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Research Article

The Economic Value of Publicly Accessible Deer Hunting Land

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ABSTRACT Access to lands for hunting is widely recognized as critical to sustaining and developing participation in hunting. Deer hunters comprise a substantial portion of recreational hunters in the United States, and numerous stakeholders benefit from the deer management services provided by hunters on public lands. We estimated the economic value of publicly accessible deer hunting land in Michigan using economic models of hunting destinations for hunters in the archery season and for hunters in the firearm season. We found that the amounts of state-owned hunting land, federally owned hunting land, and publicly accessible, privately owned Commercial Forest Act land are significant ($P < 0.001$) and positive determinants of hunting destinations. The annual economic value of Michigan's publicly accessible hunting land to archery and firearm deer hunters, beyond hunter expenditures, was estimated to be over $80 million. Access to state-owned land accounted for approximately $50 million in annual economic value to Michigan deer hunters. The average per-acre value of publicly accessible hunting land is greatest in the Southern Lower Peninsula of Michigan, where public access is scarce and the majority of hunters reside. Understanding the economic values hunters derive from publicly accessible hunting lands will enable managers and policy makers to make better decisions when considering policy options that involve reducing or increasing public access.

KEY WORDS access, economics, hunting, Michigan, *Odocoileus virginanus*, white-tailed deer.

In 2006, nearly 4.9 million hunters in the United States spent over 54 million days hunting on publicly owned land, with 1.9 million hunters hunting exclusively on public land, and 3 million hunters hunting on both public and private land (U.S. Department of the Interior [USDOI] 2006). Popular publicly owned hunting options for hunters are federally owned land, such as national forests, and state-owned land, such as state forests, state game and wildlife areas, and state parks and recreation areas. The demand for and importance of publicly accessible land to hunters have not gone unnoticed by wildlife managers and policy makers. The Sporting Conservation Council, created in 2006 to advise the Department of Interior, identified constraints to access as one of the leading impediments to sustaining and developing participation in hunting and shooting activities (Recce 2008). This organization, along with the American Wildlife Conservation Partners (a consortium of 42 wildlife conservation organizations including the Association of Fish and Wildlife Agencies and the National Rifle Association) recommends providing additional tax and financial incentives to private landowners for voluntary programs to enhance wildlife habitat and hunter access (American Wildlife Conservation Partners 2008). Executive Order 13443, "Facilitation of Hunting Heritage and Wildlife Conservation," has as a primary purpose the expansion and enhancement of hunting opportunities, and also instructs government agencies to consider the economic and recreational values of hunting, as appropriate. Numerous state wildlife management agencies have implemented programs that provide incentives to private landowners to make their land publicly accessible for hunters. Helland (2006) reports that 11 states (primarily west of the Mississippi) have Walk-In Hunting Access (WIHA) programs that facilitate access to private land. According to Benson (2001), 40% of state wildlife management agencies reported having a program in place to assist with access-related issues for hunted and/or non-hunted species, and 96% of agency administrators reported that access to private land was important for their organizations' objectives. More recently, the 2008 Farm Bill included $50 million in financial support for voluntary, state-run programs that provide incentives to encourage landowners to provide public access to their land.

Despite the substantial use of public land by hunters and the importance federal and state agencies place on public access, there is little information available regarding the economic value of publicly accessible hunting areas. Research related to this area has been primarily limited to the estimation of economic values associated with big game

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hunting experiences that occur on publicly owned land. González-Cabán et al. (2003) used the contingent valuation approach to estimate the economic value of big game habitat from natural and prescribed fires in California's San Bernadino National Forest. Luzar et al. (1992) estimated consumer surplus for deer hunting at a Louisiana Wildlife Management Area. Fried et al. (1995) used a travel cost model to estimate the willingness to pay for an opportunity to shoot elk in the Starkey Research Forest in Oregon.

Although the activities in the studies listed above take place on public land, the studies do not directly estimate the economic value of publicly owned land to big game hunters, even though it is likely that these hunters derived economic values specific to the publicly accessible nature of the land that was hunted. Big game hunters spent about 37 million days hunting public land in 2006, which indicates the importance of public land to hunters and suggests that economic value of this land to hunters may be quite substantial as well. About 94% of individuals hunting big game in 2006 pursued deer, whereas 7% pursued elk, 4% bear, and 5% another big game species (not including wild turkey; USDOI 2006). Although deer hunts may be valued less, on a per-trip basis, than hunts for elk or bear, the large number of deer hunters relative to other big game hunters suggests that on an aggregate level, economic values associated with deer hunting would likely be greater than those for other species.

