



Economic Benefits of Publicly Accessible Land for Ruffed Grouse Hunters

SCOTT KNOCHE,¹ *Department of Fisheries and Wildlife, 13 Natural Resources, Michigan State University, East Lansing, MI 48824-1039, USA*
FRANK LUPI, *Department of Fisheries and Wildlife, 13 Natural Resources, Michigan State University, East Lansing, MI 48824-1039, USA; and*
Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, MI 48824-1039, USA

ABSTRACT Although numerous studies have focused on estimating economic benefits associated with big game hunting experiences, economic valuation efforts examining small game hunting have largely been neglected. This is especially surprising with respect to hunting grouse, a family of widely distributed upland game birds targeted by about 800,000 hunters in 2011. Furthermore, despite efforts by federal and state agencies directed at improving and increasing public land for recreational hunting purposes, a dearth of studies exist regarding the economic benefits of public land to hunters. Using the travel cost method and data from a 2008 survey of Michigan ruffed grouse hunters, we examine relationships between hunting site choice and publicly accessible hunting land. We find that federally owned land, state-owned land, and publicly accessible, privately owned Commercial Forest Act (CFA) land are positive predictors of hunter site selection ($P < 0.001$). Given this relationship, we then estimated the economic benefits of different types of publicly accessible land to ruffed grouse hunters by examining the willingness of hunters to incur increasing travel costs to hunt in counties with greater amounts of publicly accessible land. We estimated the economic benefits of publicly accessible hunting land for ruffed grouse hunters in Michigan to be over \$20 million in 2008, with economic benefits of CFA land comprising about \$6.9 million of this annual total. Estimating the economic benefits of publicly accessible hunting land for outdoor recreationists provides a useful metric for policy makers to use in evaluating how changes in the amount and nature of publicly accessible hunting land affects these individuals. © 2013 The Wildlife Society.

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Hunting small game is a popular outdoor recreational activity in the United States, with 4.5 million people spending about 51 million days and \$2.5 billion hunting rabbit, squirrel, pheasant, grouse, and other small mammals and birds in 2011 (U.S. Department of the Interior [USDOI] 2011). Monetary expenditures incurred by small game hunters on trips and equipment have the potential to generate substantial economic impacts to local communities, with many of these benefits accruing to rural economies of particular concern and interest to politicians and policy makers. As a result, much attention has been paid to these retail expenditures and resulting economic impacts, which include multiplier effects (initial spending and recirculation of those expenditures throughout an economy) and the jobs generated by the initial spending and re-spending of these dollars. From 2000 to 2003, retail sales related to small game hunting in the United States averaged \$443 million annually, generating annual multiplier effects of about \$1.2 billion and over 10,100 full and part-time jobs (Southwick Associates 2007).

Economic impacts such as those detailed above are widely available and can be useful for characterizing the importance of outdoor recreational activities such as small game hunting to regional or local economies. However, estimating the economic benefits (i.e., maximum willingness to pay minus total costs) accruing to outdoor recreation participants from aspects of the recreational experience provides managers with important insights into the effects of alternative management options on these individuals. Estimating the economic benefits associated with aspects of outdoor recreation requires the use of non-market valuation techniques, which have often been used to estimate economic benefits associated with big game hunting (e.g., elk [*Cervus canadensis*], Fried et al. 1995; pronghorn antelope [*Antilocapra americana*], Boxall 1995; moose [*Alces alces*], Sarker and Surry 1998; and white-tailed deer [*Odocoileus virginianus*], Schwabe et al. 2001; Knoche and Lupi 2007, 2012). However, other than ring-necked pheasant (*Phasianus colchicus*) hunting (see Shulstad and Stoevener 1978, Adams et al. 1989, Remington et al. 1996, Hansen et al. 1999), little research has been conducted on the economic benefits associated with the small game hunting experience. In particular, the popularity of hunting ruffed grouse (*Bonasa umbellus*) on public land relative to many other small game species (Frawley 2012) offers a unique opportunity for economic valuation and policy analysis.

