to participate in the lease market and the number of leases purchased need to be jointly estimated to obtain consistent and unbiased parameter estimates (Breen 1996, Hussain et al. 2007, Greene 2008). Likewise, there is a need to jointly model the decision to lease and incremental WTP. In this research, we model the decision to purchase a lease and

Table 1. List of variables used in the analysis and hypothesized effect on dependent variables

Variable	Definition	Expected effect
The decision to purchase a hunting lease		
Dependent variable	Dichotomous: 1 if leased land; 0 otherwise	
Explanatory variables		
Opinion about public lands		
Perceived game abundance	*Abundance*: 1 if hunter perceives game abundance on public land as not satisfactory relative to private land; 0 otherwise	+
Perceived game quality	*Quality*: 1 if hunter perceives game quality on public land as not satisfactory relative to private land; 0 otherwise	+
Perceived hunter crowding	*Crowding*: 1 if hunter perceives public land as crowded or moderately crowded relative to private land; 0 otherwise	+
Age in logarithm	*LogAge*: Years expressed in natural logarithmic units	+
Residency	*Residence*: 1 if rural resident; 0 otherwise	−
Hunting avidity	*Avidity*: No. of hunting trips taken in 2006 hunting season	+
Access options	*Options*: 1 if hunter has access to other, nonleased, hunting sites; 0 otherwise	−
Household income	*Income*: Thousand dollars per year	+
WTP model		
Dependent variable	*WTPBD*: 1 if lessee willing to pay predetermined bid per acre; 0 otherwise	
Explanatory variables		
Lease attributes		
Game species	*Deer*: 1 if deer available game species; otherwise 0	+
	Turkey: 1 if turkey available game species; otherwise 0	+
	Waterfowl: 1 if waterfowl available game species; otherwise 0	+
Onsite access	*ATV*: 1 if ATV accessible only; otherwise 0	?
	Dry weather: 1 if dry weather accessible roads; otherwise 0	?
	All weather: 1 if all-weather roads; otherwise 0 (omitted category)	?
Lease size	*LogAcres*: Acres in natural logarithms	?
Lease duration	*Duration1*: 1 if duration is 1 yr; otherwise 0 (omitted category)	?
	Duration2: 1 if duration is 2 yr; otherwise 0	?
	Duration3: 1 if duration is 3 or more yr; otherwise 0	?
Lease location	*Miles*: Miles from lessee residence	+
Lease rate per acre	*LogBid*: Logarithm of prespecified bid per acre	−
Lessee attributes		
Access options	*Options*: 1 if lessee has access options; 0 otherwise	−
Hunter crowding	*Crowding*: 1 if lessee perceives public land as crowded or moderately crowded relative to private land; 0 otherwise	+
Leases	*LogLeases*: No. of leases purchased by a lessee in logarithms	−

number of leases purchased using the Heckman sample selection bias model, and we model the decision to purchase a lease and incremental WTP using a bivariate probit with selection bias (Kuate-Defo and DaVanzo 2006). The two estimation procedures are the same except that in the case of bivariate probit both of the dependent variables are dichotomous, whereas in the Heckman sample selection bias model the dependent variable in the second equation is continuous (number of leases purchased). Lease counts are integers and low numbers, ranging from 0 to 5, so they should ideally be modeled using a count model (e.g., Poisson or negative binomial). We attempted to estimate a count model using the procedure developed by Miranda and Rabe-Hesketh (2006) for count data; however, the model failed to converge and was abandoned.

The Decision to Purchase a Hunting Lease and Number of Leases Purchased

To estimate the number of leases purchased conditional on being a lessee, we used the Heckman sample selectivity model. Let y_{1i} (a dichotomous dependent variable) = 1 if

hunter i purchases a hunting lease and $y_{1i} = 0$ otherwise. After Greene (2008, p. 884), the formulation for the sample selection model is outlined as

Selection model:

$$y_{1i}^* = w_i'\alpha + \mu_i \qquad y_{1i} = 1 \quad \text{if } y_{1i}^* > 0 \quad 0 \text{ otherwise} \tag{1}$$

$$\Pr(y_i = 1|\mathrm{w}_i') = \Phi(w_i'\alpha)$$

$$\Pr(y_i = 0|\mathrm{w}_i') = 1 - \Phi(w_i'\alpha)$$

Regression model:

$$L_i = z_i'\theta + \varepsilon_i \qquad L_i \text{ observed} \quad \text{only if } y_{1i} = 1 \tag{2}$$

$$(\mu_i, \varepsilon_i) \sim \mathrm{NID}[0, 0, \sigma_\mu, \sigma_\varepsilon, \rho]$$

where w_i' is the set of factors influencing a hunter's decision (y_i) to purchase a hunting lease and z_i' is the set of factors accounting for differences in number of leases purchased, α and θ are the associated unknown parameter vectors, σ_μ and σ_ε are variances of μ_i and ε_i, respectively, and ρ is the correlation between μ_i and ε_i. Sample selection bias is tested by testing the null hypothesis that μ_i and ε_i are uncorrelated (H_0: $\rho = 0$).

The Decision to Purchase a Hunting Lease and Incremental WTP

To formalize the decision to purchase a hunting lease and incremental WTP in a probabilistic choice framework, let y_{1i} (a dichotomous dependent variable) = 1 if hunter i purchases a hunting lease and $y_{1i} = 0$ otherwise; let w be a set of factors assumed to influence the lease purchase decision. Then the probability that hunter i purchases a lease is the sum of the deterministic (αw_i) and random term (μ_i):

$$\Pr_i(y_{1i}|w_i, \alpha) = \alpha w_i + \mu_i. \tag{3}$$

Depending on the assumption about the distribution of the random term (μ_i), the parameters can be estimated based on a logistic or probit probability model.