Publicly accessible hunting land, aside from providing benefits to deer hunters, also provides deer herd management services that benefit other stakeholders through a reduction of negative deer herd impacts such as deer depredation of crops and landscape plantings, car–deer collisions, and deer-inflicted damage to natural ecosystems. Losses to crop yields from deer depredation may be substantial, with a nationwide damage estimate of $100 million annually (Conover 1997) and 67% of farmers nationwide reporting deer damage to crops (Conover 1994). Numerous research papers have documented the damage large deer populations can inflict on forests by browsing herbs, shrubs, and trees (Stromayer and Warren 1997, Waller and Alverson 1997, Alverson et al. 1988, Rooney 2001, Horsley et al. 2003). The resulting change in forest structure has also been found to negatively affect intermediate canopy nesting (ICN) songbirds (e.g., American robin [*Turdus migratorius*] and eastern phoebe [*Sayornis phoebe*]), with abundance of ICN songbirds declining 37% and mean species richness of ICN songbirds declining 27%, from lowest to highest deer densities (deCalesta 1994). Additionally, commercial foresters experience negative impacts from deer populations. In 1996, 14% of nursery owners in the northeastern United States reported damages exceeding $10,000 (Lemieux et al. 2000). Conover (1997) estimated that the deer-inflicted monetary damages realized by timber harvesters totals roughly $750 million annually. As deer populations continue to rise in suburban and urban areas, damage to ornamental shrubbery, landscaping, and gardens has become more common (Sayre et al. 1992, McCullough et al. 1997, West and Parkhurst 2002). Car–deer collisions are yet another significant negative impact. Conover (2002) estimated about 1.5 million car–deer collisions occur annually in the United States, with a total cost of over $1 billion, along with 29,000 injured people and 211 lost lives. In Michigan, about 65,000 car–deer collisions occur annually, with a mean vehicle damage of $2,300 (Marcoux et al. 2005). These collisions result in about $150 million in annual vehicle damages, though other costs to car–deer collisions (e.g., injuries and lost work time) indicate that total costs from these collisions in Michigan are likely much greater. Although lethal alternatives to hunting, such as sharpshooting (DeNicola and Williams 2008), and non-lethal alternatives, such as translocation (Beringer et al. 2002) and immunocontraception (Rudolph et al. 2000), have been used selectively in urban and suburban areas where human density is high, recreational hunting is the primary method to manage deer herds and minimize negative impacts (Riley et al. 2003).

Public access to land for deer hunting provides the dual function of reducing negative impacts to stakeholders in the area while providing value to deer hunters. Although several studies estimate the economic value to individuals that hunt on public land, there is a need for estimates of the value of public access and specifically the relative value of different types of publicly accessible hunting land. Furthermore, although numerous studies estimate economic values associated with private hunting lands, particularly regarding the market for hunting leases (e.g., Messonier and Luzar 1990, Baen 1997, Shrestha and Alavalapati 2004, Zhang et al. 2006), there is a need for research examining the economic values accruing to hunters from programs or policies that make privately owned hunting land publicly accessible. Our objective is to determine whether publicly accessible hunting land influences hunter site choice, and if so, estimate the economic value associated with various types of publicly accessible hunting land.

STUDY AREA

Our study area consisted of the entire state of Michigan. We considered 3 regions: Upper Peninsula, Northern Lower Peninsula, and Southern Lower Peninsula (Fig. 1). In the Southern Lower Peninsula, cropland constituted about 40% of the land area (Michigan Department of Agriculture 2009), with less than 3% of land in public ownership (Squibb and Hill 1988). Deer abundance was high, relative to the other 2 regions. The majority of Michigan residents lived in the Southern Lower Peninsula, and this region included large metropolitan areas such as the Detroit area (4.4 million people), Grand Rapids area (780,000), Lansing area (450,000), Flint area (420,000), and numerous other mid-size towns and cities (U.S. Census Bureau 2010*a*). In 2007, about 5.5 million hunter days were spent hunting deer in the Southern Lower Peninsula (Frawley 2009). Michigan's Upper Peninsula was lightly populated, with a population of 310,000 (U.S. Census Bureau 2010*b*), and there was an abundance of federal, state, and privately owned, publicly

