**Factors Determining Per Acre Market Value of Hunting Leases
on Sixteenth Section Lands in Mississippi***

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**Abstract:** We examined hunting lease prices on Sixteenth Section Lands in Mississippi. Hunting leases are auctioned to the highest bidder via sealed bids with the current lessee given the right to match the highest bid. The hedonic method was used to measure the impact of cover type, average Boone and Crocket score and location on hunting lease revenue. Lands in southwest MS with a greater proportion of hardwoods and higher B&C scores generated more revenue than otherwise similar lands in the rest of Mississippi. A policy implication was that land managers may be able to increase revenue by investing in habitat improvement.

**Keywords:** Boone and Crocket score, hedonic pricing, hunting leases, market segmentation, Sixteenth Section Lands

## Introduction

The state of Mississippi was formed from a portion of the Mississippi Territory in 1817. While creating the boundaries for the state, Congress set aside the sixteenth section of every township in Mississippi to support public education. School Boards in Mississippi control all such set aside lands within their school district. Sixteenth Section Lands generate income for education through the sale of timber and from various leases such as oil, gas, mineral, and hunting.

Hunting leases on Sixteenth Section Lands are awarded to the highest bidder in a sealed bid auction. The hunting leases are usually advertised in local newspapers. Interested parties respond by bidding on the lease. The highest bidder is awarded the lease with the current lessee given the option of retaining the lease by matching the highest bid. Hunting leases on Sixteenth Section Lands generated more than 2.5 million dollars in revenue in 2005. Approximately 300,000 acres of Sixteenth Section Lands in Mississippi were leased for hunting.

Many factors affect hunter willingness to pay for hunting rights on a particular location. Factors such as game quality, habitat quality and location have proven to impact hunting lease prices (Livengood 1983, Loomis et al. 1989, Stribling 1992). The objective of this study was to determine the impact of these factors on hunting lease prices for Sixteenth Section Lands in Mississippi. Hunting leases are made up of a collection of inseparable attributes such as habitat quality, game quality and location. The underlying hypothesis of this study was that each of these attributes influences the amount of revenue that a hunting lease generated. Understanding how these factors influence hunting lease prices on Sixteenth Section Lands will provide School

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Boards with base line information to evaluate the performance of their lease program relative to the rest of the state and suggest ways to improve lease revenues in the future.

**Methods and Data**

The hedonic method (Rosen 1974) was used to decompose the lease price, and determine the contribution of habitat quality, game quality, and market segmentation to lease price. The method has been used by others to determine the impact of individual lease characteristics on lease prices (Zhang et al. 2006, Munn et al. 2005). Accordingly, the hedonic price equation was specified as:

Lease price per acre = $F$ [habitat quality, game quality, location]

The dependent variable was the gross lease revenue per acre expressed in logarithmic form (log revenue). Habitat quality was represented by the percentage of the leased area in various forest cover types such as pines, hardwoods, mixed pine-hardwoods, open lands, recently regenerated lands, and water. Game quality was approximated by an average Boone and Crocket score for bucks in the county. Market segments were delineated into three broad regions based on the major population centers in the state. The resulting market segments were southwest Mississippi, northwest Mississippi, and east Mississippi. As hedonic pricing theory does not dictate which functional form to use, we experimented with several options. The semi-logarithmic form best fit the data. Hunting leases that contained 600 or more acres were selected for analysis. This restriction was imposed because cover type information was provided for the entire section although leases could cover all or part of a section. Selecting hunting leases with at least 600 acres leased allowed us to appropriately match the cover type information that applied to a particular lease. A total of 169 hunting leases were included.

*Lease price and number of acres leased.* Hunting lease information was provided by the Public Lands Division of the Mississippi Secretary of State's Office. For each hunting lease, collected information included; the number of acres leased and the amount of revenue generated.

*Cover type.* Cover type information was provided by the Mississippi Institute of Forest Inventory (MIFI). The information included the number of acres in the following cover types for each sixteenth section: pine, hardwoods, mix pine-hardwoods, water, regenerated, and open. Acreages by cover type were converted to percentage of the total sections. Percent hardwood was the base (omitted) category in the regression analysis.