Hunter WTP over and above the rate for the lessee's most expensive lease (on a per acre basis) can be hypothesized to depend on lease-specific (x_1) factors such as distance from hunter residence, onsite access roads, lease size, lease duration, game diversity, and hunter-specific (x_2) factors (e.g., alternative access options and perception of crowding) and the predetermined randomly assigned bid rate (t_i). Let y_{2i} (a dichotomous dependent variable) = 1 if hunter i is willing to pay the bid rate (t_i) and $y_{2i} = 0$ otherwise. Casting the relationship as a probabilistic choice decision, we have:

$$\Pr_i(y_{2i}|x_{1i}, x_{2i}, \gamma, \beta, \delta) = \gamma x_{1i} + \beta x_{2i} + \delta \ln(t_i) + \varepsilon_i. \tag{4}$$

The probability of individual i responding "yes" to an offered bid t_i is equivalent to the probability of the random WTP function being greater than the logarithm of the offered bid (Cameron and James 1987). When the bid variable is expressed in logarithmic form, using parameter estimates of Equation 4, the incremental WTP estimate is given as (Haab and McConnell 2003, p. 54):

$$\widehat{\mathrm{WTP}} = \exp(\gamma'\bar{z}), \tag{5}$$

where $\gamma' = (\widehat{\gamma/\delta, \beta/\delta})$ and $\bar{z}$ is the set of mean values corresponding to the variables included in vectors $\boldsymbol{x}_1$ and $\boldsymbol{x}_2$. The 95% Krinsky-Robb confidence bounds are obtained on the basis of Jeanty (2007). Given the two-stage (sequential) nature of hunter decision to purchase a lease and WTP for hunting access, it is important that estimation procedures are chosen accordingly to obtain consistent and efficient parameter estimates. Thus, a bivariate probit with sample selection bias (Eklof and Karlsson 1999, p. 3, Baum 2006, p. 271–272) is used.

Data Sources and Variable Definitions

Data for this study were generated based on a dichotomous choice contingent valuation survey of Mississippi resident and nonresident hunters. The set of variables that influence a hunter's decision to purchase a lease and incremental WTP for a lease were derived from a literature review of hunting lease markets and focus group discussions with hunters. Table 1 lists these variables along with hunter sociodemographic variables and their hypothesized impact on the decision to purchase a lease and incremental WTP.

A random sample of 2,000 hunters was obtained based on the list of licensees maintained by the Mississippi Wildlife and Fish Department. The relative shares of resident versus nonresident hunters were in proportion to their shares in all licensee sales for the year 2006. The hunters were mailed a pretested self-administered questionnaire for a total of three mailings if hunters did not respond to the first or second mailing survey. The first mailing was sent on Feb. 26, 2007, followed by a postcard a week later. The second mailing was sent on Mar. 19, 2007, and the third mailing on Apr. 16, 2007.

Consistent with the study objectives, the survey asked respondents whether they leased private lands. If so, lessee participants were asked whether they purchased leases individually, as a member of a club, or both. Lessees were then asked to provide the following information for each lease they purchased: (1) type of lease (individual or club), (2) number of acres leased, (3) rate per acre per year in dollars, (4) duration of the lease in years, and (5) distance from residence in miles. In addition, lessees were asked to provide information about onsite access and game diversity attributes of the most expensive lease. Regarding onsite access, they were asked whether the most expensive lease had (1) all-terrain vehicle (ATV) passable trails only, (2) dry weather access (dirt roads), or (3) all weather access roads (gravel roads). The game diversity information sought was whether or not deer, turkey, and/or waterfowl were present.

The dichotomous choice format (Bishop and Heberlein 1979) was chosen because of its advantages over an open-ended format. The format involves establishing attributes of the nonmarket good of interest, asking respondents whether or not he or she would pay or accept a single specific offer or bid price to access the good. The respondent merely decides whether to accept or refuse the offer. The arbitrarily

assigned sums vary across respondents. The strategy is attractive because it generates a scenario that is similar to day-to-day market transactions (Cameron and James 1987). Moreover, the strategy circumvents much of the potential bias due to strategic responses. The drawback is that WTP must be inferred, and the resulting estimate may be sensitive to the assumptions about utility function, distribution error term, and associated functional form (Loomis 1990).

The WTP experiment was designed to elicit whether a lessee was willing to pay a randomly assigned bid rate per acre over and above the rate paid for the most expensive lease on a dollar per acre per year basis. Given our a priori expectation that at least some lessees leased more than one lease, survey designs to accommodate WTP questions for multiple leases were explored but proved to be too cumbersome. It is conceivable that hunters may have been willing to pay over and above the rate they paid for any or none of the multiple leases they purchased, but a complete analysis would have required WTP bids for all leases purchased by a hunter. Because the number of leases was not known a priori, providing enough WTP questions to cover all potential leases would have dramatically increased the length of the survey. We therefore focused on the most expensive lease to facilitate survey design and to avoid an informational burden on the respondents if they had purchased more than one lease. Further research on the subject may assess implications for WTP and overall net consumer surplus in the hunting lease market of this approach.