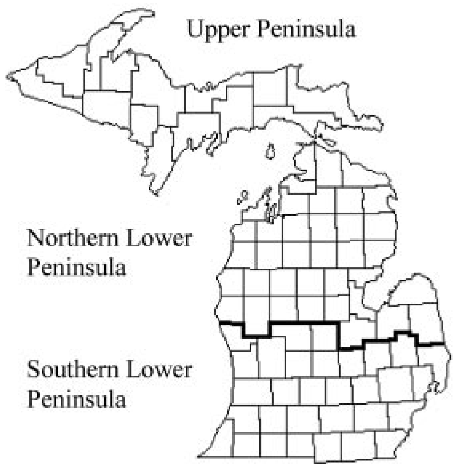

Figure 1. Geographic regions of Michigan used to evaluate the economic value of publicly accessible hunting land to deer hunters in Michigan in 2002.

accessible land available for hunting. Deer density and hunting pressure (1.1 million hunter days in 2007; Frawley 2009) were relatively light compared to the 2 other regions. The Northern Lower Peninsula was characterized by intermediate levels of human population, deer population, publicly accessible hunting land, and hunting pressure in comparison to the other 2 regions.

During the study period, Michigan provided individuals with numerous opportunities to hunt on publicly accessible land. There were 3 national forests in Michigan: Ottawa, Hiawatha, and the Huron-Manistee. Ottawa National Forest consisted of about 1 million acres of forest in the Western Upper Peninsula. Hiawatha National Forest consisted of 2 main segments, 1 segment in the Central Upper Peninsula and the other segment in the Eastern Upper Peninsula, with a total size of 880,000 acres. Huron-Manistee National Forest consisted of about 980,000 acres in 2 main segments, 1 segment in the Central-Western portion of the Lower Peninsula, and the other in the Northeastern portion of the Lower Peninsula. The USDA Forest Service runs the National Visitor Use Monitoring program (English et al. 2002), which in 2007 estimated 36,500 hunting-related trips were taken to the Ottawa National Forest, 58,000 to Hiawatha National Forest, and over 1 million to Huron-Manistee National Forest (United States Department of Agriculture Forest Service, unpublished reports).

Two National Lakeshores and United States Fish and Wildlife Service-managed land are also options for hunters, though they contain a relatively small percentage of land in Michigan relative to National Forest. Sleeping Bear Dunes National Lakeshore in the Northwestern Lower Peninsula and Pictured Rocks National Lakeshore in the Upper Peninsula contain about 129,000 acres of publicly accessible hunting land. United States Fish and Wildlife Service-managed lands contain about 116,000 acres of publicly accessible hunting land (in some of these areas some types of hunting are subject to seasonal restrictions in addition to state game regulations), with the majority of this land (95,000 acres) being in the Seney National Wildlife Refuge in the Upper Peninsula.

State-owned land is a popular option for Michigan hunters as well. Six state forests in Michigan contain about 3.8 million acres of publicly accessible hunting land. About half of this land is located in the Northern Lower Peninsula of Michigan (Au Sable, Pere Marquette, and Mackinac State Forests), with the rest of the land located in the Upper Peninsula (Copper Country, Lake Superior, and Escanaba River State Forests). Information is scarce regarding the usage of State Forests by hunters, though Nelson and Lynch (1994) estimated that deer hunters spent roughly 236,000 days hunting in Au Sable State Forest. There are numerous State Game and Wildlife Areas in Michigan with about 490,000 acres of hunting land. The majority (59%) of State Game and Wildlife Area land is located in the Southern Lower Peninsula of Michigan, where about 8.5 million people reside (U.S. Census Bureau 2010*b*). As with State Forests, little information is available regarding hunter visitation rates to these areas, though a 2005 study on recreational use of the Maple River State Game Area (located in the Southern Lower Peninsula of Michigan) estimated that about 6,700 people visited the area during the fall hunting season, spending about 52,000 person-hours at the site (Nelson et al. 2006). About 90% of individuals visiting the area reported hunting and/or trapping.