*Average Boone and Crocket Scores.* County average Boone and Crocket scores were derived from an antler index that approximates the projected average Boone and Crocket Score for each county (Strickland and Demarais 2000). The index is derived from deer harvest data collected by the Mississippi Department of Wildlife Fisheries and Parks through the Deer Management Assistance Program (DMAP). DMAP monitors the deer population in Mississippi by taking biological samples from harvested game on wildlife management areas and from participating landowners. Data includes antler measurements and deer weight.

*Geographic Regions of the state.* The state was divided into three regions to determine the impact of market segmentation on hunting lease revenue. The three geographic regions selected were east Mississippi, southwest Mississippi, and northwest Mississippi. The northwest and southwest regions include the Mississippi Delta which is a highly demanded hunting area. To model market segmentation, three dummy variables were introduced to differentiate between regions. For instance, the dummy variable for northwest MS =1 for hunting leases in this region, else 0. Dummy variables for other regions were similarly constructed. The dummy for the east region served as the base category in estimation.

## Results

*Descriptive statistics.* The average annual lease price was $5,041.37 or $7.93 per acre. Pine stands constituted 45% of the leased area, hardwoods 28%, mixed pine-hardwoods 13%, regenerated forests 8%, and open land and water accounted for the residual. The average projected average Boone and Crocket Score by county was 110.

Table 1. Descriptive statistics related to hunting leases on Sixteenth Section Lands in Mississippi in 2005 (N=169)

| Variables | Mean | Std Dev. |
|---|---|---|
| Annual lease price ($) | 5,041.37 | 4,248.03 |
| Annual lease price/acre ($) | 7.93 | 6.61 |
| Log lease price/acre | 1.83 | 0.66 |
| Avg. tract size (acres) | 636.98 | 17.10 |
| Log-acres leased | 6.46 | 0.03 |
| Southwest Mississippi | 0.40 | 0.49 |
| Northwest Mississippi | 0.11 | 0.31 |
| East Mississippi | 0.49 | 0.50 |
| % Pine | 45.03 | 29.10 |
| % Mixed pine-hardwoods | 13.01 | 8.50 |
| % Water | 0.33 | 1.25 |
| % Water squared | 1.67 | 10.82 |
| % Regeneration | 7.85 | 10.51 |
| % Open | 5.27 | 9.54 |
| % Hardwoods | 28.51 | 28.16 |
| Avg. Boone & Crocket Score | 110.31 | 13.69 |

*Regression results.* Of ten coefficients included in the model, six were significant (Table 2). Our estimation results corroborate with findings by others (Stribling et al. 1992). For instance, of the set of variables representing habitat quality, percent pine and regenerated lands were associated with significantly negative coefficients. This suggested that pine cover types and recently regenerated lands reduced lease revenue. A one percent increase in the percent share of land with pines and regenerated areas caused lease price to decrease by 0.338 % and 0.068 %,

respectively.[1]  A one percent increase in the number of acres leased causes the average lease price to increase by 3.4 %.

The coefficient on water was positive while that on water squared was negative. Although the coefficient on water squared was marginally insignificant, this relationship indicated that increases in the proportion of water on a lease only increased lease prices to a point, after which lease prices decreased.  Specifically, water increased lease revenues as long as it did not take up more than 5 percent of the leased area.

*Game quality.* The estimated coefficient on the projected average Boone and Crocket Score by county was positive and significant.  A one percent increase in the projected average Boone and Crocket score increased the average lease price by 1.08 % per acre.  This indicates that game quality is important to hunters in Mississippi.