The bid prices were chosen based on a sample of 200 auctioned hunting lease transactions specific to the Mississippi 16th Section Lands in 2008 (Rhyne et al. 2009). These leases averaged $8.73 per acre per year. Cumulative distribution analysis of lease rates per acre per year indicated that 85% of the leases were less than $15 per acre and that 95% were less than $20 per acre. This result suggested that prices beyond $30 per acre per year would choke off demand for hunting leases in Mississippi. Because the current study is interested in estimating incremental WTP, the maximum bid was, therefore, set at $10 per acre and the lowest at $0.50 per acre; bid prices ranged from $0.50 to 10.00, with the bid set defined as [0.50, 1.00, 1.50, 2.00, 2.50, …, 9.00, 9.50, 10.00]. The dichotomous choice contingent valuation question was as follows: *Considering the highest $ per acre per year lease you listed, would you have leased the same land had the lease rate been higher by an additional $x per acre per year?* The $x refers to a particular element of the bid set that was asked of each lessee. These bid limits were considered reasonable because available data about hunting leases in Mississippi showed that approximately 85% of the lessees paid rates within this range.

Empirical Results

A total of 845 surveys were returned, yielding a response rate of 42%. However, only 726 questionnaires had all the information on variables of interest to this study, resulting in a usable response rate of 36%, which is well within norms for survey research. There were 11 refusals and 108 responses that were nonusable because key questions were not answered, primarily those concerning the WTP question or lease-specific questions. Nonresponse bias was addressed by comparing the responses to the first, second, and third mailings and statistically testing for differences in means of key variables used in the willingness to pay model. Means of the key variables did not differ significantly between mailings. Given that there is no difference in the responses between mailings, it is unlikely that nonresponse bias is a concern. Another potential source of bias is the makeup of the 108 nonusable responses. If these respondents did not answer for strategic reasons and they differ from those who did, the sample of usable responses could be biased. Of the 108 nonusable responses, 101 were lessees, suggesting that strategic nonresponse by lessees may be a concern. To address this, we compared the 256 lessees who provided full information with the 101 lessees who provided incomplete information by statistically testing for differences in key variables that describe the characteristics of the lessees, i.e., age, gender, hunting experience, avidity, and residency. None were significantly different, suggesting that the two sets are similar and strategic bias is not likely to be a concern.

Of the 726 usable questionnaires, 470 were returned by nonlessees and 256 by lessees. The lessees could be separated into those that leased as a member of one or more clubs (218) and those that leased one or more properties as individuals (66); however, there was some overlap in these groups as some leased both as members of clubs and as individuals (28). Number of leases purchased by a given hunter ranged from 1 to 5. Of the lessees, 55 (21%) purchased more than one lease.

Of the 218 hunters that purchased leases as members of a club; 31 hunters were members of at least two clubs, and 7 of these hunters were members of three clubs for a total of 256 club leases. Averaged across all club leases, a typical club lease was 1,760 acres (median 995), cost $7.12 per acre (median $6.00), had a 4.7-year lease duration (median 1), and was about 49 miles (median 29) away from the hunter's residence. Individual leases were less common, representing 22% of the leases reported in this study. Of the 66 Mississippi hunters who purchased leases as individuals; 5 purchased 2 leases and, of these, 1 individual purchased 3 leases, for a total of 72 leases purchased individually. Averaged across all individual leases, a typical individual lease was 250 acres (median 155), cost $7.95 per acre (median $5.00), was 2.9 years in duration (median 1), and was 32 miles (median 12) away from the hunter's residence.

The most expensive leases, based on each lessee's highest cost per acre lease, averaged 1,439 acres (median 700), cost $7.69 (median $6.00), lasted 3.8 years (median 1), and was 48 miles from the hunter's residence. Additional details about the various leases in terms of size, duration, rate per acre, and location from hunter residence are reported in Table 2.

Paired comparison tests of the four attributes (i.e., acres leased, rate per acre, lease duration, and location relative to hunter residence) indicated that club and individual leases were distinct entities (Table 3). Individual leases were substantially smaller, shorter term, and closer to home than club leases. The most expensive leases fell between club and individual leases with respect to size and lease duration but

Table 2. Statistics for various categories of hunting leases purchased by Mississippi hunters in 2006

Type and Attribute	Mean	Median	SD	Minimum	Maximum	Observed
Club						
Size (acres)	1760.11	995.00	2986.21	7.00	35000.00	256
Rate (per acre)	7.12	6.00	5.34	0.07	50.00	256
Length (yr)	4.70	1.00	10.13	1.00	99.00	256
Distance (miles)	48.70	29.00	59.54	0.00	551.00	256
Individual						
Size (acres)	250.18	155.00	276.73	5.00	1500.00	72
Rate (per acre)	7.95	5.00	9.02	1.00	60.00	72
Length (yr)	2.94	1.00	3.68	1.00	15.00	72
Distance (miles)	31.94	12.00	56.54	0.00	325.00	72
Most expensive ↑ *						
Size (acres)	1439.11	700.00	2808.28	5.00	35000.00	256
Rate (per acre)	7.69	6.00	6.87	0.10	60.00	256
Length (yr)	3.77	1.00	5.40	1.00	45.00	256
Distance (miles)	48.14	25.00	61.86	0.00	551.00	256
Pooled						
Size (acres)	1428.66	640.00	2713.37	5.00	35000.00	328
Rate (per acre)	7.30	6.00	6.33	0.07	60.00	328
Length (yr)	4.32	1.00	9.14	1.00	99.00	328
Distance (miles)	45.02	25.00	59.22	0.00	551.00	328

* ↑, includes only the most expensive lease (on a per acre basis) that each hunter leased.

were similar to club leases regarding distance to residence. Rate per acre was not significantly different regardless of the type of lease. There was no difference between the pooled (all leases in the sample) and most expensive leases in terms of any of the four attributes; therefore, using only the most expensive leases in the WTP experiment probably did not introduce any bias in the incremental WTP estimates as a consequence of using this smaller subset of leases.

