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Nonmarket Valuation of Recreational Pursuits in Tennessee: An Application of Travel Cost and Contingent Valuation Methods

Charles B. Sims
University of Tennessee, Knoxville

To the Graduate Council:

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Donald G. Hodges, Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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NON-MARKET VALUATION OF RECREATIONAL PURSUITS IN TENNESSEE: AN APPLICATION OF TRAVEL COST AND CONTINGENT VALUATION METHODS

A Thesis
Presented for the
Master of Science Degree
The University of Tennessee, Knoxville

Charles B. Sims
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Abstract

In order to assure that public lands are being used in an efficient manner, both market and non-market values of these lands must be compared. Two popular recreational pursuits, off-highway vehicle recreation and rock climbing, were analyzed using basic economic modeling techniques to provide insight into user behavior as well as estimates of value. The scope of the study was off-highway vehicle recreation in the state of Tennessee and rock climbing at the Obed Wild and Scenic River. The objectives were to: *i*) document use numbers for both recreational pursuits, *ii*) analyze individual demographics of both user groups, *iii*) model user behavior for both user groups, *iv*) identify the acceptance/effectiveness of two proposed fee programs for off-highway vehicle recreation, *v*) estimate the value of both recreational pursuits in terms of consumer surplus, and *vi*) formulate management prescriptions based on these findings.

Data for the OHV portion of the survey was obtained from both on-site and phone surveys conducted throughout the state of Tennessee. Rock climbing survey data were obtained through on-site surveys performed at the Obed Wild and Scenic River in Morgan County, Tennessee. In addition to use numbers and personal demographics, travel cost expenditures and annual trip estimates were obtained for both types of recreation. Poisson regression techniques were used to estimate patterns in user behavior as well as various consumer surplus measures. In addition, logistic regression was used to analyze contingent valuation payment card data to determine user acceptance of two proposed fee programs.

As expected by theory, travel costs were found to have a negative effect on the number of trips taken for each type of recreation. Consumer surplus estimates per trip

were found to range between $46 and $61 depending on the type of off-highway vehicle used while consumer surplus per trip for rock climbing was found to be significantly higher at $170. Based on these estimates of use and trip taking behavior, general management recommendations are suggested for both types of recreation.

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CHAPTER 1

INTRODUCTION AND BACKGROUND

Introduction

Policymakers and analysts are focusing increasingly on the value of nonpriced commodities or values pertinent to public resources. The introduction of the fee demonstration program and the requirement of benefit-cost analysis for management proposals on federal lands have increased the need for estimating nonmarket values. Valuing nonpriced commodities or nonmarket goods and services is controversial. While many believe that placing a market value on such goods and services as clean air or the preservation of an endangered species is a perverse interpretation, the ability to measure a value for a commodity is necessary to achieve an efficient allocation of the good or service. In fact, measurement is an essential part of resource allocation because it allows the idea of efficiency to be applied, and it serves as the basis for decisions that can improve resource allocation.

The ability to measure a value in the efficient allocation of resources is especially important in the case of public goods. Markets are incapable of efficiently allocating resources with pervasive externalities, or for which property rights are not clearly defined, which is often the case with public goods. Examples of these market failures abound. Commercial harvesters of fish, for example, do not incur the future costs from the fish they catch, leading to over harvesting. The negative effects of automobile emissions are not incorporated in the costs of operating an automobile, resulting in the drivers driving an inefficiently large amount.

There are gains and losses in all of these examples that extend beyond the private individuals making the decisions. This is also true in natural resource-based recreation. Because the benefits of recreational use on public and private land have no market, it is difficult to ensure resources such as land, personnel, and facilities provided for recreational pursuits are allocated in an efficient manner. Therefore valuing recreational benefits is imperative to ensure proper resource allocation and efficient management of recreational activities.

Two major classes of techniques for measuring the value of nonmarket goods exist: revealed preference and stated preference techniques. Revealed preference approaches assess decisions regarding activities that utilize or are affected by an environmental amenity, to reveal the value of the amenity. The most popular revealed preference technique to value resource-based recreation is the travel cost method. The basic premise behind the travel cost method (TCM) is that the travel cost to a site can be regarded as the price of access to the site. If recreationists are asked questions about the number of trips they take and their travel cost to the site, enough information is generated to estimate a demand curve. Stated preference methods elicit values directly from individuals, through survey methods. The most widely used stated preference valuation technique is the contingent valuation method. The contingent valuation method (CVM) ascertains value by asking people their willingness to pay for access to a recreational site.

Objectives

This study was developed to address specific issues regarding resource-based recreation in Tennessee, including economic impact, user demographics, use estimates,

and user behavior. Modeling user behavior was accomplished through use of both travel cost and the contingent valuation techniques. These methods were applied to two popular yet very different forms of resource-based recreation in Tennessee: rock climbing and off-highway vehicle recreation. The Obed Wild and Scenic River (OWSR) located in Morgan County Tennessee was chosen as the study site for the rock climbing portion of the study. It is a popular area for local rock climbers as well as for numerous visitors from out of state and even abroad. The off-highway vehicle portion of the study included participants across the state.

Due to differences in study design between the rock climbing portion of the study and the off-highway vehicle portion of the study, different objectives were identified for each particular portion of the study. Specific objectives for the rock climbing portion of the study were to *i)* document use at each specific climbing area, *ii)* identify user demographics of climbers at the OWSR, *iii)* model spending and trip taking behavior of rock climbers at the OWSR, and i*v)* ascertain the value of access to rock climbing at the OWSR through consumer surplus estimates. Specific objectives for the off-highway vehicle portion of the study were to *i)* determine the number of off-highway vehicle recreationists in the state, *ii)* identify the economic impact of off-highway vehicle recreation on the state economy, *iii)* identify user demographics of off-highway vehicle recreationists in Tennessee, *iv)* model trip taking behavior for off-highway vehicle recreationists, *v)* evaluate the acceptance of two off-highway vehicle recreation fee programs, and *vi)* determine the value of access to off-highway vehicle recreation in Tennessee through consumer surplus estimates.

This thesis contains three chapters that describe various aspects of the research (Chapters 2 through 4). Chapter 2 is devoted to basic survey results and economic impact estimates from the off-highway vehicle survey. This includes use estimates, user demographics, and estimates of the economic impact of off-highway vehicle recreation on the state. It also includes economic modeling of the trip spending behavior for off-highway vehicle recreationists. Chapter 3 describes the use of the travel cost model to predict trip-taking behavior and generate consumer surplus estimates for off-highway vehicle recreation. The acceptance of an off-highway vehicle recreation fee program as well as average willingness to pay for access to off-highway vehicle recreation are included in this chapter. Chapter 4 focuses on survey results and the application of the travel cost model to rock climbing in the Obed Wild and Scenic River.

Rock Climbing in the Obed Wild and Scenic River

Known primarily for its excellent whitewater, the Obed Wild and Scenic River (located in Morgan County, Tennessee) has drawn climbers to its sandstone cliffs since the early 1970s. In 1973, Knoxville climber Bob Cormany visited the area on a tip from a University of Tennessee Entomology professor, who was involved in a spider study on the Obed River. Bob and a small group of other area climbers lead or toproped many of the obvious, protectable climbs at Clear Creek and Lilly Bluff. This group disbanded in the late 1970s, most of them moving away from the Knoxville area. The cliffs lay dormant throughout most of the 1980s. In 1990 a pair of Knoxville climbers began to develop climbing routes on the cliffs above the Obed River. It was only a matter of time before the ever-growing crew of climbers that frequented the area began to develop the

Clear Creek side starting with North Clear Creek and eventually moving down the creek and around the corner to South Clear Creek. Oddly enough, Lilly Bluff, the most easily accessible cliff in the park, was not developed for rock climbing until the mid 1990's (Watford 1999).

The popularity of the Obed Wild and Scenic River for climbers has grown significantly in the past decade. Numerous articles in national climbing magazines have heralded the climbing at the Obed Wild and Scenic River, providing national and international exposure. Typical of the river-carved sandstone of the region, the rock is steep and overhanging making the routes difficult. With a wide range of difficulty present for climbers, the Obed has developed a large following of beginning and advanced climbers alike. As climbing at the Obed became more popular and more climbers began to visit the area, many believed that official management action must be taken to protect the recreational experience of climbers and other visitors as well as protecting the natural characteristics of the area. Until this point much of the climbing had taken place inconspicuously and therefore warranted no management by park officials. While this self-management by the climbers resulted in relatively little impact to other visitors and the natural integrity of the area, the National Park Service (NPS) determined that a climbing management plan needed to be developed for the park. In August of 2000, the NPS placed a moratorium on establishing fixed anchors at Obed WSR until park managers could gain an understanding of the impacts of climbing on natural and cultural resources and prepare a plan to manage future climbing activities (National Park Service 2002). In February 2002 a draft climbing management plan was submitted for public revue. That management plan was finalized in July 2002.

The climbing management plan places a moratorium on developing new routes and limits climbing to six areas designated as either a bouldering area or a rock climbing zone. The plan also outlines issues related to trails, parking, access, equipment usage, and route "top-outs" which is the act of climbing a route all the way to the cliff top, which can damage rare cliff-dwelling species of vegetation. The management plan also called for a number of research studies in order to support the plan. One study outlined in the management plan was inventorying and mapping climbing and bouldering routes. Another was an inventory of sensitive habitats and rare species. The final study that was outlined in the management plan was researching the rock climbing use levels (National Park Service 2002). This final required study was the foundation of this research. These three studies and the information gained from them will be the basis for future management prescriptions in the Obed Wild and Scenic River.

Little information was known about rock climbing use levels in the Obed Wild and Scenic River. The management plan itself states, "There is a recognized lack of information regarding rock climbing at Obed WSR. Specifically, little is known about rock climbing use levels or the plant and animal communities that are affected by climbing activities." (National Park Service 2002). This research will be used by managers as input into their management prescriptions, making the information gained from this research invaluable to managers in the Obed.

Off-Highway Vehicle Recreation in Tennessee

Public and private lands alike offer a variety of trails coupled with beautiful surroundings that make Tennessee a popular area for OHV recreation.[1] Each year over 500,000 people visit national forests, state riding areas, or private lands to enjoy the natural surroundings and their vehicles (Fly et al. 2001). The annual growth rate for off-highway motorcycle and ATV sales averaged 16% from 1995 to 2000. A direct comparison of sales for the years 1995 and 2000 reveals an even sharper contrast. In 1995, motorcycle and ATV sales in Tennessee totaled 2,043 and 9,349, respectively. In 2000, sales for motorcycles and ATVs more than doubled to 4,143 motorcycles and 19,718 ATVs (MIC 2001). In addition, individuals from other states come to Tennessee to participate in numerous OHV special events that have become extremely popular. For example, thousands of OHV recreation enthusiasts come from as far away as California to compete at riding events held at Loretta Lynn's Ranch in near Waverly, Tennessee.

Along with the growing popularity of OHV recreation in Tennessee, there has been an inevitable increase in the demand for areas that provide for such recreation. Most riders seek vast areas with secluded trails and most prefer these trails to consist of some type of mountainous terrain. However, due to increasing amounts of land development and conversion, available areas of mountainous wooded terrain are becoming increasingly difficult to locate. State and federal governments are often forced to designate certain areas in state and national forests for OHV riding only to prevent user conflicts with other types of recreation. However, many states do not budget for OHV

[1] Off-highway vehicles are considered to be any type of motorized vehicle that can be taken off of the road. Examples may include off-highway motorcycles, ATVs, four-wheel drive vehicles, or rail buggies.

areas. This leaves many land management agencies struggling to allocate funding for patrolling, safety, and the extensive trail maintenance needed in OHV areas; ultimately, leading to closure or additional restrictions imposed on the recreation site. Restrictions and closures in public riding areas often result in riders venturing onto restricted public and private properties. Tennessee Code Annotated Section 70-7-101, et seq., (commonly called the "Recreational Use Statute") protects both private and governmental entities from injury lawsuits unless the landowner charges a fee or "consideration" to ride on his land. In most cases, landowners who do not charge a fee are protected from liability for simple negligence. However, landowners who allow riding on their property and charge a "consideration" or fee to offset the costs related to the OHV activity forfeit any protection offered under the Recreational Use Statute.