*Market segmentation.* The dummy variable representing southwest Mississippi was significant and positive in the model.  Hunting leases in this region generated approximately 15% higher revenues than hunting leases in the eastern portion of the state.[2] These results are understandable because hunting lands in the southwestern portion of the state are some of most desirable.  This is largely due to duck hunting which is more prevalent in the western parts of the state and the proximity of these hunting leases to urban areas such as Jackson, Mississippi, and Baton Rouge, Louisiana

Table 2.  Estimated coefficients of hedonic price model for hunting leases on Sixteenth Section Lands in Mississippi in 2005 (N=169).

| Variable | Coefficient ($\hat{\beta}_k$) | P-Value | Elasticities |
|---|---|---|---|
| Independent Variables | | | |
| Log-acres leased | 3.413 | 0.031 | 3.413 |
| Southwest MS | 0.261 | 0.036 | 15.160 |
| Northwest MS | 0.274 | 0.120 | 25.337 |
| % Pine | -0.007 | 0.001 | -0.338 |
| % Mixed pine-hardwoods | 0.003 | 0.620 | 0.033 |
| % Water | 0.172 | 0.099 | 0.055 |
| % Water squared | -0.019 | 0.110 | -0.030 |
| % Regeneration | -0.086 | 0.051 | -0.068 |
| % Open | -0.005 | 0.268 | -0.027 |
| Avg. Boone & Crocket Score | 0.010 | 0.030 | 1.081 |

[1]  Elasticities, evaluated at means, for explanatory variables were derived by using: $\partial \log price / \partial x_k = \hat{B}_k \overline{X}_k$ . Elasticities effect for log-acres leased was based

on $\partial \log price / \partial \log leased, acres = \hat{B}_{acres.}$ .  For details, see Johnson et al. (1987), p. 251.
[2]Calculated using Halvorsen and Palmquist (1980) and Kennedy (1981) elasticity effects for dummy variables: $\{Exp[\hat{\beta}_k - 1/2V(\hat{\beta}_k)] - 1\} * 100$. (V is equal to Std Dev (Table 1) squared).

**Summary**

This study used the hedonic price method to determine how habitat quality, game quality and location impacted hunting lease prices on Sixteenth Section Lands in Mississippi. All three variables significantly influenced hunting lease prices.

Our findings that pine and regenerated areas did not generate as much lease revenue as hardwoods is consistent with results found by Stribling et al. (1992) in Alabama. Hunters perceive that pine and regenerated areas do not provide as high quality habitat for game as leases that contain plentiful hardwoods. Therefore, hunters are not willing to pay as much for a hunting lease that contains pine and regenerated areas as they would for a comparable hunting lease in size and location in hardwoods.

The results of this study agreed with findings of other researchers that showed that hunting leases with a year round water supply generate greater revenue (Munn et al. 2005 and Zhang et al. 2006). However, this study also found that too much water at a particular location causes the lease price to decrease. Having a water source improves habitat for game but wetland areas can impede access and make removal of harvested game difficult (Harper et al. n.d.).

Our findings agreed with results by other studies (Standiford and Howitt 1993, Pope and Stoll 1985, and Messonnier and Luzar 1990) that there is a positive relationship between lease revenue per acre and average lease size. Other studies, however, have found a negative relationship (Shrestha and Janaki 2004).

Our study found that hunters are willing to pay more money to have the opportunity to hunt better quality game in Mississippi. This result corroborated findings by Loomis and Fitzhugh (1989) and Standiford and Howitt (1993). Uncommon quality game is prized by hunters.

Lease revenue varied across regions of the state. Hunting leases in the southwestern region were significantly greater than hunting leases in the eastern region. This shows that there are different hunting markets in Mississippi which must be accounted for in modeling lease markets. This is very similar to the results that Pope and Stoll (1985) who examined the impact of market segmentation on hunting leases in Texas. It is important that future studies using the hedonic method to examine hunting lease prices consider the impact of market segmentation.

Different hunting markets could be attributed to supply and demand of hunting areas in state. For example, hunting leases in the southwestern region are very desirable and command a premium largely due to the duck hunting that occurs in the Delta. Areas for duck hunting are not nearly as plentiful in the eastern region. The results also suggest that hunters in different regions of the state do not purchase hunting leases in other regions. It might be that because hunters prefer a hunting location near their home. Having a hunting lease located nearby, allows the hunter to take more hunting trips and decreases the time and cost associated with hunting.