The State of Michigan also provides incentives to landowners to provide public access to their privately owned lands. Commercial timber operations and other landowners pay reduced property taxes by enrolling land in Michigan's Commercial Forest Act program, which permits hunters and anglers to hunt and fish on enrolled private property. About 2.2 million acres of land is enrolled in this program, with the majority of this land located in the Upper Peninsula. Additionally, the State of Michigan, through the Hunter Access Program, leases land from agricultural landowners in the Southern Lower Peninsula of Michigan to provide access for hunters. However, enrollment in this program has been declining for some time, and is currently about 8,000 acres, well below the peak enrollment of 189,000 acres reported by Oliver (2005).

METHODS

Data

To answer our research question, we used the travel cost method (discussed in the next section). We obtained data for the travel cost model from the 2003 Michigan Deer Hunter Survey, which was mailed to 3,000 Michigan residents who purchased a deer hunting license in 2002. In order to obtain a satisfactory number of responses from hunters in less populated regions in Michigan, a stratified random sample approach was used, in which Upper Peninsula, Northern Lower Peninsula, and Southern Lower Peninsula residents were each mailed 1,000 surveys. Of the 3,000 surveys mailed out, 925 were not returned and an additional 119 were non-deliverable. There were 1,955 surveys returned out of 2,881 valid addresses (68% response rate). Given the high survey response rate, and because hunter demographics from this survey compared favorably to a much larger survey of Michigan deer hunters (Frawley 2003), a non-response survey was not conducted.

Hunters surveyed were asked numerous attitudinal, behavioral, and demographic questions. For the purposes of our study, we were most interested in hunter responses to questions designed to elicit the location and number of hunting trips, as well as demographic questions regarding location of residence and income. The trip questions requested that hunters indicate the number of trips taken to their most frequented hunting site both within and outside a 50-mile radius of the hunter's residence. We used this information to construct the dependent variable, Total_Trips. The choice set for hunting trips was the set of counties in Michigan (83 counties), that is, hunters chose a county as a hunting destination.

The survey included a detailed map of Michigan with major roads, cities, and county boundaries in order to assist hunters in identifying the county hunted. Survey recipients were asked to indicate whether trips occurred in the firearm (rifle/shotgun) or the archery season (the seasons do not overlap). We estimated separate travel cost models for each of these seasons. Although the survey included questions regarding the hunting trips and site choice of muzzleloader hunters, we determined there was insufficient data to estimate a third travel cost model based on these hunters. Because some hunters hunt in both seasons, the firearm model contained 1,419 hunters and the archery model contains 688 hunters.

We computed the variable Price to reflect the round-trip time and driving costs from each hunter's residence to each of the 83 different counties. For each survey respondent, we calculated the distance from the individual's residence to the zip code that was closest to the geographic center of each county (Lupi and Feather, 1998). We calculated the driving cost by multiplying the per-mile vehicle operating cost by the distance traveled. The 2002 per-mile operating cost, excluding fixed costs such as insurance, was 31 cents per-mile (American Automobile Association 2002). The other component of travel cost was time spent traveling to the site. To be conservative in our estimates, we used one-third of the individual's reported hourly wage as an estimate of the time component of travel costs (Parsons 2003). We computed the wage rate by dividing annual income by work hours per year. To estimate travel time, we assumed an average trip speed of 40 miles/hr.

We obtained the geographic size of each county (mean = 684 sq. miles, SD = 257) from the United States Census Bureau (2010*a*). We obtained data on the deer population per deer management unit from Michigan Department of Natural Resources (MDNR 2008). In the Lower Peninsula of Michigan, each county was a deer management unit, except in a select few areas with special management concerns. However, because this was not the case in the Upper Peninsula, some interpolation was necessary to translate the population of deer in each management unit to the counties. Thus, this variable measured the number of deer estimated in the county (mean = 22,862 deer, SD = 15,409).

The vast majority of publicly accessible hunting land in Michigan was National Forest, State Forest, and Commercial Forest Act land. To facilitate analysis of the benefits of publicly accessible land by ownership type, we created 3 variables that measured the number of acres of the 3 major ownership types of publicly accessible hunting land available in each county. We combined National Lakeshore land and United States Fish and Wildlife Service land with National Forest land to create a single variable for federally owned hunting land (mean = 33,402 acres, SD = 65,607). We combined State Parks, Recreation Areas open to hunting, and State Game and Wildlife Areas with State Forest land to create a single variable for state-owned lands (mean = 54,856 acres, SD = 60,102). The third variable exclusively represented Commercial Forest Act land (mean = 26,958 acres, SD = 66,460). Finally, region-specific dummy variables were also included in our model to capture any regional effects on hunter site choice that are not captured by other variables.