Tennessee has no enforceable OHV program that specifically addresses the use of OHVs on public and private property. The Tennessee Wildlife Resources Agency (TWRA), the Tennessee Department of Agriculture Forestry Division and multiple divisions of the Tennessee Department of Environment and Conservation (TDEC) dedicate staff and resources to managing OHV recreation or damage from the activity, while receiving little or no funds for that responsibility. Tennessee does regulate aspects of OHV use and impact. However, enforcement of these aspects appears to be limited or nonexistent. Tennessee Code Annotated section 55-6-101, for example, already provides for titling all OHVs. The statute prescribes a fee to be paid at the time of purchase. TCA section 55-3-101 currently assesses a $5.00 titling fee for new OHVs. However, only $1.50 of this goes toward the development of capital projects in recreation areas. The remainder goes back into the state's general fund. Without adequate OHV law

enforcement, it is difficult to ensure that this amount is collected consistently, particularly during sales of used vehicles. Although the Tennessee code provides for vehicle titling and encourages OHV driver training for Tennessee residents and out-of-state users, neither of these is actively pursued.

In November 1999, Tennessee Governor Don Sundquist appointed the Study Committee on Off-Highway Vehicles to evaluate the use, impact, and availability of OHV recreation in Tennessee and to address emerging economic, social and environmental issues related to this growing sport. The state extended invitations to relevant public agencies and to citizens' groups to participate in the committee. The Governor's Study Committee on Off-Highway Vehicles recommended that a formal OHV program be established in Tennessee with the goals of providing sufficient opportunities for the sport, propelling the associated economic benefits to the state, and properly managing OHV use to protect public safety, property owners, and natural resources.

The increase in the popularity of the sport and the decreasing opportunities for OHV recreation, make OHV management in the state of Tennessee a formidable task. Despite its growing popularity and apparent need for new management strategies, there is no published research devoted to modeling behavior or estimating the basic value of OHV recreation. Previous research efforts have been focused on the economic impact of OHV recreation in addition to basic use estimates; however, no research has been devoted to economic modeling of the demand for OHV recreation.

Literature Review

Travel Cost Method

The travel cost model is one of the most widely used frameworks for estimating the features of a recreation demand function. Even though most public recreation sites have zero (or nominal) entry fees, recreationists nonetheless pay an implicit price for a site's services when they visit. The implicit price includes transportation and time costs of the trip. The diversity of origins provides the variation in costs needed to estimate the demand function. The seminal works in the travel cost model include Clawson (1959), Knetsch (1963), and Clawson and Knetsch (1966). A number of studies have presented the travel cost methodology in a variety of forms and magnitudes. The following is a presentation of those studies that have compared the travel cost method with other methods or have delved into a specific issue regarding the implementation of the travel cost method.

Caulkins et al. (1986) used the travel cost method to value lake fishing in Wisconsin and to illustrate how different assumptions regarding recreationists' decision-making behavior affect the predicted changes in recreational activity given a water quality improvement. Two models of recreation demand were developed: a multinomial logit model and an alternative travel cost model. The multinomial logit model (MNL) was used rather than the more traditional travel cost model due to a predicted smaller outward shift of the recreationists' demand curve. The more traditional travel cost model was found to overestimate actual benefits for proposed lake rehabilitation. They noted that due to a lack of data, different demand equations could not be developed for different recreational lake activities. If the set of decision rules that govern the trip choices made

by one group are not the same as those made by another then separate demand functions should be estimated for each activity. Also the specification of the relevant choice sets presented problems in both models. This could be due to a number of assumptions made in the lake choice equation or could stem from the exclusion of influential site characteristics used in the site choice model. In the MNL model, the assumption that each day trip represented a decision that is independent of past or planned visits to sites does not seem plausible. This could be remedied through the use of a Markov chain model. Also issues concerning the opportunity cost of time were ignored. The exemption of these factors could substantially overestimate or underestimate value estimates depending on how individuals view the time traveling to the site and the time spent at the site.

The issue of travel cost variables and their effect on demand equations has been an issue of increasing debate as well. Travel cost variables, if developed incorrectly, can miscalculate the location and slope of the estimated demand relationship. Englin and Shonkwiler (1995) addressed this issue by developing an econometric approach that views travel costs as an unobservable latent variable. The latent variable approach utilizes indicators to capture the role of individual travel costs in recreation demand models. As opposed to conventional approaches, the latent variable approach can include both traditional components such as time and distance and non-traditional components such as the scenic beauty. The estimation procedure also results in each indicator being valued in dollar terms. A final advantage of this approach is the opportunity to greatly expand the factors that affect travel costs. Since there is no requirement that variables be

converted into dollar values, qualitative values such as scenic beauty and water quality can be used as indicators.

A number of researchers have examined the complications with multiple destination trips. If a recreational trip incorporates visits to many different sites, including all travel costs experienced on the trip will drastically overestimate the demand for the particular site in question by overestimating the total costs incurred to visit the site. Mendelsohn et al. (1992) used combinations of multiple destinations treated as unique sites and incorporated them into a demand system. Previous research had either ignored multiple destination trips or arbitrarily allocated trip costs across visited sites. Mendelsohn et al. (1992) estimated empirical demand functions for multiple destination trips that included Bryce Canyon National Park as single destination trips and multiple destination trips to other nearby recreational sites such as the Grand Canyon and Las Vegas. Comparisons of the demand functions considering the single destination (Bryce Canyon) and Bryce Canyon combined with one and two of the alternative sites revealed dependent variables ranging from –2.36 for Bryce Canyon only to –1.84 for a multiple destination trip that included Bryce Canyon, the Grand Canyon, and Arches National Park. Consumer surplus estimates for the single destination trip and variations of multiple destination trips included $10.18 for single destination trips with no substitutes, $9.47 for single destination trips with substitutes, and $16.80 for multiple destination trips.

Another issue that has garnered considerable attention has been the effect of omitting substitute prices and qualities from travel cost models. In an empirical study of 11 U.S. Corps of Engineer reservoirs in Kansas and Missouri, Rosenthal (1987) reported

that a model that omits substitute prices results in larger estimates of consumer surplus than models that do not. Gum and Martin (1975) and Burt and Brewer (1971) note that omitting substitute prices may bias the own price coefficient, which, in turn, may bias the welfare estimate of a price change. Caulkins et al. (1985) noted that the sign of the bias on the own price coefficient depends on the correlation between it and the omitted price variable. If the correlation between the two travel cost variables is positive, then omitting the substitute price biases the own price elasticity toward zero. But if the two travel costs are inversely correlated, the estimated own price coefficient is subject to a negative bias and the price elasticity of demand for visits is biased upward. Kling (1989) specifies the conditions under which these biases occur as the inability to sequence prices in calculating welfare when those prices are omitted, and the bias to the slope coefficients of demand functions from omitting a correlated variable.

A final issue that has created a significant amount of corollary interest is the opportunity cost of time and how that should be incorporated into travel cost models. The first study to address this issue in regards to the travel cost model for recreation demand was Cesario (1976). This study described the methodology behind the travel cost method, outlining how omission of travel time can lead to serious underestimates of benefits experienced by individuals. Previous attempts by earlier studies to arbitrarily allocate travel time are addressed to identify to what extent this arbitrary allocation process has reduced the bias. Methods developed by the transportation planning literature were adopted to a set of parks in the northeastern United States in order to generate benefit estimates under three different assumptions: ignoring travel time, ad hoc methodology developed in earlier studies, and valuing time in accordance with the

empirical methodology adopted from the transportation planning literature in which variable cost of automobile travel is combined with an estimate of the value of time.

Comparing the three approaches revealed that ad hoc allocation leads to higher benefit estimates as opposed to the method that attempted to include an estimate of the value of time in every case. Ignoring travel time leads to much lower benefit estimates. Since this time, several approaches have been developed to include the cost of time in the travel cost model. One approach suggests that time be considered as a separate independent variable (Brown and Nawas 1973; Gum and Martin 1975). Another approach measured the cost of time and added it to other costs (Bishop and Heberlein 1979; Brown, Charbonneau, and Hay 1978; Nichols, Bowes, and Dwyer 1978). McConnell and Strand (1981) argue that the opportunity cost of time is some proportion of the individual's market wage rate or income per hour and the scarcity value of time. Although the scarcity value of time depends in part on the wage rate, it depends also on the alternative use of time, specifically on the marginal utility of work. They argue that by using this method, the proportion can vary from study to study, rather than imposing either an arbitrary estimate or one from a sample different from the study's sample.

Sample data from a 1978 survey of sport fishermen in the Chesapeake Bay region were used to test the approach. The incomes of the individuals in the dataset produced a measurement of 0.6, indicating that the appropriate opportunity cost of time for the individuals in this study was 60% of the wage rate which is considerably higher than previously used estimates of 30%. The authors are quick to point out that because this estimate is based on income from survey respondents, this proportion could change drastically depending on the characteristics of site users. Smith et al. (1983) evaluated

proposals for valuing time in the specification of demand models by estimating demand functions for 43 water-based recreation sites. Approximately one-half of the estimated site demand models were found to be influenced by the treatment of the costs of on-site time. Both the wage rate (in 15 of 22 sites) and the Cesario proposal (in 14 of 22 sites) were rejected as the appropriate measures of the opportunity cost. The central problem with interpreting their simultaneous system for estimating trip demand is that the utility of the trip may vary directly with onsite time, in addition to varying indirectly due to the effect on trip cost.

Kealy and Bishop (1986) perpetuate the theory by assuming that individuals choose the optimal total number of site recreation days given by the product of the number and length of their recreation trips. They argue that this approach is appealing because it allows for different consumers choosing to take their recreation days based on trips that are most ideally suited to the individual. A best estimate of $19.54 per day was estimated for the value of Great Lakes fishing from primary data on individual anglers from a 1978 survey conducted on Lake Michigan. Bockstael et al. (1987) propose that time is conditional on the recreationists' labor market situation and assume that travel costs and travel time are independent variables in the demand function. This is one of the early studies to turn to corner solution models in an attempt to aggregate the characteristics of an individual's time value. McConnell (1992) explored the implications of two assumptions in the travel cost model: people choose the amount of time that they spend on a site and the time spent on-site is exogenous. A simplification of the standard travel cost demand function is postulated using a duality result when on-site time is chosen. Shaw (1992) argues that the basic assumption made in the previous

literature that the value of an individual's time spent in any activity is equal to the individual's wage rate will not hold in all cases. Shaw points out that while the wage equation implies that the value of leisure time is the individual's market wage rate, it also implies that a high marginal utility of income implies a low value of time in some activity. Therefore, a low income user will place less value on leisure time than one with a higher income.

A number of studies have also compared travel cost methods and forms of direct methods for estimating environmental benefits. Smtih et al. (1986) compared contingent valuation and travel cost methods for valuing site attributes in a data set of lake users and both users and nonusers along the Monongahela River. They also estimated travel cost parameters and income parameters for independent variables such as total shore miles, number of recreational and developed access points on the site, size of the pool surface in relation to the total area, percent saturation of dissolved oxygen, and variance in the dissolved oxygen over the six observations. A comparison of first and second generation travel cost models, assuming an average income of $10,409 to $19,589 in 1977 dollars, led to corresponding average travel costs of $3.04 to $52.23 in 1977 dollars. The use of various payment vehicles was also demonstrated in the study. Direct questioning, payment cards, and iterative bidding were used to determine individuals mean benefits for changes in water quality.