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¹E-mail: knochesc@msu.edu

Wildlife managers and policy makers at both the federal and state levels have enacted programs to increase and enhance the provision of publicly accessible lands for hunting and other types of outdoor recreation. 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 have a program that assists hunters and landowners with access-related issues for hunted and/or non-hunted species, with 96% of agency administrators reporting that access to private land is important for their organizations' objectives. At the federal level, President Obama launched the America's Great Outdoors initiative in 2010, which recommends full funding of \$900 million per year (by 2014) for the Land and Water Conservation Fund (LWCF), a federal government funding program which over the past 40 years has enabled the purchase of 1.2 million ha of recreation lands and the funding of over 29,000 projects to develop basic recreational facilities on public lands. In 2012, the LWCF distributed more than \$42 million in grants for land acquisition and recreation development purposes, which subsequently leveraged an additional \$48 million from state, local, and private sources. Hunting-specific federal initiatives such as the United States Department of Agriculture's Public Access and Habitat Incentive Program (VPA-HIP) provided grants to 25 states totaling \$17.8 million to encourage private landowners to make their land available to the public for hunting.

Despite efforts by state and federal governments to 1) improve or increase access to publicly owned recreation land and 2) to implement programs that incentivize landowners to allow public hunting access on their privately owned lands, few research efforts (other than Knoche and Lupi 2012) have examined the economic benefits accruing to hunters as a result of changing amounts of publicly accessible land for hunters. To address these gaps in the literature, we used the travel cost valuation method to first determine which site attributes (e.g., harvest rate, public land acreage) influence a ruffed grouse hunter's site selection decision. We then estimated the economic benefits to hunters generated by the types of publicly accessible hunting land that are statistically significant predictors of hunter site selection. This method allowed the estimation of economic benefits of publicly accessible land to grouse hunters by examining the tradeoffs individuals make between the amount and nature of publicly accessible land at a hunting site and the cost incurred in traveling to that hunting site.

STUDY AREA

The ruffed grouse is the most popular upland game bird in the upper Great Lakes region, with about 193,000 hunters spending over 1.5 million days hunting ruffed grouse in Michigan and Wisconsin in 2007, compared to 116,000 hunters spending about 800,000 days hunting pheasant in these 2 states (Dhuey 2008, Frawley 2008). Ruffed grouse hunting participation and harvest can vary substantially, as ruffed grouse in this region, as well as in Alaska and much of Canada, have approximately 10-year cycles of abundance

(Rusch et al. 1999), with hunter numbers and ruffed grouse harvest fluctuating with respect to the population cycle (Dessecker 2006). During cyclic highs, about 3 million ruffed grouse are harvested evenly across Minnesota, Wisconsin, and Michigan, with about 900,000 harvested during cyclic lows (Dessecker and McAuley, 2001). Our survey uses data from the 2008 ruffed grouse hunting season, during which ruffed grouse populations were rebounding from population lows documented during 2004–2005 (Frawley and Stewart 2009).

In 2008 in the state of Michigan, an estimated 91,000 hunters spent 624,000 days harvesting 301,000 ruffed grouse (Frawley 2012). For the purposes of delineating ruffed grouse population areas of interest in Michigan (see figure 1 in Knoche and Lupi 2012), the Upper Peninsula and much of the Northern Lower Peninsula of Michigan (along with northern portions of Wisconsin and Minnesota, and portions of southern Canada) are considered to be part of the Boreal Transition Forest area, defined as a transitional forest landscape between deciduous-dominated forests to the south and coniferous-dominated forests to the north (Dessecker 2006). The remaining southern portion of the Lower Peninsula of Michigan, along with the southern two-thirds of Wisconsin and Central Minnesota, are defined to be part of the Prairie Hardwood Transition, a transitional landscape between prairies to the west and south and deciduous-dominated forests to the east and north (Stewart et al. 2006). All forested landscapes in these regions can support populations of ruffed grouse. However, mature forests generally support only low-density populations of ruffed grouse, whereas ruffed grouse are most prolific in young (early successional) forests. The Michigan portion of the Boreal Transition Forest area has a substantial amount of ruffed grouse habitat, with about 4.1 million ha of large-diameter forest (>12.7 cm) and 1.3 million ha of small-diameter forest (≤ 12.7 cm; Dessecker 2006). The southern portion of the Lower Peninsula of Michigan, which has been heavily affected by humans via agricultural use and urban or suburban development, has about 1 million ha of large-diameter and 400,000 ha of small-diameter forest (Dessecker 2006).