Economic Model

The travel cost method is often used to estimate economic values associated with outdoor recreation (Parsons 2003). The method uses the travel costs of reaching recreation sites as a part of the implicit price of those sites, and then estimates a demand relationship between those prices and the number of trips to the recreation sites. Once a demand model is derived, it can be used to compute economic value, which represents the net economic benefits to visitors, beyond their expenditures.

The net economic benefit, per person, is the difference between the highest amount an individual would be willing to pay for a recreational experience, and the cost actually incurred to participate. Just as an individual necessarily derives economic value from a retail purchase in the marketplace (the item would not be purchased if willingness-to-pay was below purchase price), an outdoor recreationist derives value from recreational experiences that require monetary expenditures in order to participate. To model hunter site choice and estimate economic values associated with publicly accessible hunting land, we used a multiple-site method referred to as the Random Utility Travel Cost Model (Freeman 1993, Grijalva et al. 2002, Knoche and Lupi 2007). The advantage of the Random Utility Travel Cost Model (as opposed to a single site travel cost model) is that one can estimate the economic values of site characteristics by examining the tradeoffs individuals make between the characteristics of various hunting sites and the costs of traveling to those hunting sites (Haab and McConnell 2002, Lupi et al. 2003, Parsons 2003).

With the Random Utility Model, individuals gain utility, or satisfaction, from visiting sites. The utility is a function of site characteristics (e.g., public access and deer population) and the costs of traveling to and from a site. The site characteristics typically do not vary among individuals, but the travel costs vary among sites as well as among individuals. Because not all site characteristics that are valuable to people can be measured by the researcher, the utility also contains a random term. Thus, the amount of utility derived from a particular site, assuming the commonly used linear form, can be expressed mathematically as

$$v_i = \beta_{\mathrm{tc}}\mathrm{tc}_i + \beta_q q_i + e_i$$

where v_i is the utility a person receives from visiting site i, tc_i is the trip cost for reaching site i, q_i is a vector of site characteristics, e_i is a random error term capturing unmeasured characteristics associated with site i, and βs are parameters (Parsons 2003). This site utility function gives the utility conditional upon a trip to the site. The greater the degree to which a site characteristic influences utility, the larger in magnitude the parameter will be for that particular characteristic; a negative sign on a parameter indicates that an increase in the variable decreases the utility from the site. We expected β_{tc} (i.e., travel cost parameter) to be negative, since an increase in travel costs to a site, all else equal, is expected to decrease an individual's utility with respect to that site. We hypothesized that site utility would increase with characteristics thought to be desirable for deer hunters, such as deer density or publicly accessible land.

In Random Utility Model theory, an individual chooses the site that offers that individual the highest utility. With this assumption, site k would be chosen over all other possible sites i when

$$\beta_{\mathrm{tc}}\mathrm{tc}_k + \beta_q q_k + e_k \geq \beta_{\mathrm{tc}}\mathrm{tc}_i + \beta_q q_i + e_i \text{ for all } i \text{ in } C$$

where C is the set of possible recreation sites one can visit. An individual's trip utility can thus be represented by

$$u = \max(v_1, v_2, \ldots v_c)$$

where u is the maximum utility obtainable from the C sites. If site k provides the individual with the highest level of utility, then the individual's utility from the trip is $u = v_k$. Because the site utility functions contain immeasurable characteristics represented by the error terms, we use probability functions to give the probability that site k is best among C alternatives. Specifically, the probability that a person chooses site k is

$$\Pr(\beta_{\mathrm{tc}}\mathrm{tc}_k + \beta_q q_k + e_k \geq \beta_{\mathrm{tc}}\mathrm{tc}_k + \beta_q q_k + e_k \text{ for all } i \text{ in } C)$$