Contingent Valuation

The contingent valuation method (CVM) is used to estimate values for environmental amenities and other non-market goods and services. Surveys are used to

ask respondents about their monetary values for non-market goods contingent upon the creation of a market or other means of payment. CVM has been applied in hundreds of studies, many of which have been designed to further develop the method. Because of this vast amount of previous research, this literature review will deal only with important issues in CVM and the seminal works that have contributed to the evolution of the method.

As CVM has been used in a wider range of applications, the acceptance of the method for valuing non-market commodities has grown as well. It was authorized for the valuation of outdoor recreation in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (US Water Resources Council, 1983). Later, the US Army Corps of Engineers prepared its own manual for applying the method (Moser and Dunning, 1986) and has conducted many CVM studies (Mitchell and Carson, 1989). The US Fish and Wildlife Service have also deemed CVM acceptable for human use and environmental studies (US Fish and Wildlife Service, 1985). In addition, the US Environmental Protection Agency, in its Guidelines for Performing Regulatory Impact Analysis, lists CVM as one of the four basic methods for valuing the environmental benefits of proposed regulations (US Environmental Protection Agency, 1983).

Nevertheless, the accuracy of contingent valuation continues to be debated. Other valuation methods, including market valuation and applications of other styles of non-market valuation techniques (travel cost, hedonics) depend on values and behavior actually revealed in market situations. Obviously, preferences revealed through actual behavior have great credibility in economics. This has led many scientists to question the

validity of CVM (Mitchell and Carson, 1989). They explain validity and how it applies to CVM in this manner:

> The validity of a measure is the degree to which it measures the theoretical construct under investigation. This construct is, in the nature of things, unobservable; all we can do is to obtain imperfect measures of that entity. In the contingent valuation context the theoretical construct is the maximum amount of money the respondents would actually pay for the public good if the appropriate market for the public good existed.

In general, CVM is valid to the extent that it is effective in accurately measuring people's true values.[2]

The intensity of the controversy in the United States over the validity of CVM increased tremendously when steps were taken to apply it to assess damages from spills of oil and toxics in the context of litigation. Requirements under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Oil Pollution Act of 1990 forced federal agencies to evaluate the method on a nonpartisan basis for these types of damage assessments. This coupled with the Exxon Valdez oil spill created a rush of CVM studies and growing questions regarding the validity of CVM. The National Oceanic and Atmospheric Administration (NOAA) convened a panel to assess the usefulness of CVM for measuring non-market values.[3] NOAA asked the panel to consider whether CVM is sufficiently valid to be used in assessing damages from oil spills. The panel concluded (US Department of Commerce, 1993):

> It has been argued in the literature and in comments addressed to the Panel that the results of CV studies are variable, sensitive to details of the survey instrument used, and vulnerable to upward bias. These arguments are plausible. However, some antagonists of the CV approach go so far as to

[2] True values here refer to people's compensating surplus (WTP) or equivalent surplus (WTA)
[3] NOAA is the agency assigned to promulgate rules for assessing the damages form oils spills in US waters

> suggest that there can be no useful information content to CV results. The panel is unpersuaded by these extreme arguments.

In the body of its report, the Panel identified a number of guidelines for CVM applications. These guidelines are met by the best CVM surveys and need to be present in order to assure reliability and usefulness (Haab and McConnell 2002):

1.) conservative survey design,
2.) use of WTP as opposed to WTA,
3.) use of referendum format,
4.) provision of adequate information,
5.) pretesting any and all photographs,
6.) reminder of substitute commodities,
7.) adequate time lapse from the accident,
8.) temporal averaging,
9.) provision of a "no-answer" option,
10.)yes/no follow-up questions,
11.)additional questions to interpret the responses to the primary valuation question,
12.)checks on understanding and acceptance (pretesting)

Without necessarily endorsing each guideline for CVM studies or the research that is advanced, the NOAA panel succeeded in capturing three essential points. First, there is too much evidence supporting CVM to warrant a complete dismal of the method. CVM is capable of providing information about values even though the method may be imperfect. Second, CVM studies do not automatically provide information. A CVM study must have a high degree of content validity at the outset. Third, more research is needed to learn how to enhance the validity of CVM (Bishop et al. 1995). It is reasonable to conclude that a negative report from the NOAA panel may have doomed the existence of CVM. However, through the completion of the Panel's report, CVM has gained a wider acceptance and respect as a method for non-market valuation. Since that time researchers have delved into the limitations of CVM that were addressed by the Panel and the method as a whole has improved significantly

As was stated earlier, the Exxon Valdez oil spill spawned a number of CVM studies to address the extent of the damage to non-market commodities like recreation, wildlife habitat, scenic quality, and water quality. Hausman et al. (1995) employed a utility consistent, combined discrete choice and count data model to recreational demand behavior in Alaska in order to estimate the welfare losses suffered by recreational users due to the Exxon Valdez oil spill. A second stage in their analysis utilized a multinomial choice model, which produced a price index for the commodity, which is used to estimate the count data model. Models were estimated for sportfishing, pleasure boating, hunting, and hiking/camping/viewing with the model form being the same for each activity. The researchers provided demographic information on estimated participation rates, estimated number of trips, an analysis of transportation mode, estimated percentage of trips taken to the infected area, and consumer surplus estimates per trip. Consumer surplus per trip ranged from $49 for hunting to $194 for hiking/viewing. Estimated loss in use value was also estimated and ranged from a $399,398 gain in pleasure boating to a $1,092,215 loss for hiking/viewing. The researchers also came to two conclusions from the study. First, the differences between the damage estimates of the multinomial logit models, which restrict site substitution, and the nested multinomial logit models, which allow freer site substitution, demonstrated the importance of allowing for less restricted patterns of site substitution. The second conclusion is that recreational use damages due to the Valdez oil spill are estimated to be approximately $3.8 million for 1989.

Survey design and framing issues have been points of contention between CVM proponents and critics. Many critics of CVM believe that the scope and wording of CVM questions affect responses substantially. Many researchers have evaluated the severity of

this effect as well as methods to alleviate this bias (Ready, Whitehead, and Bloomquist 1995; Wang 1997; Dubourg, Jones-Lee, and Loomes 1994). A recent study by Ready et al. (2001) addresses the question of how respondents with uncertain willingness to pay answer CVM questions. Four elicitation methods were compared in a split sample, contingent valuation study valuing avoidance of episodes of ill health linked to air pollution. Respondents to traditional payment card questions gave willingness-to-pay values that were lower than those implied by dichotomous-choice (DC) responses. However, follow-up questions demonstrated that DC respondents were less certain of their stated behavior than were payment card respondents. When respondents were told to be "almost certain" of their responses, responses to the DC and payment card formats converged.

Payment card applications of contingent valuation are considered a predecessor to discrete choice contingent valuation techniques. Mitchell and Carson (1989) discuss the issues related to payment card methods along with the relevant limitations of this approach. In this method the interviewer describes the situation to the respondent, explains the need to pay, and then presents a card to the respondent with a list of payment options. The respondent is then asked a willingness to pay question based on the payment card. This method is useful in that it is easy to interpret for the survey respondent and it is easy to calculate welfare estimates form the data. However, many limitations have caused this method to be viewed as an inferior method to more current discrete choice methods. The chief difficulty with the payment card mechanism is that its incentive properties are suspect. This comes in part from the cueing implicit in the formulation of the payment card. It is also considered discrete/internal information,

which is less efficient in that it provides an upper and lower bound but is not able to pinpoint precise welfare measures.

Rock Climbing

Grijalva et al. (2000) used the random utility model (RUM) to value the loss of climbing access in wilderness areas on a national level. The authors utilized a version of the RUM known as the repeated nested logit (RNL) random utility model. It was the first study to apply the RNL model to recreation on a national scale, and one of only a few studies that attempted to develop a nested model with three layers. This allowed for the repeated nature of the model that allows for multiple trips. They valued the loss of climbing areas for 10 aggregate site regions using variables such as number of climbs in an area, years climbing, and work flexibility. The goal of this report was to show that the loss of climbing resulted in a significant loss to the climbing community therefore seasonal participation was needed, which was another reason for using the RNL model.

Due to the growing popularity of rock climbing and the number of new regulations that have been created to manage for rock climbing, many studies have been conducted to model rock climbing demand and estimate welfare for current or proposed regulation changes. Shaw and Jakus (1996) estimated the demand for rock climbing and calculated welfare measures for changing access to a number of climbs at Mohonk Preserve in New York State. The authors extend the travel cost methodology by combining the double hurdle count data model with a multinomial logit model of site-choice. The combined model allows the authors to simultaneously explain the decision to participate and to allocate trips among sites. The application is to climbers who visit one

of the premiere rock-climbing areas in the northeastern United States and its importance to substitute sites. The authors also estimate a conventional welfare measure, which is the maximum WTP to avoid loss of access to the climbing site.

Hanley et al. (2001) used a repeated nested multinomial logit random utility model to predict the impacts on welfare and trips of two alternative rationing mechanisms currently being considered by resource managers: (1) the imposition of car-parking fees and (2) measures to increase access time. The recreational sites in question were disaggregated by type of climbing and site location in Scotland. Results indicate that loss in seasonal compensating variation per climber could range between £12.50 and £40 resulting in a seasonal loss of between £155,312 and £497,000. In general an increase in access time seemed to result in a smaller loss in compensating variation. Change in predicted trips ranged from 7.87 to 0.002 for the fee increase and 7.90 to 0.002 for the increase in approach time depending on the site.

Hanley et al. (2002) utilized the choice experiment method for modeling the demand for technical rock climbing. The sample area consisted of eight climbing sites located throughout Scotland. Both nested and non-nested models were estimated and were compared to a revealed preference data model based on the same sample of climbers. Specifically, the authors estimated the preferences of climbers for alternative sites as a function of site characteristics and climber characteristics. The six attributes of climbs that were determined to be central to the choice decision were length of climb, approach time, crowding, climb quality, scenic quality, and distance. They then derived implicit prices from these attributes using the multinomial logit model and a nested logit model. In both models all the site attributes were found to be significant, with the only

exception being a climb quality attribute. In addition all attributes exhibited the expected signs and their changes in magnitude were consistent with the hypothesis. Implicit prices were calculated for each attribute and were interpreted as willingness-to-pay amounts. For example, research found that an extra meter of climbing route length added £0.11 to the value of the climb. A one-hour reduction in approach time added £11.61. Big increases in value were also found in decreasing the number of people at a climb. Moving from a crowded climb to a not crowded climb added £18.22 in value. Climbs that were considered "very scenic" added £25.06 to the value of the climb. Implicit prices estimated from the multinomial logit model and the nested logit model were not significantly different. In addition, the authors investigate whether results are sensitive to the complexity of the choice task and incorporate tests of the underlying rationality of respondents' behavior.

Off-Highway Vehicle Recreation

The previous literature concerning OHV recreation is somewhat limited. To the author's knowledge, no previous travel cost or contingent valuation studies have been performed on OHV recreation. Previous work has been performed on other aspects of OHV recreation ranging from trail design to fuel use. Wernex (1993) evaluated trail design and maintenance for off-highway motorcycles and ATVs. The goal was to identify design and construction methods that would lessen needed maintenance, harden the trails to prevent environmental damage, and increase user satisfaction. The Federal Highway Administration (1994) assessed OHV recreation by addressing conflicts on multiple use trails. While all outdoor trail-related activities create some type of

environmental impact, the research found that OHV activities were particularly damaging. Environmental impacts such as noise pollution, water pollution, air pollution, and plant degradation account for a number of conflicts between OHV riders and other groups.