Forests in both regions described above contain productive ruffed grouse habitat. Additionally, much of this forest acreage is located on publicly accessible land, available to all Michigan hunters for free access or for a small entrance fee. Publicly owned hunting options in Michigan include State Forest (1.5 million ha), National Forest (1.1 million ha), State Game and Wildlife areas (200,000 ha), State Parks and Recreation areas (107,000 ha), 2 National Lakeshores (52,000 ha), and United States Fish and Wildlife Service Land (47,000 ha). Additionally, about 900,000 million ha of privately owned, publicly accessible land is available to hunters through Michigan's Commercial Forest Act (CFA), which provides tax incentives for private landowners (predominantly timber companies) to allow hunting and angling on their land. Federally owned land, state-owned land, and CFA land are the 3 major types of publicly accessible hunting lands in Michigan, and served as the focal

point of our analysis (see Knoche and Lupi 2012 for greater detail relating to publicly accessible hunting lands in Michigan).

Policy Scenario

Currently, the vast majority of federally and state-owned land in Michigan is open to recreational hunting. However, national forests are legally responsible for providing for a variety of uses and benefits by the Multiple Use and Sustained Yield Act (1960), which states that "... it is the policy of Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes." Managing land for multiple uses can result in stakeholder conflict when a stakeholder's use of the resource is affected by, or incompatible with, the use of the resource by another stakeholder. Conflict between recreational users of national forest land (e.g., hikers, birdwatchers, and snowshoers vs. gun hunters and snowmobilers) is at the heart of a recent court ruling requiring the United States Forest Service to consider closing 14 semi-primitive areas containing about 27,000 ha of the approximately 400,000-ha Huron-Manistee National Forest to recreational gun hunting. The Huron-Manistee National Forest is popular with outdoor recreationists (with about 4 million estimated visits during 2007), and recreational hunting is one of the most popular recreational activities, with about 25% of Huron-Manistee National Forest visits being for the primary purpose of hunting (U.S. Department of Agriculture [USDA] 2009). Closing portions of this National Forest to gun hunting has the potential to negatively affect hunters pursuing a multitude of game species found on these lands, including white-tailed deer, black bear (*Ursus americanus*), wild turkey (*Meleagris gallopavo*), and ruffed grouse. In a 27 January 2012 decision, the USDA Forest Service officially selected a management alternative detailed within the Final Supplemental Environmental Impact Statement (USDA 2012) that will continue to allow gun hunting at these 14 areas; however, this decision has since been appealed and may not be settled for some time. This particular user conflict scenario provides a useful setting for examining how economic benefits accruing to a particular user group would be affected when access privileges are reduced or eliminated.

METHODS

Data

To examine how hunter trips are influenced by the different levels of attributes at potential hunting sites, we must describe the various hunting site options within the hunter's choice set. For the purposes of this study, we defined each of the 83 counties in Michigan as being a hunting site alternative (see figure 1 in Knoche and Lupi 2012). Developing a predictive model of hunter site selection and ultimately estimating the economic benefits to hunters from hunting site attributes requires information on hunter site choice and trip frequency to each site, and the levels of attributes available at each hunting site (e.g., harvest rate of game species, amount of publicly accessible hunting land).

To obtain information on hunter site choice and site visitation frequency, we use data from the Michigan 2008–2009 Upland Game Harvest Report survey (Michigan Department of Natural Resources 2009) administered by the Michigan Department of Natural Resources (MDNR). This was a mail survey sent to 9,987 randomly selected people who were eligible to hunt small game in Michigan, with up to 2 follow-up questionnaires sent to non-respondents. Questionnaires were undeliverable to 242 people and were returned by 5,532 people, yielding a 57% response rate. For our analysis, we included only Michigan residents who hunted ruffed grouse in Michigan ($n = 1,275$). Information on the number of trips to a site is generally required to estimate a travel cost model, however, the Upland Game Harvest Survey provides data on the number of days spent hunting, as opposed to the number of trips. To convert the reported number of days hunted into an estimate of hunting trips, we relied on relationships between hunting trips, hunting days, and travel distance that we identified using data from a 2003 survey of Michigan deer hunters. Using this data to estimate multiple travel cost models in which both reported trips and estimated trips are used as the dependent variable, we identified several plausible formulations of this relationship that generated economic benefits estimates that closely approximated benefits estimates obtained when using hunter-reported trips (S. Knoche and F. Lupi, Michigan State University, unpublished data). We applied the best formulation to convert grouse hunting days into grouse hunting trips. Using this formulation, we estimate that 12,006 days hunting resulted in 9,666 trips, which is about 1.24 days per hunting trip.