To obtain estimates for the parameters of the utility functions, one needs to adopt a functional form for the probability functions. We follow convention and use the conditional logit form to estimate the probability an individual chooses site k as

$$pr(k) = \exp(\beta_{\mathrm{tc}}\mathrm{tc}_k + \beta_q q_k) / \sum_{i=1}^{C} \exp(\beta_{\mathrm{tc}}\mathrm{tc}_i + \beta_q q_i)$$

The probability of a trip to site k is a function of the travel cost and site quality attributes of site k, and the travel cost and site quality attributes of all the other substitute sites. These probability functions can be interpreted as the expected demand functions for the sites. Having formed the choice probabilities, the parameters can be estimated using Maximum Likelihood Estimation by choosing values for the βs to maximize the likelihood function, L, which is defined by

$$L = \prod_{n=1}^{N} \prod_{i=1}^{C} pr(i)^{r_{in}}$$

where $r_{in} = 1$ if individual n visited site i and equal to zero otherwise, and $pr(i)$ is the conditional logit form from the above equation.

Calculating Economic Values for Site Quality Changes

Once we estimated the parameters, we estimated the changes in economic value resulting from changes in recreational site attributes. A simple measure of the economic value of the site attributes of interest is obtained by dividing the estimated parameter of a site characteristic by the estimated parameter of the travel cost variable.

$$\text{Marginal implicit price} = \frac{\hat{\beta}_q}{-\hat{\beta}_{\mathrm{tc}}}$$

The estimated parameter, $\hat{\beta}_q$, in the above equation is associated with a site attribute and marginal implicit price represents the economic value associated with an incremental change in the quality or level of a site attribute across every site. In our application, the marginal implicit price illustrates how an equal increase in a type of public land across all sites impacts the economic value generated by a recreational trip.

For a quality change in some or all sites, the economic value is given by the change in the expected maximum utility with and without the changes in site attributes. When the site probability functions take the conditional logit form, this measure of economic value is computed as

$$\hat{S}_n = \frac{\ln\left\{\sum_{i=1}^{C} \exp(\hat{\beta}_{\mathrm{tc}}\mathrm{tc}_i + \hat{\beta}_q q_i')\right\} - \ln\left\{\sum_{i=1}^{C} \exp(\hat{\beta}_{\mathrm{tc}}\mathrm{tc}_i + \hat{\beta}_q q_i)\right\}}{-\hat{\beta}_{\mathrm{tc}}}$$

where $\hat{S}_n$ denotes the change in per-trip economic value resulting from a quality change at 1 or multiple sites, and the $\hat{\beta}s$ represent estimated parameters (Parsons 2003). To obtain the seasonal aggregate economic value of a quality change at some or all sites, $\hat{S}_n$ is multiplied by the estimated total number of archery and firearm hunting trips taken in Michigan, which is calculated by multiplying the number of individuals in the population (i.e., Michigan resident archery or firearm hunters) by the average number of archery or firearm trips taken by an individual during the season.

RESULTS

The firearm hunter model ($n = 1{,}429$) and archery hunter model ($n = 688$) were estimated with their full set of variables using Maximum Likelihood Estimation. Both fit the respective data quite well; we rejected the hypothesis that all parameters equaled 0 ($P < 0.0001$) for both models based on likelihood ratio tests. Of the 83 possible counties that are the hunting sites, the firearm model correctly predicted the county hunters chose 43.2% of the time and the archery model correctly predicted the county hunters chose 48.7% of the time. As expected, all public access variables for both firearm and archery models were significant and positive, indicating that an increase in the amount of federal, state, and Commercial Forest Act land increased the probability of a hunting trip to that county. Also, as expected, the probability of taking a trip to a county decreased as travel costs increased, and the probability of taking a trip to a county increased as the population of deer increased. Marginal implicit prices from deer population for the firearm and archery models were \$6.49 and \$3.65, respectively, which is the increase in per-trip economic value that a hunter realizes from increasing the population of deer by 10,000 in each county. Holding constant the amount of publicly accessible land in a county, the probability of a trip to a county decreases as the additional size of the county increases. That is, the results suggest that counties that are larger, but do not have any additional public hunting lands, are not as preferable to hunters. The variables for Upper Peninsula and Northern Lower Peninsula were significant and indicated that relative to the Southern Lower Peninsula, there are additional positive features of counties in these regions that are not captured by the other variables and that increase their probability of being chosen relative to the Southern Lower Peninsula counties (Table 1).