While 35 states possess some form of OHV infrastructure, only a handful have developed OHV management plans. California has established a completely self-funded OHV management program, and was also the first state to complete an OHV management plan in 1971. The structure of the California Off-Highway Motor Vehicle Recreation (OHMVR) Program consists of an OHMVR Commission composed of industry executives, land managers, environmental organizations, and OHV recreationists. The state also has 6 OHV recreation areas totaling more than 90, 000 acres. The state boasts an OHV grant program aimed at raising funds for OHV management. The management plan calls for vehicle registration and an OHV fuel tax to support OHV management in the state. The management plan reported that 14.2% of all California households had an OHV recreation enthusiast totaling 3.5 million OHV recreationists in the state. OHV registration was also found to have increased 108 percent since 1980. Economic impact for OHV use exceeds $3 billion dollars in economic activity statewide. The survey also reported that OHV recreation generates roughly $1.6 billion in personal income and affects 43,000 jobs within California (California Department of State Parks and Recreation 1993).

Arizona has completed an extensive OHV management plan as well. The first OHV management plan in Arizona was put into effect in 1993. It was then superceded by a revised plan in 2000. As part of the 2000 plan, a trail user survey was conducted for

both motorized and non-motorized users. A random phone survey, random mail survey, and a targeted mail survey were employed to gather the information. This survey revealed that 77 percent of Arizona residents consider themselves trail users and of this 21% consider themselves motorized trail users.[4] Motivations for using the trail system were to observe scenic beauty, to enjoy the sounds and smells of nature, to be away from crowds, to enjoy solitude, and to be in the mountains. A positive note for the future funding possibilities of an OHV management plan in Tennessee is the success of the Arizona OHV Recreation Fund Competitive Grants Program. From 1993 to 1998, the OHV Recreation fund secured 57 grants totaling more than $7 million dollars. Survey participants were also asked what they considered to be the three most important issues concerning trails in Arizona and were given 20 issues from which to choose. The top three trail issues for motorized trail users were closure of trails and roads, lack of trail etiquette and environmental ethics, and loss of public access to trails (Arizona State Parks 1999).

The Study Committee on Off-Highway Vehicles appointed the University of Tennessee to perform a survey of OHV users in 1999. This survey sought to gather information concerning opinions, user demographics, trip characteristics, motivations, and economic impact. Population estimates from this survey suggest that there are 553,000 OHV users in the state of Tennessee with 156,000 households containing at least one active user. Survey demographics reveal that the average OHV rider in Tennessee is a 38- to 44-year old white, male, with a high school degree and some college education.

[4] Motorized refers to four-wheel drive vehicles, ATVs, off-highway motorcycles, dune buggies, and snowmobiles

He earns between $50,000 and $74,999 per year (Fly et al. 2001). Further analysis estimate the economic impact of OHV activity to have been $3.6 billion between June 30, 2000, and June 30, 2001. The total number of jobs affected by OHV recreation in Tennessee was found to be 52,300 (English et al. 2001a). OHV activity impacted a range of businesses as well. The top five were:

- Automotive dealerships and service stations
- Miscellaneous retail operations
- Automobile repair shops
- Hotels and other lodging places
- Eating and drinking establishments

The estimated economic impact of OHV special events was found to range from $225,470 for the Dixie Run event to $65,420 for the Appalachian Jeep Jamboree (English et al. 2001b). All economic impact estimates were generated using IMPLAN. Researchers considered expenditures incurred in preparing for, getting to and from organized events and individual riding excursions. While these numbers exhibit the importance of OHV recreation to the state and local economy, they do little to supply information on OHV user behavior that is critical for proper OHV management.

CHAPTER 2

MODELING THE DEMAND FOR AND VALUE OF OHV RECREATION IN TENNESSEE

This chapter is a lightly revised version of a paper by the same name submitted for publication to the *Journal of Forest Economics* in 2004 by Charles Sims, Donald Hodges, Burton English, Mark Fly, and Becky Stephens.

My use of "we" in this chapter refers to my co-authors and myself. My primary contributions to this paper include (1) selection of the topic and development of the problem into a work relevant to my study of nonmarket valuation of recreational resources, (2) analysis of travel cost data, (3) economic modeling of demand and value, (4) most of the gathering and interpretation of the literature, (5) pulling the various contributions into a single paper, and (6) writing of the paper.

Introduction

Off-highway vehicle (OHV) recreation has experienced a significant increase in popularity throughout the United States.[5] According to the USDA Forest Service Resources Planning Act (RPA) Assessment, participation in off road driving has increased by nearly 44% since 1995. Sales reports from each outdoor vehicle industry indicate that sales of outdoor vehicles are up by at least 15% (MIC 2001). This increase in popularity has occurred particularly in the southeastern United States where the use of OHVs by fishermen, hunters, and off-road enthusiasts have combined to form a large population of off-highway vehicle users.

A mix of public and private lands, coupled with beautiful surroundings and a wide variation in topography, presents a range of opportunities that make Tennessee a popular site for OHV recreation. Each year over 500,000 people visit national forests, state riding areas, or private lands to enjoy OHV recreation (Fly et al. 2001). As a result of the

[5] Off-highway vehicles are considered to be any type of motorized vehicle that can be taken off of the road. Examples may include off-highway motorcycles, ATVs, four-wheel drive vehicles, or rail buggies.

growing popularity of OHV recreation in Tennessee, the demand for areas that provide for such recreation has increased dramatically. Most riders seek vast areas with secluded trails and trails that consist of some type of mountainous terrain. Due to increasing amounts of land development and conversion, however, available areas of mountainous wooded terrain are becoming increasingly difficult to find. On public lands, managers are often forced to designate certain areas in state and national forests for OHV riding only to prevent user conflicts with other types of recreation. However, many states do not budget funds for OHV areas. This leaves many land management agencies struggling to allocate funding for patrolling, safety, and the extensive trail maintenance needed in OHV areas; ultimately, leading to closure or additional restrictions imposed on the recreation site.

Restrictions in and closures of public riding areas often result in riders venturing onto restricted public and private properties. Tennessee Code Annotated Section 70-7-101, et seq., (commonly called the "Recreational Use Statute") protects both private and governmental entities from injury lawsuits unless the landowner charges a fee or "consideration" to ride on his land. In most cases, landowners who do not charge a fee are protected from liability for simple negligence. However, landowners who allow riding on their property and charge a "consideration" or fee to offset the costs related to the OHV activity forfeit any protection offered under the Recreational Use Statute.

Tennessee Governor Don Sundquist appointed the Study Committee on Off-Highway Vehicles in November 1999 to evaluate the use, impact, and availability of OHV recreation in Tennessee and to address emerging economic, social and environmental issues related to this growing sport. The state extended invitations to

relevant public agencies and to citizens' groups to participate in the committee. The Study Committee recommended that a formal OHV program be established in Tennessee with the goals of providing sufficient opportunities for the sport, propelling the associated economic benefits to the state, and properly managing OHV use to protect public safety, property owners, and natural resources.

The increase in the popularity of the sport and the decreasing opportunities for OHV recreation, make OHV management in the state of Tennessee a formidable task. Despite its growing popularity and apparent need for new management strategies, there is no published research devoted to modeling behavior or estimating the basic value of OHV recreation. Previous research efforts have focused on the economic impact of OHV recreation in addition to basic use estimates; however, no research has been devoted to economic modeling of the demand for OHV recreation. The goal of this research was to address this void of information by modeling OHV recreation demand behavior using various regression methods. In order to model travel cost behavior, ordinary least squares (OLS) regression was used to identify relevant factors effecting travel cost spending decisions. Using the basic travel cost methodology, Poisson regression was used to model trip taking behavior. Additionally, basic use estimates, demographics, and economic impact information will be presented on OHV recreation in the state of Tennessee.

Survey and Sampling Methodology

This research is an extension of the study conducted for the Study Committee on Off-Highway Vehicles. Data were gathered through a combination of on-site, telephone,

and mail surveys. Three subpopulations were identified and surveyed, including OHV special event participants, Tennessee sportsmen, and the general population. A brief description of the survey procedures and results is provided below. A more detailed description of the survey methodology is provided in Fly et al. (2001).

Event riders consisted of participants from four OHV special events. These events included the Dixie Run and the Appalachian Jeep Jamboree in the Cherokee National Forest of Tennessee and Nantahala National Forest in North Carolina, the Gateway to the Cumberlands in south-central Kentucky, and the VSTA off-road motorcycle event in Middle Tennessee. These respondents completed a short on-site survey and were asked if they could be contacted in the future. Participants in those events who live in Tennessee and who agreed to be contacted were sent a mail survey. Of those 340 participants, 169 completed and returned mail surveys for a response rate of 49.7%.

Tennessee sportsmen interviewed during the Fall 2000 Tennessee Wildlife Resources Agency (TWRA) Hunting and Fishing Survey were asked if they owned or used an OHV for recreational purposes. Those who responded "yes" were then asked if they could be contacted for a follow-up mail survey. A random sample of those sportsmen who agreed to be contacted was selected to receive an OHV mail survey. Of those 587 sportsmen, 180 completed and returned mail surveys resulting in a response rate of 31.7%.

For the general population survey, a randomly generated sample of Tennessee telephone numbers was purchased from Survey Sampling, Inc. Upon contact, the person answering the phone was asked if anyone in the household had driven or ridden an OHV

in the past 12 months. If the response to this question was affirmative, then the person administering the survey asked to speak with the primary OHV user in that household. Using Random Digit Dial (RDD), 721 households were contacted, and 411 interviews were completed by telephone for an RDD telephone response rate of 57.0%. A follow-up mail survey was then sent to 158 OHV users identified in the RDD telephone survey. Of those follow-up surveys, 60 were completed and returned for a 38.0% response rate.

Survey responses from the event surveys, the TWRA surveys, and the general population surveys were then aggregated. Of the 409 surveys that were returned from all three survey procedures, 271 were usable. Because of significant differences in the costs experienced by the different OHV user groups, these 271 usable surveys were disaggregated by type of OHV user: off-highway motorcycle users (n=86), ATV users (n=89), and four-wheel drive users (n=96).

Travel Cost Method

A model of an OHV recreationist's (off-highway motorcycle, ATV, or four-wheel drive) choice of the number of visits to make to an OHV recreation site was modeled using a traditional individual travel cost model (TCM). The basis of the TCM is that visitors will choose the annual number of trips to a recreation site based on the cost of traveling to the site. The number of trips will be inversely related to the travel cost (Loomis and Walsh 1997). This feature is critical because the inverse relationship allows the demand curve to be estimated based on travel costs and the number of trips taken. Once the demand curve is estimated, calculating the net willingness to pay or consumer

surplus simply entails summing the areas below the demand curve and above the price for the various users (Rosenthal et al. 1984).

Several assumptions must hold for travel costs to be a proxy for price in the TCM (Freeman 1999). The first assumption is that the visitor is on a single-destination, single-purpose trip. For our purposes this would be a trip to a single OHV site in Tennessee for the sole purpose of OHV recreation. Mendelsohn et al. (1992) have proposed a method for including multiple destination trips in the TCM, however it was for a zonal, linear application. For this paper, this assumption will be addressed through survey design. Individuals indicating a multipurpose trip were asked to report the number of days spent for OHV recreation in relation to the total number of days for the trip. A percentage of days spent for OHV recreation was calculated and this percentage was applied to total travel cost estimates for the trip. Another assumption is that net utility derived from travel time is a function of miles traveled. The time that it takes to travel to a site represents a loss in wages. If a trip to a recreation site is many miles away it will take longer to get there and will represent a greater loss in wages therefore a greater cost. Therefore, we assume that the number of miles traveled to a recreation site will represent the cost of travel time and will have a negative influence on the number of trips taken.