**Discussion**

Based on these findings, School Boards can improve hunting lease revenues in several ways. First, improving wildlife habitat by planting mast-producing trees in pine stands and refraining from harvesting all mast-producing trees on regenerated areas can increase hunting revenue. Second, water on the property also increases lease revenue suggesting that creating water bodies (e.g. ponds, water impoundment levees, etc.) on leased areas that do not have a natural water source may be a viable practice. Third, in light of the fact that larger leases generated more per acre revenue, School Boards should consider bundling larger blocks together, instead of breaking sections up into multiple leases. This study did not examine the costs of making these changes; however, assistance is available from Federal Agencies and NGOs. The costs of these changes are worth considering because Sixteenth Section Lands will be owned by the schools in Mississippi for the foreseeable future. This will provide a long horizon in which to recoup costs incurred from providing better habitat. Each School Board must decide if these suggested changes would be worthwhile.

The model also provides School Boards with an estimate of how much revenue their hunting leases should generate based upon the characteristics of those leases. If a lease does not generate as much revenue as other leases with comparable characteristics, a possible solution might be a more intensive marketing strategy for the lease.

**Literature Cited**

Halvorsen, R., and R. Palmquist. 1980. The interpretation of dummy variables in semi-logarithmic equations. Am. Econ. Rev. 70(3):474-475.

Harper, A.C., E.C. Dixon, M.P. Jakus, and D.A. Barefield. n.d. Earning additional income through hunt leases on private land. The Agricultural Extension Service. The University of Tennessee, PB1627.

Johnson, A.A., M.B. Johnson, and R.C. Buse. 1987. Econometrics:basic and applied. Macmillan Publishing, Inc. New York USA.

Kennedy, E.P. 1981. Estimation with correctly interpreted dummy variables in semi-logarithmic equations. Am. Econ. Rev. 71(4):801.

Livengood, K.R. 1983. Value of big game form markets for hunting leases: the hedonic approach. Land Econ. 59(3):287-291.

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. Trans N. Am. Wildl. Natur. Resourc. Conf: 197-201.

Messonnier, M.L., and E.J. Luzar. 1990. A hedonic analysis of private hunting land attributes using an alternative functional form. South. J. Agric. Econ. 22(2):129-135.

Munn, I.A, E.K. Loden, S.C. Grado, J.C. Jones, and W.D. Jones. 2005. Comparing hunting lease prices: A price decomposition approach. P. 193-200 in: Proceedings of the 2004 Annual Southern Forest Economics Workshop. Alavalapati, R.R. and D.R. Carter, eds. March 14-16, 2004. St. Augustine, FL.

Pope, C.A., and J.R. Stoll. 1985. The market value of ingress rights for white-tailed deer hunting in Texas. South. J. Agric. Econ. 17(1):177-182

Rosen, S. 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. J. Polit. Economy 82:34-555.

Shrestha, R.K., and R.A. Janaki. 2004. Effect of ranchland attributes on recreational hunting in Florida: A hedonic price analysis. J. Agric. Appl. Econ. 36(3):763-772.

Standiford R.B., and R.E. Howitt. 1993. Multiple use management of California's hard-wood rangelands. Journal of Range Management 46(2):176-182.

Stribling, H.L., J.P. Caulfied, B.G. Lockaby, D.P. Thompson, H.E. Quicke, and H.A. Clonts. 1992. Factors influencing willingness to pay for deer hunting in the Alabama piedmont. South. J. Appl. For. 16(3):125-129.

Strickland, B.K., and S. Demarais. 2000. Age and regional differences in antlers and mass of white-tailed deer. J. Widl. Manage 64:903-911.

Zhang, D., A. Hussain, and J.B. Armstrong. 2006. Supply of hunting leases from non-industrial private forest lands in Alabama. Human Dimensions of Wildlife 11:1-14.