For both per-trip values and the seasonal value of access, state-owned land was the most valuable type of land in the firearm and archery models (Table 2). Eliminating state-owned land as an option for deer hunters would result in a reduction of seasonal economic value of approximately \$50 million. Eliminating the publicly accessible hunting land resulted in a reduction of economic value for firearm hunters of about \$54 million, and a reduction of almost \$27 million for archery hunters. The Upper Peninsula had the greatest aggregate value of publicly accessible hunting land, followed by the Northern Lower Peninsula and Southern Lower Peninsula (Table 3).

DISCUSSION

We show that the amount of state-owned, federally owned, and Commercial Forest Act land all increase the likelihood of a deer hunting trip to a particular county, for both archery and firearm hunters. Furthermore, our results show that public access provides over \$80 million/year in seasonal economic value for Michigan deer hunters—economic values accruing to hunters that are beyond their expenditures on hunting. The Upper Peninsula has the greatest aggregate economic value of publicly accessible hunting land, followed by the Northern Lower Peninsula and Southern Lower Peninsula. However, this is largely because of the distribution of public land in Michigan. There are roughly 5.7 million acres of publicly accessible hunting land in the Upper Peninsula, followed by about 3.4 million acres of public hunting access in the Northern Lower Peninsula and only about 400,000 acres of public hunting access in the Southern Lower Peninsula. The average per-acre value of public hunting land is greater in the Southern Lower Peninsula where public land is scarce and the cost of traveling to these sites for most hunters is relatively low. However, despite the Upper Peninsula having about 68% more publicly accessible hunting land than the Northern Lower Peninsula, per-acre values for the 2 regions are relatively comparable, with the average per-acre value being slightly greater in the firearm model, and being virtually the same in the archery model.

In our analysis, hunters have the option of hunting both publicly accessible land as well as privately owned land that is not accessible to the general public. We are unaware of any other papers, at a state-wide or a similarly large scale, which capture the value of publicly accessible hunting land while accounting for hunting on private land as a substitute. In our model, individuals were still able to hunt when publicly accessible land was eliminated, but they shifted to hunting on private land. To the extent that this option is unavailable to all hunters, we would be underestimating the economic value of publicly accessible hunting land.

Our research also provides insight into Michigan's Commercial Forest Act, a landowner-based incentive program that provides property tax reductions to private landowners as an incentive to retain and manage land for long-term timber production. Since lands in this program are open to the public for hunting and angling without the need to receive permission from the landowner, the opportunity existed to estimate the economic value resulting from the publicly accessible nature of this privately owned land. Our research shows that the public access provision of the Commercial Forest Act contributes \$19 million annually to Michigan deer hunters. This is about 50% greater than the seasonal value accruing to deer hunters from the existence of federal land, despite there being about 3 million acres of federal land accessible to hunters, compared to about 2.2 million acres of Commercial Forest Act land. Possible explanations for this include the perception (or reality) of

Table 1. Conditional logit results for firearm and archery models of deer hunting in Michigan in 2002.

	Firearm model			Archery model		
Variable	**Coef.**	**SE**	***P*-value**	**Coef.**	**SE**	***P*-value**
Price	−0.033	0.0003	<0.001	−0.039	0.0003	<0.001
Deer (10,000 deer)	0.213	0.0101	<0.001	0.141	0.0106	<0.001
Federal (100,000 acres)	0.348	0.0291	<0.001	0.636	0.0322	<0.001
State (100,000 acres)	0.795	0.0322	<0.001	0.908	0.0353	<0.001
CFA (100,000 acres)	0.999	0.0502	<0.001	0.927	0.0662	<0.001
Size (100 sq. miles)	−0.142	0.0089	<0.001	−0.109	0.0086	<0.001
Upper Peninsula	2.534	0.1144	<0.001	1.615	0.1469	<0.001
Northern Lower Peninsula	0.616	0.0344	<0.001	0.537	0.0321	<0.001

Table 2. Marginal implicit prices for an increase of 10,000 acres in each county of each type of publicly accessible hunting land, and the per-trip economic values and aggregate seasonal economic values to deer hunters for the existence at current levels of each type of publicly accessible hunting land in Michigan in 2002 (relative to there being 0 acres of that type of publicly accessible hunting land available for hunting).