Model Specification

The first issue that should be addressed in specifying a travel cost model is price. As is well known (Cesario 1976; McConnell and Strand 1981), travel time as well as travel cost should be included in a travel cost model. Some researchers treat travel time as an endogenous variable (Shaw and Ozog 1999; Desvouges and Waters 1995); others

have included a proportion of the wage rate as an additional factor in the travel cost measurement (Randall 1994; Englin and Shonkwiler 1995). The cost of travel time is incorporated as a function of the number of miles traveled from origin to the average OHV site visited and included as a separate variable. Recent research has led some to the conclusion that "the wage rate does not necessarily reveal anything about the shadow value of discretionary leisure time, either as an upper or lower bound" (Larson et al. 1997). While leisure cost of time could play a large part in trip choice behavior and in consumer surplus estimates, survey data limitations and questions concerning the validity of the wage rate as a shadow price for leisure time force the exclusion of costs associated with leisure time in this study.

The cost of a trip to an OHV site is composed of two parts: the admission fee f and the cost of travel (both monetary and time costs). Since most OHV recreation sites charge no admission fee to the area, total cost is comprised of the monetary and travel time cost of travel (Freeman 1999). The monetary costs of travel have been split into five parts: lodging, food and beverage, transportation, off-highway vehicle expenses, and other expenses. Since OHV recreation requires substantial purchases to begin participation (high fixed costs) and it is reasonable to believe that these purchases may play a significant part in travel choice behavior, additional OHV expenditures are needed to supplement the marginal costs experienced by OHV users on each trip.

The second issue that must be addressed through model specification is that of substitute sites. In a traditional single site travel cost model, the value an individual places on that particular site is affected significantly by neighboring sites that may provide similar recreational experiences. These substitution effects are critical for precise

model specification, as their exclusion may overstate the estimates of consumer surplus (Rosenthal 1987). However, the resource being measured by this model is OHV recreation in the state of Tennessee and not at a single site. Because OHV recreation in different parts of the state can have different substitutes, it is difficult to identify possible substitutes. OHV recreation at a site in eastern Tennessee would have a different set of substitutes than a recreation site in western Tennessee. Additionally, among survey respondents, across vehicle types, the highest percentage of OHV riding was conducted in Tennessee (80%-94%). Based on this information, it is reasonable to assume that substitute effects for OHV recreation in Tennessee are minimal and were ignored in this study.

A Poisson model (travel cost model) was employed to model the demand for OHV recreation in Tennessee. The Poisson distribution is far more consistent with a data generating process producing only a few trips per visitor. Hellerstein (1992) shows that when the estimated number of trips is small (such as this data set, where the average is 11.24) the Poisson is a much closer approximation than regression techniques based on the normal distribution. In addition, the Poisson model is one in which the maximum likelihood estimator (MLE) is robust to certain misspecifications of the model, such as the failure to incorporate latent heterogeneity in the mean. In order to correct for this misspecification, a robust covariance matrix was used. The model estimated has a Poisson distribution with the general specification being:

$$Y_i = \exp(\text{PRICES}_i, \text{QUALITY}_i, \text{DEMOGRAPHICS}_i, \text{error term}) \quad (1)$$

Due to differences in travel cost between different OHV users, survey results were disaggregated into three user groups: off-highway motorcycle users, ATV users, and four-wheel drive users. While nominal costs (transportation, lodging, food and beverage) were similar between the three user groups, the fixed costs (OHV purchases, OHV maintenance, etc.) varied greatly between user groups. In addition, many OHV areas are specified for particular OHV users. Because different types of OHV recreation require different site characteristics, sites may be more suited for certain user groups. This leads to a variation in site quality between user groups in the form of satisfaction with OHV opportunities and OHV management. To isolate these differences between user groups, the model was applied to all three user groups. The model is specified as follows:

$$\ln TRIPS = B_0 - B_1*TC - B_2*PUBRIDER + B_3*EXP + B_4*OHVOPP + B_5*OHVMNG + B_6*EDU + B_7*OHVGRP + B_8*INC - B_9*MILES \quad (2)$$

Where TRIPS is the estimated number of OHV trips taken; TC is travel costs for an OHV trip; PUBRIDER is a dummy variable to determine where the individual rides most often (1=public land, 0=private land); EXP is the individual's experience level measured in number of years riding; OHVOPP is the individual's satisfaction with OHV opportunities; OHVMNG is the individual's satisfaction with OHV management; EDU is the individual's education level; OHVGRP is whether the individual is a member of an OHV group or organization; INC is the individual's annual household income; and MILES is the number of miles traveled on average for OHV recreation.

The inclusion of appropriate explanatory variables is important to model the demand for recreational areas, but existing travel cost literature provides little insight into selecting explanatory variables for modeling OHV recreation. Therefore, model variables were selected based on travel cost studies performed on similar types of recreation. The basis of any travel cost model is the travel cost variable itself. Based on previous research we would expect the coefficient on travel costs to be negative, inferring a negative relationship between travel cost and the number of trips (Loomis and Walsh 1997; Fix and Loomis 1997).

Because individuals make choices about recreation based on the quality of recreation at a particular site, previous literature has included various quality variables with great success (Morey 1981; Smith, Desvouges, and McGivney 1983a; Caulkins, Bishop, and Bouwes 1986; McConnell 1986). Quality variables can be based on quantitative data or can be represented by some measure of perceived quality derived from questions asked of recreation participants. For a single OHV site, quantitative quality variables might include number of trails, difficulty of trails, or a measure of congestion. However, when modeling recreation over numerous unspecified sites (as is the case in this study), these types of quality measurements are impossible to include due to variances in quality between OHV sites located throughout the state. Therefore, two measurements of perceived quality of OHV recreation were included in the model. OHVOPP and OHVMNG measure the respondent's satisfaction with OHV recreation opportunities and OHV site management in the state of Tennessee. It is assumed that the higher the individual's satisfaction level for these two variables, the more OHV trips that

individual is likely to take. Therefore, it is hypothesized that these two variables should have positive coefficients.

Basic demographic variables (income, education, experience) were included in this model to coincide with previous travel cost studies (Morey 1981; Samples and Bishop 1985; Shaw and Jakus 1996; Grijalva et al. 2002). These variables are consistently found in various travel cost models. Because OHV groups and organizations sponsor numerous riding events annually, participation in such groups should reasonably lead to more OHV trips taken. In order to include this effect (which is expected to be positive) in trip taking behavior a variable was added to identify participation in OHV groups. Additionally, survey data indicated that a lack of public OHV recreation areas was a main reason for reduced participation in OHV recreation. Therefore to address effects in OHV trip taking behavior based on OHV recreation area ownership, an additional variable was included to identify the type land ownership that was predominately used for OHV recreation (public riding areas versus private riding areas). Because of this identified lack of public OHV recreation areas, it is assumed that individuals that participate in OHV recreation on private land would participate more often due to increased recreation opportunities.

The value of access equals the area under the expected demand curve. For the exponential demand function, the price at which no trips will be taken or the choke price (C^*) is infinite. Assume a simple demand specification: $x=e^{\beta_0+\beta_1 C}$ where C is the travel cost, and β_0 can be a constant or a function of covariates other than own price. For any finite C, $x= e^{\beta_0+\beta_1 C}>0$. Defining C^0 as the current travel cost, consumer surplus for access is

$$WTP = \left[(e^{\beta_0+\beta_1 C})/\beta_1\right] = -x/\beta_1 \quad (3)$$

where x represents the number of trips taken by the individual and β_1 is the parameter estimate for travel costs. In the Poisson expression for sample mean WTP, one can use the mean of observed trips or mean of the expected trips because the Poisson model has the property that it is mean fitting (Haab and McConnell 2002). The mean of observed trips was used for calculations in this study. Consumer surplus estimates generated through this procedure provide an estimate of the individual value of OHV recreation in Tennessee.

Results

Survey Information

The descriptive nature of the OHV user survey produced an abundance of information concerning OHV user population estimates, OHV user demographics and participation rates, and economic impact. The following is a summary of these findings for the state of Tennessee and a comparison to available information obtained from similar surveys performed in California and Arizona (California Department of State Parks and Recreation 1993; Arizona State Parks 2000).

Using a random sample population of Tennessee citizens, OHV usage in the state of Tennessee was disaggregated into geographical regions and presented in Table 1. The total number of OHV users represents individuals who had ridden an OHV at some time. Active users refer to those individuals who had ridden an OHV for recreational purposes

Table 1. Tennessee OHV Population Estimates

	West	Middle	Plateau	East	Total
% of households with OHV user	10.47	10.89	12.57	12.86	11.61
Est. number of households with OHV user	61717	75720	45875	74995	259240
Mean number of OHV users per OHV household	2.06	2.21	2.28	2.05	2.14
Est. total number of OHV users	127137	167341	104595	153740	554774
Est. number of active users	82270	73212	58950	66047	280161
% of households with one active user	67.4	60.2	61.3	53.9	60.1
Est. number of housholds with one active user	41597	45583	28121	40422	155803

*based on 2000 census data

at least once in the past 12 months. The total number of OHV users in Tennessee was estimated at more than 550,000 compared to 3.5 million in California and over 1 million in Arizona. These numbers represent approximately 10% of the state population in Tennessee, 10% of the state population in California, and 21% of the state population in Arizona, respectively. Per capita estimates reveal that while California boasts the largest OHV user population in the country, OHV recreation is just as popular in Tennessee as it is in California. Population estimates per user group revealed that the four-wheel drive user group was the largest at over 324,000 followed by the ATV user group at roughly 153,000 and the off-highway motorcycle user group at approximately 46,000. Additionally, there were more than 500,000 total OHVs in Tennessee. According to population estimates the largest numbers of OHV users were found in middle and east Tennessee. However, the largest number of active users (those who have ridden OHV for recreational purposes in the past 12 months) was found in middle and west Tennessee.

Survey results also provided a great deal of demographic information concerning OHV users. The average OHV user in Tennessee was primarily middle-aged, with the most frequently reported age groups being 40-49 followed closely by 30-39 (Figure 1).

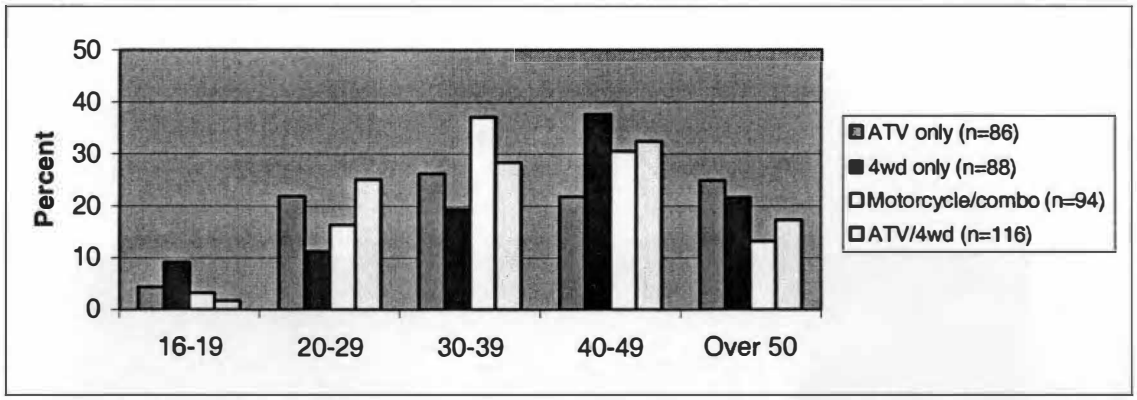

Figure 1. Age of OHV users in Tennessee by type of OHV

Table 2. Tennessee OHV Trip Characteristics

Variable	Mean	Std Dev
Travel Cost	$214.95	146.0532
Trips	19.18	17.5026
WTP/vehicle/day	$8.27	4.7411
WTP/vehicle/year	$38.91	21.8005

The majority (+80 percent) of OHV users in Tennessee were male, Caucasian (+90 percent), and married (+70 percent). These estimates are very similar to survey results in California and Arizona. Almost 30 percent of OHV users in Tennessee completed high school, more than 20 percent have some college education, and more than 20 percent are college graduates (Figure 2). The most frequently reported range of income among survey respondents was $50,000-$75,000, followed closely by the over $75,000 range (Figure 3). The most frequently reported occupations of OHV users in Tennessee were professional worker, skilled tradesperson or craftsman, or manager and executive.