We computed the variable, price, to reflect the round-trip time costs and driving costs from each hunter's residence to each of the 83 different counties. For each survey respondent, we used PC*Miler software (ALK Technologies, Princeton, NJ) to calculate the driving distance from the individual's zip code of residence to the zip code that is closest to the geographic center of each hunting site. We computed the driving cost by multiplying the per-mile vehicle operating cost by the distance traveled. The per-mile operating costs, excluding fixed costs such as insurance, were 40.2 cents per mile based on data published annually by the American Automobile Association (2008). The other component of travel costs was the opportunity cost of the time the individual spent to travel to the site. For this, we used the individual's address, in conjunction with ARCGIS (Environmental Systems Research Institute, Inc., Redlands, CA) software, to assign each individual the United States Census Bureau median household income for their census tract of residence (Cameron 1992, Kahn 1998). Some individual's addresses were not identifiable using ARCGIS software, for these cases, we assigned individuals median household income for their zip code of residency. We used these Census-based median household income figures as proxies for individuals' annual wage rate. Using the same data and travel cost modeling approach as described in the previous paragraph, we found that for 2 different types of hunting, substituting median household income estimates (based on

zip code of residence) for individual-reported income had a negligible effect on economic benefits estimates (S. Knoche and F. Lupi, Michigan State University, unpublished data). Though some debate continues regarding the appropriate portion of an individual's wage rate to attribute to the time component of travel cost, the recreation literature has generally accepted that the opportunity cost of time spent driving ranges from a third of the hourly wage rate to the full wage rate (Parsons 2003). We used a third of the wage rate. We computed the wage rate by dividing the Census-based median income figure by the number of work hours per year. To estimate travel time, we assumed an average trip speed of approximately 64 km (40 miles) per hour.

We obtained seasonal ruffed grouse harvest data from the Michigan Upland Game Harvest Report surveys implemented by the MDNR. In Michigan, the ruffed grouse hunting season is approximately 3 months long, beginning 15 September and lasting through 1 January, with the exception that ruffed grouse hunting is not permitted during the firearm deer season (15–30 Nov). Using hunter survey responses from the 2006–2007, 2007–2008, and 2008–2009 Michigan Upland Game Harvest Report surveys, we estimated a per-day ruffed grouse harvest rate, averaged over 3 years, for each county in Michigan.

Economic Model

The travel cost method is commonly used to estimate economic benefits associated with outdoor recreation (Parsons 2003). Understanding the relationship between the cost (price) of a recreational trip and the number of trips taken allows the construction of a demand relationship between these 2 variables, which then can be used to estimate economic benefits. Economic benefits, as defined in this article, represent the difference between the greatest amount an individual would be willing to pay to participate in the activity and the trip-related expenses actually incurred to participate. If an individual participates in the recreational activity, then the activity must be worth at least as much as the cost incurred to participate. The individual realizes an economic benefit when the amount the individual would be willing to pay for the recreational experience exceeds the cost of the experience.

As our primary research interest was to estimate economic benefits associated with publicly accessible hunting land, we used a multiple-site approach known as the Random Utility Travel Cost Model (Freeman 1993, Grijalva et al. 2002, Knoche and Lupi 2007). The Random Utility Travel Cost

Model allows the estimation of the economic benefits of site attributes by comparing the attribute levels to the costs of traveling to those hunting sites (Haab and McConnell 2002, Lupi et al. 2003, Parsons 2003, Kotchen et al. 2006). The modeling of hunter site choice, estimation of site attribute parameters, and calculation of economic benefits for publicly accessible land within this article closely follows the economic theory and econometric methods described in detail by Knoche and Lupi (2012).