	Firearm			Archery		
	Marginal implicit price	Per-trip value	Aggregate seasonal value	Marginal implicit price	Per-trip value	Aggregate seasonal value
Federal	$1.06	$2.00	$7,278,000	$1.64	$2.73	$5,488,000
State	$2.42	$9.12	$33,187,000	$2.35	$8.30	$16,747,000
Commercial Forest Act	$3.04	$3.99	$14,519,000	$2.40	$2.29	$4,621,000
All land eliminated		$14.81	$53,892,000		$13.24	$26,714,000

lesser hunter congestion due to the privately owned nature of the land, less congestion from competing users of the resources (e.g., hikers, backpackers, and campers) and/or higher quality deer due to beneficial timber management practices, though further research would be needed to clarify the reasons.

When considering the economic value individuals derive from the outdoor recreational use of public lands, it is important to recognize that for some public lands, hunting accounts for a small percentage of recreational trips, with deer hunting a smaller percentage yet still. This paper does not capture economic values associated with hunting other game species (e.g., turkey, bear, and small game) on public land, nor does it capture the economic values associated with the recreational experiences of a multitude of other users of public land resources, such as hikers, campers, anglers, wildlife watchers, and bicyclists. Since 8% of individuals visiting national forests in the United States indicated that hunting was the primary activity during their visit (Stynes and White 2005), aggregate economic values across the multitude of recreational users may be many times the economic values accruing to the recreational deer hunters examined in this paper. Furthermore, there are potentially substantial benefits accruing to other stakeholders through the deer management services provided by deer hunters, and the economic impact to local communities generated by nearby publicly accessible hunting lands.

MANAGEMENT IMPLICATIONS

Wildlife managers and policy makers at both the federal and state levels, along with numerous non-governmental organizations, have strongly emphasized the importance of public access to hunters and are advocating substantial efforts to improve access to hunting land. Our results confirm that continued investments in this area are appropriate; both publicly owned and privately owned, publicly accessible hunting lands are positive predictors of hunting site choice for deer hunters in Michigan, contributing in excess of $80 million in seasonal economic value to these hunters. Our results also confirm the importance and value of incentive-based programs that provide access to land for hunters. A single requirement of the broad-based Commercial Forest Act of Michigan—that owners make their lands publicly accessible for hunters and anglers—generates substantial economic value for deer hunters. Hunters in other states are likely to experience similar economic values from the adoption or continuation of programs that require landowners to provide public access for hunters and anglers as part of incentive-based land and timber management programs. There is also evidence that recent efforts to expand the Hunter Access Program in the Southern Lower Peninsula are appropriate. The average per-acre value to deer hunters of publicly accessible land in the Southern Lower Peninsula is about 2.8 times greater than current maximum annual payments ($10 per acre) and over 5 times greater than the average annual payments ($5.50 per acre) made to landowners by the State of Michigan. The MDNRs objective is to increase Hunter Access Program enrollment acreage to 15,000 acres by 2013 through the use of federal and state funds, including a $500,000 grant from the United States Department of Agriculture Voluntary Public Access and Habitat Incentive Program, to improve program outreach efforts as well as to increase landowner payments to a maximum of $25. As we have estimated that the aggregate annual economic value of public access in the Southern Lower Peninsula is about $28 per acre, increasing payments to encourage greater participation seems appropriate, given that our analysis does not capture values associated with hunting other species, nor does it address that there may be characteristics of Hunter Access Program land (e.g., proximity to agricultural land) that result in this land generating greater economic value than the average acre of publicly accessible hunting land in the Southern Lower Peninsula.

Table 3. Average per-acre economic values, and the per-trip economic values and aggregate seasonal economic values to deer hunters for the existence at the current level of all types of publicly accessible hunting land in 3 regions of Michigan in 2002 (relative to there being 0 acres of all types of publicly accessible hunting land available for hunting in the region of interest).

	Firearm			Archery		
	Average/acre	Per-trip value	Aggregate seasonal value	Average/acre	Per-trip economic value	Aggregate economic value
Upper Peninsula	$4.73	$7.42	$27,000,000	$1.81	$5.12	$10,331,000
Northern Lower Peninsula	$5.06	$4.80	$17,467,000	$2.98	$5.10	$10,290,000
Southern Lower Peninsula	$16.77	$1.85	$6,732,000	$11.16	$2.22	$4,479,000

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