Trip characteristics identified in the Tennessee OHV user survey revealed that on average OHV participants spent $215 per trip and took an average of 19 OHV trips per year (Table 2). Most OHV trips in Tennessee lasted less than a day while approximately

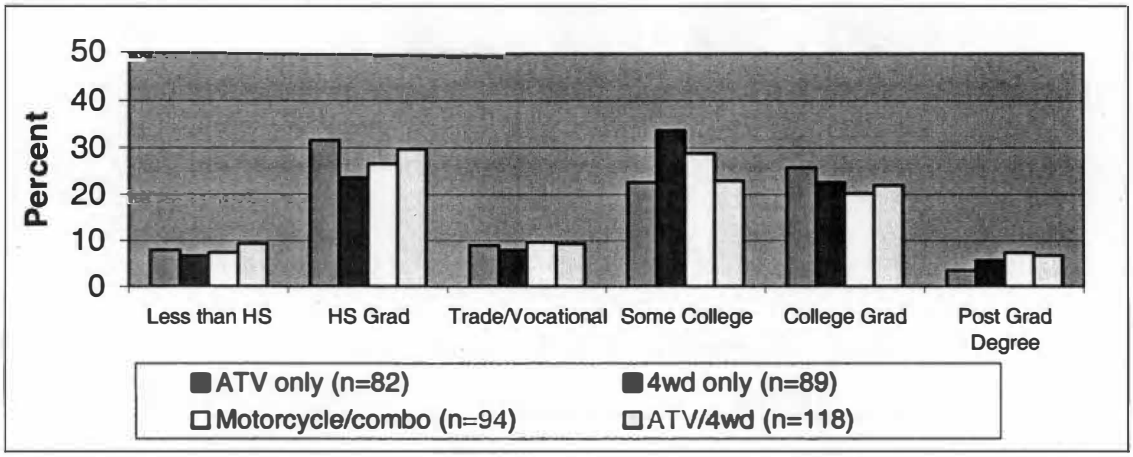

Figure 2. Education level of OHV users in Tennessee by type of OHV

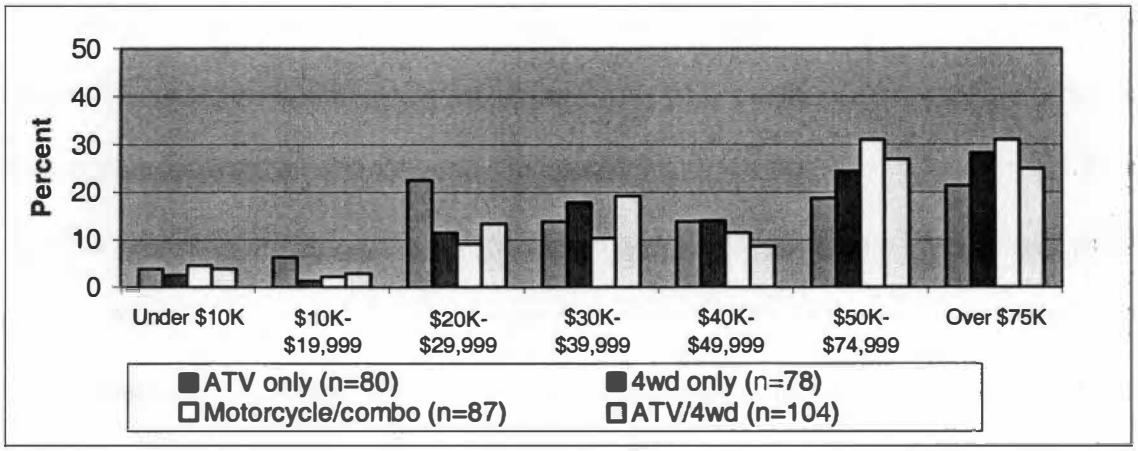

Figure 3. Income level of OHV users in Tennessee by type of OHV

20 percent of respondents said that their typical OHV trip lasted more than a day. Multiple day trips typically involved three days and a total of six or seven hours per day riding. Satisfaction with OHV opportunities in Tennessee was very low. Across vehicle types, more people were dissatisfied than satisfied with OHV opportunities and management in Tennessee. In Arizona, over 50% of respondents said that they are very satisfied or extremely satisfied with Arizona's trail opportunities. A number of factors could attribute to this difference of opinion on OHV management between the two states. For instance, Arizona has a greater percentage of federal land, providing more riding opportunities. In addition, Arizona has instituted a competitive grant program that has awarded over $7 million for OHV recreation (Arizona State Parks 2000).

Respondents were also asked how much they would be willing to pay for OHV recreation if this money was used to improve OHV management and opportunities. The question was posed using a daily fee and a yearly fee as payment vehicles. Average responses and standard deviation to these willingness to pay questions are provided in Table 2. Survey data also revealed that the majority of OHV recreation occurs on private land. ATV users recreate on private land most often (78%) while four-wheel-drive users utilize less private land (55%). The percentage of public and private land usage for OHV recreation is presented in Figure 4.

Tennessee's statewide economic impact analysis of the OHV industry was performed using IMPLAN and is presented in Table 3.[6] The estimated economic impacts from OHV activities in 1998 dollars was approximately $3.43 billion in total economic activity, $2.33 billion in value added, and over 52,000 full- and part-time jobs. A similar

[6] All IMPLAN analysis was performed by co-author Burton English

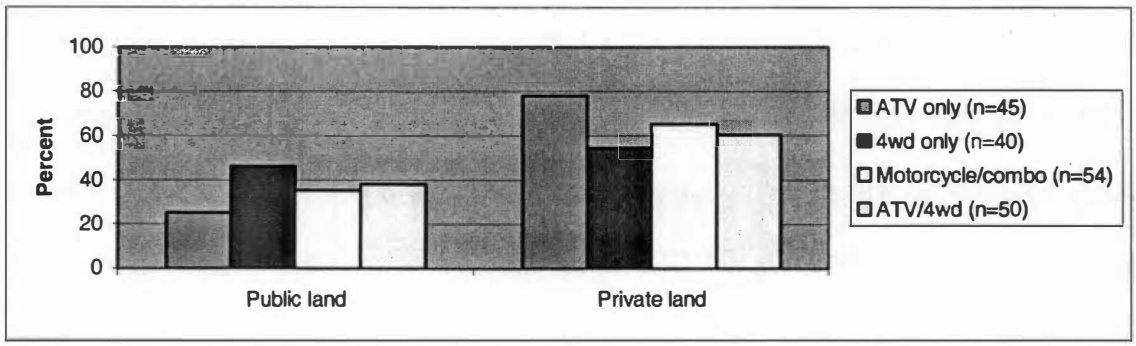

Figure 4. Percentage of time ridden on public vs. private land

Table 3. Estimated Economic Impacts from OHV Survey for Tennessee		
	Direct	Total
	($ Billion)	
Total Industry Output*	$1.76	$3.43
Total Value Added*	$1.30	$2.33
	(number)	
Jobs	29800	52300
*1998 Prices		

study performed in California in 1993 revealed that OHV recreation produced $3 billion dollars and 43,000 jobs (California Department of State Parks and Recreation 2002). The estimated top ten sectors impacted as a result from OHV users in Tennessee were v*ehicle dealers and service stations, miscellaneous retail, vehicle repair and services, hotels and lodging places, eating and drinking, wholesale trade, food stores, transportation equipment, real estate, and owner-occupied dwellings* (English et al. 2001).

Estimated average per trip expenditures for lodging, food and beverages, transportation to the OHV site, OHV (rental fees, repairs and service, trail use fees, plus fuel and oil), and other expenses are presented in Table 4. The food and beverage category has the largest average per trip expenditure followed by OHV, lodging, other expenses, and transportation to the OHV site. Within the food and beverage category

Table 4. Average OHV Per Trip Expenditures	
Lodging	$17.83
Food and Beverages	$26.72
Transportation to OHV Site	$13.82
Off-Highway Vehicle	$19.96
Other Expenses	$14.63

Table 5. Average OHV Expenditures in Past 12 Months	
OHVs purchased	$4,615
Support vehicles purchased	$667
Repairs	$366
Modifications/upgrades	$321
Insurance	$205
Routine Maintenance	$194
Other support equipment	$137
Riding apparel	$109
Club membership	$19
Other	$14

(i.e., restaurant dining, food purchased at convenience stores, groceries purchased at food stores), restaurant dining represented the largest average at close to $35 per trip. Within the remaining categories, the largest average per trip expenditures were $50 for OHV repairs and services (OHV category), lodging at hotels, motels, etc., at $34, hunting supplies at $58 for the other expenses category, and roughly $37 dollars on fuel and oil for transportation to OHV sites (English et al. 2001).

Table 5 contains the average annual OHV related expenditure categories ranked in order of magnitude for Tennessee. The total average annual OHV related expenditure was $6,647. Off-highway vehicles purchased include ATVs, four wheelers, dirt bikes, dual sport motorcycles, four-wheel drive trucks and jeeps, sport utility vehicles, and rail/dune buggies. The term support vehicle refers to trailers, car carriers, etc. Special tires, mufflers, engines, etc, are included in the modifications/upgrades category. Other support equipment includes air compressors, pressure washers, welders, etc. (English et al. 2001).

Those participating in off-highway activities spent approximately $1 billion. Initially, these dollars were used to purchase inputs, creating another $300 million dollars of economic activity. However, another $1.3 billion dollars of economic activity was induced through these expenditures. The top ten sectors impacted through induced effects include: *wholesale trade, owner-occupied dwellings, state and local government education and no education, real estate, doctors and dentists, eating and drinking, hospitals, new residential structures, and banking.* Jobs created also follow a similar pattern. Of the 52,000 jobs created in the state by the off-highway vehicle sector, 19,000 are through induced effects, with nearly 30,000 created directly (English et al. 2001).

OLS Regression

For the simple OLS regression of travel costs per trip it was assumed that the explanatory variables include natural log of the number of trips taken, experience in OHV recreation, age and education of individual, whether the individual is part of an OHV organization, and the natural log of the individual's income.[7] An individual's travel costs per trip were modeled as a function of these explanatory variables in the following manner:

$$travel\ costs_i = \alpha + \sum \beta_{ji} x_{ji} + u_i \qquad (4)$$

[7] The variable on OHV group is a dummy variable where 1=member of an OHV organization, and 0=non-member

where j represents each variable, i represents the individual, and x is the value of each variable. This model was applied to off-highway motorcycle users, ATV users, and four-wheel drive users. This was done to isolate the differences in travel cost behavior between the user groups.