RESULTS

Despite the Upper Peninsula having only about 3% of Michigan's residents, 27.4% of Michigan ruffed grouse hunters live in the Upper Peninsula (Table 1). Likewise, about 13.5% of Michigan residents reside in the Northern Lower Peninsula but 31.8% of ruffed grouse hunters live in this region. The Southern Lower Peninsula has the majority of Michigan's ruffed grouse hunters but comprises a smaller share of the total population of their regions than do the northern regions. Regional trends are also evident regarding hunting site selection. Upper Peninsula residents are more likely to hunt in the county they live in or hunt in 2 or more counties, and they drive the shortest distance to hunting sites. Southern Lower Peninsula residents are least likely to hunt in their county of residence or hunt in 2 or more counties, and they drive the furthest distance to hunting sites, whereas hunting site selection figures of Northern Lower Peninsula residents lie between the other 2 regions. Comparing Michigan ruffed grouse hunter demographics to Michigan hunters in general, we see that the mean age of Michigan hunters (for all species) is 42, and percent male composition of hunters is 92% (Frawley 2006), both of which are below the ruffed grouse hunter age and gender statistics for all 3 regions in Michigan. However, care should be taken with these demographic comparisons as Frawley's figures are from the 2005 hunting seasons, and the ruffed grouse figures for use in this analysis are from the 2008 hunting season.

For the economic model of hunter site choices, the price variable represents the implicit price an individual hunter pays to hunt at a particular site. With most goods purchased in the marketplace, as price of the good increases, holding all else constant, the quantity of the good purchased decreases. The same holds true here; price had a negative effect on number of trips taken by a hunter to a specific county ($P < 0.001$), meaning that increases in travel cost to a hunting site, all else equal, result in fewer hunting trips to

Table 1. Michigan ruffed grouse hunter demographics and hunting site choices by region of residence, 2008–2009.

Region of residence	Publicly accessible hunting land by region (1,000s ha)			Hunter demographics and hunting site choices					
	Federal	State	CFA	% of ruffed grouse hunters living in each region	Avg. age	% male	% hunting in county of residence	% hunting in ≥ 2 counties	Avg. distance from residence to site hunted (km)
Upper Peninsula	724	699	887	27.4	47.3	94.9	87.2	29.3	52.5
Northern Lower Peninsula	392	989	17	31.8	49.1	96.6	64.6	27.8	108.6
Southern Lower Peninsula	6	155	2	40.8	48.3	98.3	12.5	21.6	307.3
Statewide	1,122	1,843	906		48.3	96.8	49.5	25.7	174.3

that hunting site (Table 2). As expected, the 3-year average of ruffed grouse harvested per day (harvest) and amount of the 3 types of publicly accessible hunting land per county (CFA, Federal, and State) had a positive effect on number of trips taken by a hunter to a specific county ($P < 0.001$). The region-specific dummy variables for the Upper Peninsula and the Northern Lower Peninsula both had a positive effect on number of trips to a county ($P < 0.001$). Because of the nonlinearity of the conditional logit model, the precise value of a single coefficient does not have a straightforward interpretation. However, when comparing across variables measured by the same metric (e.g., hectares of the different types of publicly accessible hunting land), the relative magnitude of these β s indicates the importance of a marginal increase in the level of a hunting site attribute in generating economic benefits to hunters.

Estimating economic benefits for the 3 types of publicly accessible land individually in our model, we find annual economic benefits for ruffed grouse hunters to be about \$11.1 million for state-owned land, \$6.9 million for CFA land, and \$3.0 million for federally owned land. We estimate that the 3 types of publicly accessible hunting land in Michigan together generate about \$20.8 million in economic benefits annually for ruffed grouse hunters. Average per hectare economic benefits for publicly accessible land are greatest for CFA land (\$7.67/ha), followed by state-owned land (\$6.04/ha), and federally owned land (\$2.64/ha). We also examined the effects of different assumptions regarding the percentage of wage rate and driving costs, as these assumptions will affect the economic benefits estimates detailed above (e.g., English and Bowker 1996, Layman et al. 1996, Bin et al. 2005, Edwards et al. 2011). We find that instead of using a third of the wage rate, using 25% of wage rate reduces economic benefits by 7% when considering all publicly accessible hunting land in Michigan, whereas using 40% of the wage rate increases economic benefits by 6%. Similarly, we find that decreasing the travel rate by approximately 16 km (10 miles) per hour increases economic benefits by 10%, whereas increasing the travel rate by approximately 16 km (10 miles) per hour reduces economic benefits by 6%.

Table 2. Conditional logit results for a travel cost model of variables predicting the number of trips ruffed grouse hunters ($n = 1,275$) took to a specific county in Michigan in 2008–2009. Log likelihood = $-23,237.24$.