Descriptive statistics of variables used in the analysis (Table 4) show significant differences between lessees and nonlessees with regard to avidity (number of hunting trips during 2006), opinions about game quality and hunter crowding on public lands, availability of alternative hunting access options (i.e., public lands, personal, and friends' lands), and household income. Opinions about game abundance on public lands relative to private lands were not significantly different. Considering only hunters' most expensive lease on a $ per acre per year basis, 98% of these leases had deer, 84% had turkey, and 18% had waterfowl (Table 4). Almost all of the 328 leases included multiple species. Only 31 leases included only deer, only 3 included only waterfowl, and none included only turkey. Internal access was only possible by ATVs on 38% of the leases. On the remaining 62%, roads provided additional internal access; however, in half of these leases, roads were only passable in dry weather. For the majority of leases (54%), the lease duration was 1 year, followed by 3+ years (29%). On average, leases were located about 50 miles from hunter residences. There were major differences between individual leases as suggested by the large standard deviations.

The Decision to Purchase a Hunting Lease and Number of Leases Purchased

Estimation results of the Heckman sample selectivity regression concerning a hunter's decision whether or not to lease and number of leases ultimately purchased are reported in Table 5. The overall model fits well as suggested by the Wald statistic ($P > 0.000$). Based on the likelihood ratio test, the null hypothesis of zero correlation between the errors of the two equations cannot be rejected. Under this circumstance, it is tempting to estimate only the equation of interest and report those results, but it is still appropriate from a statistical point of view to jointly estimate the two equations because although the correlation is statistically insignificant, it is not zero. Consistent with others (e.g., Hussain et al. 2004), results based on the jointly estimated equations are reported.

The Decision to Purchase a Hunting Lease

Probit parameter estimates of the lease participation model are reported in the upper segment of Table 5. All parameter estimates have the expected signs. Hunter-specific variables such as hunting avidity (proxied by frequency of trips during the 2006 season), perception that public lands are crowded relative to private lands, and household income have positive signs. Thus, hunters who have a tendency to take more trips in a season, perceive public lands to be crowded relative to private lands, and are relatively well off are more likely to participate in leasing. Coefficients on all these variables are statistically significant at the 10% level of significance or better. As indicated by the marginal effects for these three variables, not having alternative hunting access options has the greatest (46%) impact on the decision to purchase a hunting lease. The coefficient on alternative access options is negative and significant, suggesting that hunters with alternative access options are less likely to purchase a lease, all else equal. Other hunter-specific variables (e.g., perception of game abundance, game quality, residence, and age) have the expected signs but are not statistically significant.

Table 3. Paired mean tests of statistical differences between leases in terms of lease size, rate, length, and distance from residence that were purchased by Mississippi lessee hunters in 2006

Attribute	Club versus individual	Individual versus expensive	Club versus expensive	Pooled versus most expensive
Size (acres)	***	***	*	
Rate (per acre)				
Length (years)	***	*	*	
Distance (miles)	***	***		

*** and * refer to statistical significance at 1, and 10%, respectively.

Determinants of the Number of Leases

Consistent with a priori expectations, these results show that the set of factors underlying the decisions to lease or not and how many properties to lease are different. Although the decision whether or not to purchase a lease is influenced by hunter perception of congestion on public lands, hunting avidity, alternative access options, income, and age, the number of leases purchased is only affected by hunter perception of congestion on public lands and alternative access options. Furthermore, the variable "alternative access options," which is significant in both equations, does not have the same sign. Having alternative access options negatively affects the decision to purchase a lease; however, it is positively related to the number of leases purchased.

Willingness to Pay with Selection Bias Model

Maximum likelihood estimation results of the bivariate probit with selection bias model are reported in Table 6. As indicated by the χ^2 statistic, which is significant at 1%, the model fits well. Based on the likelihood ratio test, the null hypothesis of zero correlation between the errors of the two equations cannot be rejected. As with the previous set of equations, we nonetheless report the results of the jointly estimated equations.

WTP Estimates

Parameter estimates based on the exponential WTP model are reported in the lower segment of Table 6. Consistent with a priori expectations, availability of game species has a positive impact on incremental WTP. The coefficient on waterfowl is statistically significant at the 5% level and incremental WTP increases 20% for hunting sites having waterfowl as a game species. The coefficients on deer and turkey are also positive but are not statistically significant at the 10% level. Note that the coefficient on deer is not significant because of a lack of variability (essentially all sites have deer as a game species).

The coefficients on variables representing "1 year" and "3+" are negative and significant at 5%, indicating that these lease lengths are less preferred than "2-year" leases (base category). The associated marginal effects suggest that incremental WTP is 36% less for 1-year leases and 28% less for 3+-year leases compared with 2-year leases. Consistent with consumer demand theory, incremental WTP is negatively associated with an increase in bid price per acre, and this relation is statistically significant at 1%. The associated marginal effect indicates that a 1% increase in lease rate per acre (above the amount currently paid) would reduce the probability that hunters would be willing to pay the specified price by 20%. Coefficients associated with site location (distance from residence), onsite access (ATV passable and dry weather or all weather roads), and lease size (log acres) have the expected signs. None of these variables are, however, statistically significant.

Incremental WTP estimates under alternative scenarios

Using the estimated parameters of the WTP model, estimates of incremental median WTP per acre and 95% Krinsky-Robb confidence bounds are reported in Table 7. Four scenarios are presented, illustrating how WTP is affected by changes in the availability of alternative hunting access options, perceived crowding on public lands, game diversity, and lease duration. The remaining variables are set at their mean values if continuous variables and at 1 if categorical variables. In particular, the variables lease size, distance from hunter residence, and number of leases are set at the mean level. The categorical variables for onsite access, deer, turkey, and lease duration were all set = 1, indicating that onsite access was by ATV only, deer and turkey were present, and the lease duration was 1 year.