The OLS model was corrected for heteroscedasticity using White's correction (White 1980); the adjusted t-values represent the t-value obtained after correcting for heteroscedasticity. Adjusted probabilities were then calculated based on the adjusted t-values. A visual inspection of the tolerance levels revealed that multicollinearity between variables was minimal and had no significant effects on the model results.[8]

The model explained nearly all of the variation in travel costs (modified R^2 ranged from .87 for four-wheel drive users to .90 for off-highway motorcycle users). Table 6 provides results of the OLS regression for all three user groups. The natural log of the number of trips taken was significant at the 1% level for all user groups, and negatively influenced the amount of travel cost incurred by the individual as expected. In addition, income elasticities were found to be around one for each user group.

Poisson Model

A Poisson model was used in a standard travel cost application by modeling the number of trips taken based on travel costs and a number of other variables. Variable definitions can be found in Table 7. The standard travel cost model was modified slightly by taking the natural log of the number of trips taken. This was done to remedy the effects of a standard error greater than the mean for this variable. The range of trips

[8] Tolerance levels were all found to be greater than 0.60.

Table 6. Results of OLS Regression for Travel Costs

	Off-Highway Moto		ATV		4-Wheel Drive	
Variable	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
intercept	6.21148**	0.105	6.02787**	0.082	6.22119**	0.101
lntrips	-0.33786**	0.013	-0.28975**	0.011	-0.34554**	0.015
exp	0.00175	0.001	0.0001199	0.001	-0.00195	0.001
age	-0.00141	0.002	-0.0001928	0.001	0.00126	0.001
edu	0.01539	0.010	-0.00491	0.007	0.00304	0.010
ohvgrp	-0.02076	0.043	-0.0161	0.022	-0.03848	0.030
lninc	-0.00224	0.050	0.05619*	0.030	0.02852	0.044

*significant at the 5% level of probability
** significant at the 1% level of probability

Table 7. Regression Variable Definitions

Variable	
TC	Expenditures incurred while visiting OHV site
PUBRIDER	Dummy variable = 1 if majority of OHV riding time is on public land
EXP	Years of OHV riding experience
OHVOPP	Dummy variable = 1 if satisfied with OHV riding opportunities
OHVMNG	Dummy variable = 1 if satisfied with OHV management
EDU	Education level of respondent
OHVGRP	Dummy variable = 1 if member of an OHV group or organization
INC	Annual household income of the respondent
MILES	Average roundtrip miles traveled to recreation area

taken was 1 to 120 with the average number of trips estimated at 19. The number of OHV trips an individual takes in Tennessee was modeled as:

$$number\ of\ OHV\ trips_i = e^{\wedge}(\alpha + \Sigma\beta_{ji}x_{ji} + u_i) \quad (5)$$

Once again this same model was duplicated for the three user groups to identify differences in trip taking behavior between the three user groups.

The results of the Poisson regression for the three user groups revealed that the model fit the data well (Chi-squared probabilities <0.0001 for all models). Model results reveal that our cost variables (TC and MILES) were significant at the 1% level in all models. As expected, travel costs and the number of miles traveled negatively influenced the number of OHV trips taken. Specifically, a one dollar increase in the price of an OHV trip will result in a 1.6% to 2.2% decrease in the number of trips taken. This is small, but not surprising in this case given the limited number of substitute sites.

Level of OHV experience was also found to be significant in the off-highway motorcycle model. This insinuates that as the level of experience increased for this user group, the number of off-highway motorcycle trips increased. Amount of OHV management was found to have a negative affect on the number of trips taken for the four-wheel drive user group while amount of OHV opportunities have a positive effect for the off-highway motorcycle and four-wheel drive user groups. The variable on PUBRIDER was also found to be significant for the four-wheel drive user group revealing a one percent increase in public land used for four-wheel drive recreation will

Table 8. Poisson Regression Results

	Off-Highway Moto		ATV		4-Wheel Drive	
Variable	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Intercept	5.8552**	0.4128	6.8823**	0.3211	6.1201**	0.4055
TC	-0.0163**	0.0016	-0.0217**	0.0020	-0.0181**	0.0018
PUBRIDER	0.0953	0.0992	-0.0252	0.0824	0.2043**	0.0778
EXP	0.0102*	0.0048	-0.0009	0.0080	0.0012	0.0039
OHVOPP	0.3249*	0.1644	-0.1520	0.1010	0.2115*	0.1166
OHVMNG	-0.1810	0.1842	-0.0267	0.1165	-0.2927*	0.1160
EDU	0.0483	0.0348	-0.0107	0.0427	0.0735**	0.0271
OHVGRP	0.1545	0.1382	-0.0149	0.1151	-0.0890	0.0931
INC	-0.3382	0.0308	0.063*	0.0300	0.0073	0.0248
MILES	-0.0008**	0.0002	-0.0012**	0.0005	-0.0016**	0.0005
Observations	86		89		96	

*significant at the 5% level of probability
** significant at the 1% level of probability

result in a 20% increase in the number of four-wheel drive trips. This result is not surprising as survey results reveal that the four wheel drive user group recreates on public land much more often than the other user groups. Education was also found to be highly significant and positive for only the four wheel drive user group. Poisson regression results are found in Table 8.

The choke price, or the price at which no OHV trips will take place, was estimated to be around $350 for all user groups. Average consumer surplus for an average OHV trip in Tennessee was calculated as the area under the demand curve and above the expenditure level, at the mean level of visits. Estimated average consumer surplus per trip ranged from $46.17 for the ATV user group to $61.19 for the off-highway motorcycle user group. As expected, the price elasticity of demand was found to be negative and highly responsive to travel costs. Specifically, as the price of an OHV trip increased by 10%, the demand for these trips decreased by 37.3%, 45.9%, and 41.4%

for off-highway motorcycle users, ATV users, and the four-wheel drive user group, respectively.

Conclusions

This study represents one of the first attempts to model the demand for OHV recreation. Travel cost spending behavior for OHV trips appears normal. Specifically the variable on trips was found to be significant and the income elasticity ranged from 0.99 to 1.02. Individual mean WTP per trip was found to range between $46.17 and $61.19 with off-highway motorcycle users exhibiting the largest consumer surplus and ATV users the smallest. It was shown that price reflected an elastic relationship to the number of OHV trips. This data could be useful to land managers who may wish to limit OHV use by instituting a user fee. It also provides insight into the possible decreases in OHV user rates as a result of any OHV user fee as a part of a statewide OHV management plan.

While these numbers are useful as the first model estimates of OHV recreation, it is important to pinpoint possible sources of bias. Due to survey information limitations, substitute prices as well on-site time were ignored in this analysis. The omission of substitute prices will bias the WTP estimate upwards as well as affect estimates of price elasticity. If the correlation between the two travel cost variables is positive, then omitting the substitute prices biases the own price elasticity toward zero. But if the two travel costs are inversely correlated, the estimated own price coefficient is subject to a negative bias and the price elasticity of demand for visits is biased upwards. While it is reasonable to assume that the effect of substitutes is relatively small for OHV recreation,

this could be the source of possible bias. In most cases, ignoring on-site time leads to much lower benefit estimates. Due to these survey data limitations and misspecifications, more regional studies should be performed.

CHAPTER 3

ECONOMIC MODELING OF OFF-HIGHWAY VEHICLE RECREATION: A COMPARISON OF TRAVEL COST AND CONTINGENT VALUATION METHODS

This chapter is a lightly revised version of a paper by the same name submitted for publication to *Journal of Leisure Research* in 2004 by Charles Sims, Aaron Wells, Donald Hodges, Mark Fly, and Becky Stephens.

My use of "we" in this chapter refers to my co-authors and myself. My primary contributions to this paper include (1) selection of the topic and development of the problem into a work relevant to my study of nonmarket valuation of recreational resources, (2) analysis of travel cost and contingent valuation data, (3) economic modeling, (4) most of the gathering and interpretation of the literature, (5) pulling the various contributions into a single paper, and (6) writing of the paper.

Introduction

The issue of valuing nonpriced commodities or nonmarket goods and services is a controversial one. While many believe that placing a market value on such goods and services as clean air or the preservation of an endangered species is a perverse interpretation, the ability to measure a value for a commodity is necessary to achieve an efficient allocation of the good or service. In fact, measurement allows the idea of efficiency and effectiveness to be applied, and it serves as the basis for decisions that can improve resource allocation.

The ability to measure a value in the efficient allocation of resources is especially important in the case of public goods. Markets are incapable of efficiently allocating resources with pervasive externalities, or for which property rights are not clearly defined, which is often the case with public goods. Examples of these market failures abound. Commercial fishers, for example, do not realize the future costs of present harvests, which lead to over harvesting. The negative effects of automobile emissions are

not accounted for in decisions concerning the amount of automobile use so automobile drivers tend to drive an inefficiently large amount.

These examples have the characteristic that there are gains and losses that extend beyond the private individuals making the decisions. This is also true in natural resource-based recreation. Because the benefits of recreational use on public and private land have no market, it is difficult to ensure resources such as land, personnel, and facilities provided for recreational pursuits are allocated in an efficient manner. This makes the valuation of recreational benefits imperative to ensure proper resource allocation and therefore efficient management of recreational activities.

Non-market valuation techniques (i.e., travel cost, contingent valuation) have been used extensively to value various forms of natural resource-based recreation. However, to the author's knowledge, these procedures have never been applied to off-highway vehicle (OHV) recreation. The popularity of OHVs has been growing rapidly in recent years. While OHVs were originally used in conjunction with other forms of recreation like hunting and fishing, OHV riding has become its own form of recreation. According to the Forest Service's RPA Assessment, off road driving has recently experienced nearly a 44% increase in participation rates, making it the fourth fastest growing form of land-based recreation. However, the nature of OHV recreation requires large amounts of land and makes it incompatible with many other forms of trail recreation. The increase in the popularity of the sport and the decreasing opportunities for OHV recreation, make OHV management a formidable task. Despite its growing popularity and apparent need for new management strategies, there is no published research devoted to modeling behavior or estimating the basic value of OHV recreation.

Previous research efforts have looked at the economic impact of OHV recreation in addition to basic use estimates; however, no research has been devoted to economic modeling of the demand for OHV recreation.

The goal of this research was to utilize travel cost and contingent valuation procedures to develop management recommendations for OHV recreation. These recommendations will be based on information gathered from a 2001 OHV user survey for the state of Tennessee (Fly et al. 2001). The remainder of this paper will be divided into six sections. In the first, a preliminary discussion of the state of OHV recreation in Tennessee is presented. The second section will be devoted to an analysis of two of the larger and more formalized OHV management plans in the country. The third section will be devoted to a brief discussion of the travel cost ands contingent valuation methods of nonmarket valuation. Following this characterization of the valuation methods, focus will be directed on specifications to the basic models that were needed in this study. A detailed description of survey and sampling methodologies will be presented in the fourth section. The fifth section will present results of the travel cost and contingent valuation analysis. The concluding section will draw upon these results as well as the analysis of alternative management plans to formulate management prescriptions for OHV recreation in the state of Tennessee.

Off-Highway Vehicle Recreation in Tennessee

Public and private lands alike offer a variety of trails coupled with beautiful surroundings that make Tennessee a popular area for OHV recreation. Each year over 500,000 people visit national forests, state riding areas, or private lands to enjoy the

natural surroundings and their vehicles (Fly et al. 2001). The annual growth rate for off-highway motorcycle and ATV sales averaged 16 percent from 1995 to 2000. A direct comparison of sales for the years 1995 and 2000 reveals an even sharper contrast. In 1995, motorcycle and ATV sales in Tennessee totaled 2,043 and 9,349, respectively. In 2000, sales for motorcycles and ATVs more than doubled to 4,143 motorcycles and 19,718 ATVs (MIC 2001).