Variable ^a	Coefficient	SE	P
Price	-0.029	0.0003	<0.001
Harvest (an additional ruffed grouse)	1.373	0.086	<0.001
Federal (10,000 ha)	0.072	0.0044	<0.001
State (10,000 ha)	0.169	0.0066	<0.001
CFA (10,000 ha)	0.148	0.0071	<0.001
Size (100 km ²)	-0.049	0.0028	<0.001
Upper Peninsula	4.502	0.098	<0.001
Northern Lower Peninsula	2.475	0.057	<0.001

^a Price, travel costs; harvest, 3-year average of grouse hunted per day; federal, state, and CFA, area of land in the county that is federally owned land, state-owned land, and publicly accessible, privately owned Commercial Forest Act, respectively; size, area of county; Upper Peninsula and Northern Lower Peninsula represent region-specific dummy variables (reference region is Southern Lower Peninsula).

The vast majority of publicly accessible hunting land is in the Upper Peninsula and Northern Lower Peninsula of Michigan, with public lands in these areas generating substantial economic benefits for ruffed grouse hunters. The approximately 2.3 million ha of publicly owned and privately owned, publicly accessible hunting land in the Upper Peninsula of Michigan generates about \$14.4 million in annual economic benefits for ruffed grouse hunters, and the approximately 1.4 million ha of publicly accessible hunting land in the Northern Lower Peninsula generates about \$5.3 million in annual economic benefits. Publicly accessible land in the Southern Lower Peninsula generates slightly more than \$300,000 in annual economic benefits. The Upper Peninsula generates the greatest amount of average annual economic benefits per hectare (\$6.25/ha) followed by the Northern Lower Peninsula (\$3.83/ha). Despite the relative scarcity of publicly accessible hunting land in the Southern Lower Peninsula, combined with the proximity of this public land to high population centers (e.g., Metropolitan Detroit, Lansing, and Grand Rapids) where many hunters live, an average hectare of publicly accessible hunting land in this region is valued at \$1.90/ha, less than an average hectare in the Upper Peninsula or Northern Lower Peninsula.

The above results illustrate the annual economic benefits to ruffed grouse hunters from the existence of the current levels of publicly accessible hunting land, relative to each type of publicly accessible hunting land (or all publicly accessible hunting land in each region) being completely eliminated. Although obtaining a clearer picture of the total economic benefits from publicly accessible hunting land allows managers to compare and contrast hunter economic benefits to state and federal land management costs, it does not provide insight into the extent marginal changes to the amount of publicly accessible hunting land would impact economic benefits from ruffed grouse hunting. Estimating hunter economic benefits from marginal changes in publicly accessible hunting land allows managers to better account for the benefits and costs of more realistic policy scenarios in which hunters compete with other stakeholders within the political and legal systems for preferential access to federal and state-owned lands. We estimate that eliminating approximately 27,000 ha of National Forest land contained within 14 semi-primitive areas in Michigan would result in a reduction of economic benefits to ruffed grouse hunters of about \$51,500 annually.

DISCUSSION

Although the economic impacts of small game hunting generated by hunter retail expenditures have been well documented, almost no insight exists into the economic benefits small game hunters derive from their hunting experiences. This is surprising, given the popularity of small game hunting for species such as squirrel (1.7 million hunters, 21 million days), rabbit (1.5 million hunters, 17 million days spent hunting), quail (841,000 hunters, 9 million days), and grouse (812,000 hunters, 8 million days) (USDOI 2011). Our research helps to address this gap in the literature by estimating economic benefits hunters realize

from the use of publicly accessible hunting lands for ruffed grouse hunting.