In Scenario 1, which assumes that lessees have alternative access options and do not perceive public lands to be crowded, the median incremental WTP is \$0.56 per acre. Under scenario 2, which assumes that lessees perceive public lands to be crowded and have no alternative access options (just the opposite of scenario 1), median incremental WTP is \$1.37 per acre. Under scenario 3, which is similar to scenario 2 except that waterfowl are available as game species in addition to deer and turkey, the median incremental WTP is \$3.10 per acre. Under scenario 4, which is again similar to scenario 2 except the lease duration is 2 years rather than 1, the median incremental WTP is \$6.40 per acre.

Discussion

This study addressed two limitations of earlier research on hunter preferences and WTP for hunting access. First, previous research on the subject assumed a simplified leasing context whereby hunters purchased one lease. Our results showed that 21% of hunters who lease hunting rights purchase more than one lease, representing a substantial portion of hunters actively engaged in the lease market. Ignoring the leasing behavior of this segment would distort any findings. Second, previous research did not fully specify factors that influence WTP for hunting access. These limitations have implications at many levels. For instance,

Table 4. Descriptive statistics of model variables used in the analysis

	Nonlessees (n = 470)		Lessees (n = 256) ↑ *		All (n = 726)	
	Mean	SD	Mean	SD	Mean	SD
The decision to purchase a hunting lease						
Lease participant (yes = 1)			1.000	0.000	0.353	0.478
Abundance	0.430	0.496	0.445	0.498	0.435	0.496
Quality	0.402	0.491	0.438	0.497	0.415	0.493
Crowding†	0.594	0.492	0.652	0.477	0.614	0.487
Age (years)†	43.102	12.766	44.621	12.534	43.638	12.697
LogAge†	3.712	0.340	3.755	0.306	3.727	0.329
Residency (rural = 1)	0.668	0.471	0.672	0.470	0.669	0.471
Avidity (no. of hunting trips)†	18.987	19.230	32.258	22.811	23.667	21.506
Options†	0.928	0.259	0.715	0.452	0.853	0.355
Income ($000; min = 35,000)†	71.06	34.20	76.77	35.41	73.08	34.72
WTP model						
WTP bid (yes = 1)						
Game species						
Deer			0.984	0.124		
Turkey			0.836	0.371		
Waterfowl			0.180	0.385		
On-site access						
ATV			0.383	0.487		
Dry weather			0.309	0.463		
All weather			0.309	0.463		
Lease size(acres)			1439.109	2808.281		
LogAcres			6.434	1.367		
Lease duration(years)						
Duration1			0.535	0.500		
Duration2			0.172	0.378		
Duration3			0.293	0.495		
Miles			48.139	61.863		
Bid ($)			5.227	2.909		
LogBid			1.413	0.808		
Lease rate ($/acre)			7.687	6.874		
Logarithm (lease rate)			1.760	0.810		
Options	0.928	0.259	0.715	0.452	0.853	0.355
Crowding	0.594	0.492	0.652	0.477	0.614	0.487
Leases			1.281	0.606		
LogLeases			0.174	0.348		

* ↑, these statistics pertains to the most expensive lease.
† Significantly different at 10% or better between lessees and nonlessees.

how do we frame contingent valuation questions when a hunter purchases multiple leases? Should incremental WTP be invoked for the most expensive or least expensive lease? What drives the decision whether or not to purchase a lease versus how many leases to purchase?

To address the issue of multiple leases, we used a multistage utility maximization framework. The decision whether or not to purchase a lease was hypothesized to be influenced by factors that affected a lessee's budget allocation across broad commodity groups, whereas the decision to purchase more than one lease was hypothesized to be influenced by factors related to the ability of a given lease to satisfy lessee demand for game diversity and quality. Conceptually, the former decision is about budget allocation between broad commodity groups (e.g., food, housing, education, and recreation), whereas the later is about budget allocation within a commodity group. For instance, the budget for recreation may be spent to purchase one, two, or more leases depending on the ability of the leases to satisfy the hunter's demand for game quality and diversity, given considerations such as accessibility and crowding.

Our empirical findings suggest some insights into the multiple lease aspect of the hunting lease market. First, the initial decision of whether or not to purchase a lease is much more complex than the subsequent decision about how many leases to purchase. The former is affected by a wide range of factors, whereas the latter is only significantly affected by hunters' access options and perception of congestion on public lands. Second, having alternative access options negatively influences the decision to lease yet positively influences the number of leases purchased. That there are some who have free hunting options yet actively engage in leasing suggests that some gain utility from having a range of hunting options. Maximizing the utility of their lease dollars involves leasing multiple properties to provide a range of hunting experiences. The opposite signs on the same variable in this two-equation model are thus understandable.

To more completely specify factors that influence WTP for hunting access, a decision first had to be made to invoke WTP either for all leases or for a specific lease. Whereas a lessee may not be willing to pay over and above the rate paid for the most expensive lease, he or she may be willing to pay more for one or all of the other leases. Economic

Table 5. Estimation of number of leases conditional on being a lessee using Heckman sample selectivity regression

	Parameter estimates			Marginal effects		
	Coefficient	SE	*P* value	Coefficient	SE	*P* value
The decision to purchase a hunting lease						
Abundance (α_1)	−0.089	0.131	0.500	−0.032	0.048	0.499
Quality (α_2)	0.047	0.133	0.722	0.017	0.049	0.723
Crowding (α_3)	0.217	0.110	0.049	0.078	0.039	0.046
LogAge (α_4)	0.233	0.165	0.157	0.002	0.060	0.157
Residence (α_5)	0.034	0.114	0.764	0.012	0.041	0.764
Avidity (α_6)	0.022	0.003	0.000	0.008	0.001	0.000
Options (α_7)	−1.239	0.148	0.000	−0.464	0.049	0.000
Income (α_8)	0.004	0.002	0.019	0.001	0.001	0.019
Constant (α_0)	−1.156	0.657	0.078			
Number of leases						
Abundance (θ_1)	0.030	0.087	0.730	0.030	0.087	0.730
Quality (θ_2)	0.023	0.086	0.794	0.023	0.086	0.794
Crowding (θ_3)	0.182	0.080	0.023	0.182	0.080	0.023
LogAge (θ_4)	0.057	0.124	0.644	0.001	0.124	0.644
Residence (θ_5)	0.074	0.079	0.352	0.074	0.079	0.352
Avidity (θ_6)	0.003	0.002	0.172	0.003	0.002	0.172
Options (θ_7)	0.269	0.131	0.040	0.269	0.131	0.040
Income (θ_8)	0.001	0.001	0.336	0.001	0.001	0.336
Constant (θ_0)	0.587	0.522	0.261			
Rho (ρ)	−0.166	0.221				
Sigma (σ)	0.579	0.029				
Lambda (λ)	−0.096	0.130				
Sample size (all)	726					
Censored (nonlessees)	470					
Uncensored (lessees)	256					
Log-likelihood at convergence	−616.189					
Wald $\chi^2(8)$	28.600					
Probability $> \chi^2$	0.000					

Likelihood ratio test of independent equations (null hypothesis H_0: $\rho = 0$): $\chi^2(1)$: 0.40; probability $> \chi^2 = 0.529$.

theory guides the fact that consumers equate marginal utility per dollar when faced with budget allocation across a bundle of competing goods and services. In equilibrium there is no potential benefit for reallocating budget from one competing good to another. Because of the lack of information and uncertainty, however, deviations from optimality are likely.

In this study, we considered it appropriate to confine the focus of the research to the most expensive lease and frame the contingent valuation question in a way that incorporated the complexity of this reality. The decision to focus on the most expensive lease has merit because the existence of a most expensive lease implies that the lessee was indeed willing to pay over and above the rate paid for the least expensive lease. In contrast, invoking WTP for all leases would have been tedious and time-consuming for lessee hunters and could have compromised information quality and/or resulted in a lower response rate. Furthermore, the most expensive leases did not differ significantly from the set of all leases with respect to size, proximity to the hunter's residence, lease length, or lease rate so any distortions due to focusing on this subset are to be minor. Nonetheless, it is important to emphasize that our results pertain only to the incremental WTP for the most expensive leases and can be extrapolated to leases in general only with caution.

Empirical findings incorporating fully specified lease factors suggest that incremental WTP is positive even for the most expensive leases and considerable consumer surplus exists in the lease market and that incremental WTP is sensitive to lease duration and game diversity. In particular, a 2-year lease is valued more than a 1-year lease or 3+-year lease. A possible explanation is that a 2-year lease best balances the tradeoffs between the costs of renegotiating the lease (or the possibility of losing the lease) annually and the lack of flexibility with a longer-term lease; i.e., hunters value the option (flexibility) to move on to new properties or strike better hunting lease deals with current landowners if warranted. The idea that lease prices may vary in a nonlinear fashion with lease length has only been discussed by Buller et al. (2006). Although not directly comparable (because the objective in that study concerned whether WTP changed as lease length increased from a 1-day to a 3-day hunting package trip), this finding also suggests a nonlinear relationship between lease length and WTP. In contrast, Rhyne et al. (2009) found that hunters prefer longer term leases; therefore, additional research on this aspect of the lease market is warranted. Future researchers should also explore the link between returns and lease length from both the hunter and landowner perspectives.

Regarding game diversity, findings show that game diversity plays a significant role in hunters' WTP for hunting access; sites that include waterfowl as game species have an advantage over sites with only deer or turkey. The finding that game diversity positively influences WTP corroborated with findings by others (Buller et al. 2006, Hussain et al.

Table 6. Estimation of WTP conditional on being a lessee using a bivariate probit model with sample selection bias