Furthermore, our research is easily compared and contrasted with research by Knoche and Lupi (2012), which provides estimates of the annual economic benefits of public land accruing to firearm and archery deer hunters in Michigan. We estimated the annual economic benefits from publicly accessible hunting land to the average Michigan resident ruffed grouse hunter to be \$235.74, which is 285% and 265% greater than the annual economic benefits for the average Michigan firearm deer hunter (\$82.94) and archery deer hunter (\$88.71), respectively (Knoche and Lupi 2012). These results are intuitive within the context of the use of public land by deer and ruffed grouse hunters, given that 79% of ruffed grouse hunters hunted on public land at least once during the 2009 hunting season (Frawley 2012), compared to 41% for deer hunters during the 2006 hunting season (Frawley and Rudolph 2008). Additionally, increasing levels of public access variables, Federal, State, and CFA, were statistically significant and positive predictors of hunter site selection for both the ruffed grouse travel cost model presented in this article as well as the 2 deer hunting travel cost models (Knoche and Lupi 2012). Both studies provide evidence that hunters for deer and grouse have stronger preferences for state-owned land and CFA land, relative to preferences for federally owned land. Specifically, coefficients on Federal variables are markedly lower than State and CFA coefficients in the 3 models described above, with State and CFA coefficients being between 107% and 162% greater than the coefficients for Federal in the ruffed grouse model and firearm deer hunting model results, and between 43% and 46% greater than Federal in the archery deer hunting model results. State and CFA coefficients are relatively comparable, with the greatest coefficient difference in the firearm model where the CFA coefficient was 26% greater than the State coefficient. The above percentage differences of coefficients across models reflect necessary scaling adjustments, as the unit of measurement in Knoche and Lupi (2012) is acres, as opposed to hectares as in this paper. The multiple types of state land (e.g., state forests, recreation areas, game/wildlife areas) may offer enhanced access opportunities through more developed facilities and increased access points with CFA land offering similar access benefits via access points and roads built and maintained to facilitate timber management. In contrast, much of Michigan's federally owned land consists of large, contiguous blocks of national forest land, which may present access challenges to recreational hunters.

Finally, although we showed that annual economic benefits to ruffed grouse hunters would be reduced by about \$51,000 as a result of the proposed policy to ban hunting on approximately 27,000 ha of National Forest land, this amount is only a portion of the lost annual economic benefits from such a policy. This land, which is located in the Northern Lower Peninsula of Michigan, offers additional, diverse hunting opportunities including (but not limited to) white-tailed deer, black bear, wild turkey, and small game species such as rabbit and squirrel. The approximately 91,000

ruffed grouse hunters in Michigan are only a small portion of the 753,000 people that hunted in Michigan in 2006 (USDOJ 2006), suggesting that reductions in economic benefits to all hunters might be many times the lost economic benefits to ruffed grouse hunters. A rigorous cost-benefit analysis of this policy would need to include these reduced benefits to these other hunters as result of the closure, as well as any changes in economic benefits to individuals whose outdoor recreational experiences are positively affected from the closure to hunting.

MANAGEMENT IMPLICATIONS

Our results are relevant to wildlife managers and policy makers who are considering whether to increase or enhance access for ruffed grouse hunters to both publicly owned and privately owned, publicly accessible hunting land. When faced with difficult decisions on how to best allocate limited public funds to provide the most benefit to hunters, anglers, and other outdoor recreationists, policy makers can look at our research and note that a relatively small group of outdoor recreationists (about 91,000 ruffed grouse hunters) derive over \$20 million in annual economic benefits from the availability of publicly accessible hunting land. With the annual economic benefits associated with publicly accessible land for deer hunting in Michigan estimated to be over \$80 million (Knoche and Lupi 2012), along with the economic benefits of this land for hunting other game species in Michigan (e.g., wild turkey, pheasant, waterfowl, black bear) and for participating in other types of outdoor recreation (e.g., angling, hiking, camping, mountain biking, cross country skiing) still unaccounted for, total economic benefits accruing to users of public lands in Michigan is hundreds of millions of dollars per year. The large economic benefits of state-owned land relative to federally owned land and CFA land takes on more importance with the Governor of Michigan recently signing into law Senate Bill No. 248 (2012) which caps the amount of land the State of Michigan can own at 4.65 million acres (approx. 1.88 million ha) until the legislature approves a strategic plan for buying and selling land. Although when (or if) the Michigan legislature will develop and approve a strategic plan is not clear, in the meantime the state is faced with sharp constraints on acquiring land for outdoor recreation purposes, land that we have shown to be quite valuable to a single segment of outdoor recreationists. Finally, our analysis also indicates that a policy proposal to close about 27,000 ha of national forest land from hunting would result in an annual loss of over \$51,000 in economic benefits to ruffed grouse hunters in Michigan. Given the relatively stronger preferences for state-owned and CFA land over federally owned land, we expect that similar management actions undertaken on these lands would result in greater losses of economic benefits to ruffed grouse hunters. Regardless, with the roughly 648,000 days spent hunting ruffed grouse in Michigan (Frawley 2012) being a small percentage of the estimated 11.9 million days spent hunting in Michigan in 2006 (USDOJ 2006), reduced economic benefits to ruffed grouse hunters would likely

comprise only a small portion of the losses realized by all hunters.

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