	Parameter estimates			Marginal effects		
	Coefficient	SE	*P* value	Coefficient	SE	*P* value
The decision to purchase a hunting lease						
Hunter characteristics						
Abundance (α_1)	−0.096	0.130	0.459	−0.035	0.047	0.458
Quality (α_2)	0.050	0.131	0.711	0.018	0.048	0.711
Crowding (α_3)	0.215	0.110	0.051	0.077	0.039	0.048
LogAge (α_4)	0.225	0.164	0.170	0.082	0.060	0.169
Residence (α_5)	0.039	0.113	0.733	0.014	0.041	0.732
Avidity (α_6)	0.022	0.003	0.000	0.008	0.001	0.000
Options (α_7)	−1.235	0.148	0.000	−0.463	0.049	0.000
Income (α_8)	0.004	0.002	0.010	0.001	0.001	0.010
Constant (α_0)	−1.149	0.652	0.078			
WTP model						
Lease attributes						
Game species						
Deer (γ_1)	0.020	0.879	0.982	0.006	0.256	0.982
Turkey (γ_2)	0.507	0.330	0.124	0.159	0.129	0.218
Waterfowl (γ_3)	0.577	0.258	0.025	0.197	0.099	0.047
Onsite access						
ATV (γ_4)	0.140	0.242	0.564	0.042	0.074	0.566
Dry (γ_5)	0.256	0.260	0.327	0.080	0.084	0.340
LogAcres (γ_7)	−0.120	0.077	0.120	−0.035	0.027	0.196
Lease duration (years)						
Duration1 (γ_8)	−1.037	0.435	0.017	−0.363	0.167	0.029
Duration3 (γ_9)	−0.950	0.438	0.030	−0.278	0.172	0.106
Miles (γ_{11})	−0.002	0.002	0.260	−0.001	0.001	0.296
LogBid (δ)	−0.691	0.127	0.000	−0.203	0.108	0.062
Lessee attributes						
Options (β_1)	−0.060	0.304	0.844	−0.018	0.089	0.841
Crowding (β_2)	0.260	0.225	0.248	0.074	0.069	0.283
LogLeases (β_3)	−0.223	0.309	0.471	−0.065	0.098	0.505
Constant (β_0)	1.405	1.030	0.172			
Rho (ρ)	−0.406	0.254				
Incremental WTP/per acre						
Sample size (all)	726					
Censored (nonlessees)	470					
Uncensored (lessees)	256					
Log−likelihood at convergence	−496.413					
Wald $\chi^2(13)$	57.49					
Probability $> \chi^2$	0.000					

Likelihood ratio test of independent equations (null hypothesis H_0: $\rho = 0$): $\chi^2(1)$: 1.42; probability $> \chi^2 = 0.233$.

2007, Rhyne et al. 2009). However, with the exception of Buller et al. (2006), the rest of these studies looked at the relationship between game diversity and lease revenues from a supply side perspective (i.e., how landowners returns varied as game diversity on their sites changed). Furthermore, these studies only indirectly established the link between game diversity and lease-related returns because they used the relative proportions of forest cover types, e.g., natural and planted pines and upland and bottomland hardwoods, as proxies for game diversity (increased forest type diversity was assumed to be associated with increased game diversity).

Fully specifying lease characteristics in the WTP model provided the necessary information to explore how incremental WTP varied in light of changes in lease characteristics. With use of empirical estimates derived from the incremental WTP model, four scenarios were simulated. First, the incremental WTP estimate from scenario 1 indicated that hunters were willing to pay an additional $0.56 per acre even if they had alternative access options and crowding on public lands was not a perceived issue. Given that the most expensive leases averaged 1,440 acres, consumer surplus for a lease with the specified characteristics was $806 (= $0.56 × 1,440) per year. Under scenario 2, postulating no access options and crowding, the corresponding consumer surplus increased to $1,973 (= $1.37 × 1,440). Under scenario 3, postulating no access options and crowding and adding waterfowl to deer and turkey as game species, consumer surplus was $4,464 (= $3.10 × 1,440). Assuming that landowners can capture this consumer surplus through increased rates, they can significantly increase lease revenues by providing the appropriate habitat to attract huntable populations of waterfowl. Whether or not the cost of providing the necessary habitat (e.g., by installing levees and managing beaver ponds) exceeds the extra revenue probably depends on the presence of suitable sites on the

property and proximity to major or minor flyways. Last, under scenario 4, which explored the marginal WTP for a 2-year lease, consumer surplus averaged \$9,216 (= \$6.40 × 1,440). These results suggest that setting the contract length to accommodate hunter preferences can substantially increase hunter consumer surplus and/or returns to the landowner.

Concluding Remarks

Hunting access continues to be a natural resource management issue (Knoche and Lupi, 2007) and a challenge to public and private resource managers because hunters are willing to pay more for hunting leases even when they have alternative access options and do not perceive public lands to be crowded. Because hunters look for quality hunting experiences and not just hunting access, public land managers need to do more than minimize crowding while providing access to public lands. Landowners who allow hunting access could also enhance lease-related financial returns by forming cooperatives and bundling leases together to provide combinations of lease attributes that better address hunters' needs, keeping in mind that game diversity, quality, hunter crowding, lease duration, and accessibility are important considerations from the hunter's perspective.

Future researchers on hunting lease markets would need to be cognizant of three specific issues suggested by the current analysis. First, it is important to recognize the phenomenon of multiple leases and how it can be appropriately analyzed. The need to purchase multiple leases is probably motivated by the inability of a given lease to satisfy the lessee's demand for alternative hunting experiences. Although some hunting sites may be good for deer hunting, others may be good for turkey and waterfowl hunting. Second, the decision to purchase a lease and how many leases to purchase conditional on being a lessee are driven by different sets of factors. Whereas the former concerns budget allocation across broad commodity groups, the latter requires equalization of utility per dollar between leases. Given the complexity entailed by invoking incremental WTP for all leases simultaneously, this research only explored incremental WTP for an easily identified portion of the market. Establishing WTP and consumer surplus for the full market using any variant of the dichotomous choice contingent valuation method may not be feasible. A choice modeling approach may be more amenable to dealing with these complexities.

Finally, waterfowl-specific leases can be dramatically different from more generic, multiple species leases. Waterfowl leases are often delineated by number of blinds, "holes," or pits rather than number of acres. The corresponding land base may be quite small, and, obviously, water is required. These factors will have a significant effect on the WTP for hunting leases at the scale of \$ per acre per year. In the current study, only 3 of the 256 leases were waterfowl-specific; thus, the general results presented here probably do not pertain to such leases. There are, however, numerous generic leases that can accommodate waterfowl. In such circumstances the results presented here would be relevant. Future researchers could better address WTP for species-specific leases such as waterfowl by using a stratified, sampling design based on species.

Literature Cited

BAUM, C.F. 2006. *An introduction to modern econometrics using Stata.* A Stata Press Publication, StataCorp LP, College Station, TX. 341 p.

BENSON, E.D. 2001. Wildlife and recreation management on private lands in the United States. *Wildl. Soc. Bull.* 29(1):359–371.

BISHOP, R.C., AND T. HEBERLEIN. 1979. Measuring values of extramarket goods: Are indirect measures biased? *Am. J. Agric. Econ.* 61(5):926–930.

BREEN, R. 1996. *Regression models: Censored, sample-selected, or truncated*. Sage Publications, Inc., Thousand Oaks, CA. 80 p.

BROWN, L.T., T.A. MESSMER, AND D.J. DECKER. 2001. Access for hunting on agricultural and forest lands. P. 269–288 in *Human dimensions of wildlife management in North America*, Decker, D.J., T.L. Brown, and W.F. Siemer (eds.). The Wildlife Society, Bethesda, MD. 447 p.

BULLER, V.M., M.D. HUDSON, G. PARKHURST, AND A.F. WHITTINGTON. 2006. *The impact of hunting packing attributes on hunting package prices in Mississippi.* Research Report 2006-01. Department of Agricultural Economics, Mississippi State University, Mississippi State, MS.

CAMERON, T.A., AND M.D. JAMES. 1987. Efficient estimation methods for close-ended contingent valuation surveys. *Rev. Econ. Stat.* 69(2):269–276.

CORDELL, H.K., J.C. BERGSTROM, R.J. TEASELY, AND J.A. MAETZOLD. 1998. Trends in outdoor recreation and implications for private land management in the East. P. 4–10 in *Proceedings: Natural resources income opportunities for private lands*, Key, J.S., G.R. Goff, P.J. Smallidge, W.N. Grafton, and J.A. Parkhurst. (eds.). University of Maryland, Cooperative Extension Service, College Park, MD.

DEATON, A., AND J. MUELLBAUER. 1980. *Economics and consumer behavior*. Cambridge University Press, New York, NY. 450 p.

EKLOF, J.A., AND S. KARLSSON. 1999. *Testing and correcting for sample selection bias in discrete choice contingent valuation studies.* SEE/EFI Working Paper Series in Economics and Finance, No. 171. Department of Economic Statistics, Stockholm School of Economics, Stockholm, Sweden.

GREENE, W.H. 2008. *Econometric analysis*. 5th ed. Prentice Hall, Upper Saddle River, NJ. 1178 p.

HAAB, T.C., AND K.E. MCCONNELL. 2002. *Valuing environmental and natural resources: The econometrics of non-market valuation*. Edward Elgar Publishing, Northampton, MA. 352 p.

HUSSAIN, A., D. ZHANG, AND J. ARMSTRONG. 2004. Willingness to pay for hunting leases in Alabama. *South. J. Appl. For.* 28(1):21–27.

HUSSAIN, A., I.A. MUNN, S.C. GRADO, B.C. WEST, W.D. JONES, AND J.C. JONES. 2007. Hedonic analysis of hunting lease revenue and landowner willingness to provide access. *For. Sci.* 53(4):493–506.

JEANTY, P.W. 2007. Constructing Krinsky and Robb confidence interval for mean and median willingness to pay (WTP) using Stata. In *Proc. of the 6th North American Stata Users Group Meeting, Aug. 13–14, 2007, Boston, MA*.

KNOCHE, S., AND F. LUPI. 2007. Valuing deer hunting ecosystem services from farm landscapes. *Ecol. Econ.* 64(2):313–320.

KUATE-DEFO, B., AND J. DAVANZO. 2006. Reliability of reasons for early termination of breastfeeding: Application of a bivariate probability model with sample selection to data from surveys in Malaysia in 1976–77 and 1988–89. *Popul. Stud.*

60(1):83–98.

LOOMIS, J.B. 1990. Comparative reliability of the dichotomous choice and open-ended contingent valuation techniques. *J. Environ. Econ. Manag.* 18(1):78–86.

LOOMIS, J.B., AND L. FITZHUGH. 1989. Financial returns to California landowners for providing hunting access: Analysis and determinants of returns and implications to wildlife management. P. 196–201 in *Transactions of the 54th North American Wildlife and Natural Resources conference.* Wildlife Management Institute, University of California–Davis, Davis, CA.

MACKENZIE, J. 1990. Conjoint analysis of deer hunting. *Northeast. J. Agric. Resour. Econ.* 19(1):109–117.

MESSONNIER, M.L., AND E.J. LUZAR. 1990. Factors influencing the decision to lease Louisiana forest land for hunting. *Louisiana Rural Econ.* 52(7):7–12.

MIRANDA, A., AND S. RABE-HESKETH. 2006. *SSM: STATA program to estimate endogenous switching and sample selection models for binary, count, and ordinal variables using ML.* Statistical Software Components S456509, Boston College Department of Economics, Boston, MA.

MOZUMDER, P., C.M. STARBUCK, R.P. BERRENS, AND S. ALEXANDER. 2007. Lease and fee hunting on private lands in the U.S.: A review of the economic and legal issues. *Hum. Dimens. Wildl.* 12:1–14.

RHYNE, J.D., I.A. MUNN., AND A. HUSSAIN. 2009. Hedonic analysis of auctioned hunting leases: A case study of Mississippi 16th Section Lands. *Hum. Dimens. Wildl.* 14(4):227–239.

U.S. DEPARTMENT OF THE INTERIOR, FISH, AND WILDLIFE SERVICE. 2007. *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. NCTC Publication Unit, U.S. Fish and Wildlife Service, Shepherdstown, WV. 164 p.