As a result of the growing popularity of OHV recreation in Tennessee, demand for areas that provide for such recreation have increased. Most riders seek vast areas with secluded trails and most prefer these trails to consist of some type of mountainous terrain. However, due to increasing amounts of land development and conversion, available areas of mountainous wooded terrain are becoming increasingly difficult to locate. State and federal governments are often forced to designate certain areas in state and national forests for OHV riding only to prevent user conflicts with other types of recreation. However, many states do not budget for OHV areas. This leaves many land management agencies struggling to allocate funding for patrolling, safety, and the extensive trail maintenance needed in OHV areas; ultimately, leading to closure or additional restrictions imposed on the recreation site. Restrictions and closures in public riding areas often result in riders venturing onto restricted public and private properties. Tennessee Code Annotated Section 70-7-101, et seq., (commonly called the "Recreational Use Statute") protects both private and governmental entities from injury lawsuits unless the landowner charges a fee or "consideration" to ride on his land. In most cases, landowners who do not charge a fee are protected from liability for simple negligence. However, landowners who allow riding on their property and charge a

"consideration" or fee to offset the costs related to the OHV activity forfeit any protection offered under the Recreational Use Statute.

Tennessee has no enforceable OHV program that specifically addresses the use of OHVs on public and private property. The Tennessee Wildlife Resources Agency (TWRA), the Tennessee Department of Agriculture Forestry Division and multiple divisions of the Tennessee Department of Environment and Conservation (TDEC) dedicate staff and resources toward management of OHV recreation or damage from the activity, while receiving little or no funds for that responsibility. Tennessee does regulate aspects of OHV use and impact. However, enforcement of these aspects appears to be limited or nonexistent. Tennessee Code Annotated section 55-6-101, for example, already provides for titling of all OHVs. The statute prescribes a fee to be paid at the time of purchase. TCA section 55-3-101 currently assesses a $5.00 titling fee for new OHVs. However, only $1.50 of this goes toward the development of capital projects in recreation areas. The remainder goes back into the state's general fund. Without adequate OHV law enforcement, it is difficult to ensure that this amount is collected consistently, particularly during sales of used vehicles. Although the Tennessee code provides for vehicle titling and encourages OHV driver training for Tennessee residents and out-of-state users, neither of these is actively pursued.

In November 1999, Tennessee Governor Don Sundquist appointed the Study Committee on Off-Highway Vehicles to evaluate the use, impact, and availability of OHV recreation in Tennessee and to address emerging economic, social and environmental issues related to this growing sport. The state extended invitations to relevant public agencies and to citizens' groups to participate in the committee. The

Governor's Study Committee on Off-Highway Vehicles recommended that a formal OHV program be established in Tennessee with the goals of providing sufficient opportunities for the sport, propelling the associated economic benefits to the state, and properly managing OHV use to protect public safety, property owners, and natural resources.

The Tennessee Study Committee on Off-Highway Vehicles appointed the University of Tennessee to perform a survey of OHV users in 1999. This survey sought to gather information concerning opinions, user demographics, trip characteristics, motivations, and economic impact. Population estimates from this survey suggest that there are 553,000 OHV users in the state of Tennessee with 156,000 households containing at least one active user. Survey demographics reveal that the average OHV rider in Tennessee is a 38- to 44-year old white, male, with a high school degree and some college education. This representative individual earns between $50,000 and $74,999 per year (Fly et al. 2001). The annual economic impact of OHV activity in Tennessee was found to be $3.6 billion (for fiscal year 2001). The total number of jobs affected by OHV recreation in Tennessee was found to be 52,300 (English et al. 2001). All economic impact estimates were generated using IMPLAN. Researchers considered expenditures incurred in preparing for, traveling to and from organized events and individual riding excursions. While these numbers exhibit the importance of OHV recreation to the state and local economy, they do little to supply information on OHV user behavior that is critical for proper OHV management.

OHV Recreation and Management Programs

While 35 states have some form of OHV infrastructure, only a handful have an OHV management plan. Management plans that have been created are predominately based on basic use and economic impact estimates. Two of the largest and more formalized OHV management programs are found in California and Arizona.

California has established a completely self-funded OHV management program and, was also the first state to complete an OHV management plan (completed in 1971). The structure of the California Off-Highway Motor Vehicle Recreation (OHMVR) Program consists of an OHMVR Commission and an OHV Stakeholders Roundtable. The OHMVR Commission was created in 1982 to allow public input and provide policy guidance for the OHV program. The Commission's duties include: allocating funds for OHV capital outlay expenditures and OHV grants and cooperative agreements; certifying general plans; and considering adverse impacts on property in the vicinity of OHV areas. The OHV Stakeholders Roundtable was established in 2000, and is a consensus-building group of almost 50 individuals. Comprised of representatives from public agencies, environmental and OHV organizations, law enforcement associations, rural counties, and OHV manufacturers, the roundtable meets monthly to discuss the pending reauthorization of the OHV program and short and long-term actions expected to improve it.

Funding for OHV recreation in California is placed in an OHV Trust Fund. Sources for the OHV Trust Fund are a percentage of fuel taxes collected (80.9%), OHV registration fees (5.7%), and entrance fees, (3%). The OHV Trust Fund receives only $8 of the $21 biennial OHV registration fee. Expenditures from the OHV Trust Fund

include Local Assistance Grants (44%), support services (40%), and capital outlay for acquisition and development of OHV recreation areas (16%).

The California management plan found that 14.2% of all California households had an OHV recreation enthusiast totaling 3.5 million OHV recreationists in the state. OHV registration was also found to have increased 108% since 1980. The economic impact of OHV use was found to exceed $3 billion dollars in economic activity statewide (for fiscal year 1993). The survey also found that OHV recreation generates roughly $1.6 billion in personal income and affects 43,000 jobs within California (California Department of State Parks and Recreation 1993).

Another state that has completed an extensive OHV management program is Arizona. Arizona State Parks established the State Off-Highway Vehicle Program in 1991 to enhance motorized trail recreation. An advisory committee, the Off-Highway Vehicle Advisory Group, provides the Arizona State Parks Board and State Parks Staff with input on motorized trail issues, state policies, and recommendations on funding for grant projects. The first OHV management plan in Arizona was put into effect in 1993. It was then superceded by a revised plan that was put into effect in 2000. As part of the revised 2000 plan, a trail user survey was conducted for both motorized and non-motorized users. A random phone survey, random mail survey, and a targeted mail survey were employed to gather the information. This survey found that 77% of Arizona residents consider themselves trail users and of this 21% consider themselves motorized trail users.[9]

[9] Motorized refers to four-wheel drive vehicles, ATVs, off-highway motorcycles, dune buggies, and snowmobiles

Funding for OHV programs in Arizona is placed in an OHV Recreation Fund. This fund comes from a percentage of total license tax on motor vehicle fuel estimated as consumed by off-highway vehicles, monies appropriated by the legislature, federal grants and private gifts, and matching monies from public and private entities. From 1993 to 1998 approximately 43% of this money collected was given to state agencies for OHV management. The remaining 57% is divided between federal agencies, counties, cities, state agencies, nonprofits, etc. in the form of competitive grants. These competitive grants cover a variety of OHV recreation issues including creation of educational materials, mitigation, route inventory, support facilities, signage, and trail/road construction or reconstruction. From 1993 to 1998, the Arizona OHV Recreation Fund awarded 57 competitive grants for a total of $7,086,389 (Arizona State Parks 2000).

Travel Cost and Contingent Valuation Methods

The travel cost method of valuation has been extensively used in the valuation of recreational sites. With this method, demand curves are estimated for the recreation site using travel costs as a surrogate for the price of the site (Clawson and Knetsch 1966; Knetsch 1963).

A model of an OHV recreationist's (off-highway motorcycle, ATV, or four-wheel drive) choice of the number of visits to make to an OHV recreation site was modeled using a traditional individual travel cost model (TCM). The basis of the TCM is that visitors will choose the annual number of trips to a recreation site based on the cost of traveling to the site. The number of trips will be inversely related to the travel cost (Loomis and Walsh 1997). This feature is critical because the inverse relationship allows

the demand curve to be estimated based on travel costs and the number of trips taken. Once the demand curve is estimated, calculating the net willingness to pay or consumer surplus simply entails summing the areas below the demand curve and above the price for the various users (Rosenthal et al. 1984).

Several assumptions must hold for travel costs to be a proxy for price in the TCM (Freeman 1999). The first assumption is that the visitor is on a single-destination, single-purpose trip. For our purposes this would be a trip to a single OHV site in Tennessee for the sole purpose of OHV recreation. Mendelsohn et al. (1992) have proposed a method for including multiple destination trips in the TCM, however it was for a zonal, linear application. For this paper, this assumption will be addressed through survey design. Individuals indicating a multipurpose trip were asked to report the number of days spent for OHV recreation in relation to the total number of days for the trip. A percentage of days spent for OHV recreation was calculated and this percentage was applied to total travel cost estimates for the trip. Due to concerns over the appropriate shadow price, on-site leisure time is ignored leading to the assumption that time on-site is constant across individuals.

The first issue that should be addressed in the specification of a travel cost model is price. As is well known (Cesario 1976; McConnell and Strand 1981), travel time as well as travel cost should be included in a travel cost model. Some researchers treat travel time as an endogenous variable (Shaw and Ozog 1999; Desvouges and Waters 1995); others have included a proportion of the wage rate as an additional factor in the travel cost measurement (Randall 1994; Englin and Shonkwiler 1995). For our purposes travel time will be incorporated in the model as a function of miles traveled and included

as a separate variable. The cost of a trip to an OHV site is composed of two parts: the admission fee *f* and the cost of travel (both monetary and travel time costs). Since most OHV recreation sites charge no admission fee to the area, total cost in most instances is comprised of the cost of travel (Freeman 1999). The monetary costs of travel have been split into five parts: lodging, food and beverage, transportation, off-highway vehicle expenses, and other expenses. Since OHV recreation requires substantial purchases to begin participation (high fixed costs) and it is reasonable to believe that these purchases may play a significant part in travel choice behavior, additional OHV expenditures are needed to supplement the marginal costs experienced by OHV users on each trip. Omission of these fixed costs result in a model with very low explanatory power.

The second issue that must be addressed through model specification is that of substitute sites. In a traditional single site travel cost model, the value an individual places on that particular site is significantly affected by neighboring sites that may provide similar recreational experiences. These substitution effects are critical for precise model specification, as their exclusion may overstate the estimates of consumer surplus (Rosenthal 1987). However, the resource being measured by this model is OHV recreation in the state of Tennessee and not at a single site. Because OHV recreation in different parts of the state can have different substitutes, it is difficult to identify possible substitutes. OHV recreation at a site in eastern Tennessee would have a different set of substitutes than a recreation site in western Tennessee. Additionally, among survey respondents, across vehicle types, the highest percentage of OHV riding was conducted in Tennessee (80%-94%). Based on this information, it is reasonable to assume that

substitute effects for OHV recreation in Tennessee are minimal and were ignored in this study.

A Poisson model (travel cost model) was employed to model the demand for OHV recreation in Tennessee. The Poisson distribution is far more consistent with a data generating process producing only a few trips per visitor. Hellerstein (1992) shows that when the estimated number of trips is small (such as this data set, where the average is 11.24) the Poisson is a much closer approximation than regression techniques based on the normal distribution. In addition, the Poisson model is one in which the maximum likelihood estimator (MLE) is robust to certain misspecifications of the model, such as the failure to incorporate latent heterogeneity in the mean. In order to correct for this misspecification, a robust covariance matrix was used. The model estimated has a Poisson distribution with the general specification being:

$$Y_i = \exp(\text{PRICES}_i, \text{QUALITY}_i, \text{DEMOGRAPHICS}_i, \text{error term}) \quad (6)$$

Due to differences in travel cost between different OHV users, survey results were disaggregated into three user groups: off-highway motorcycle users, ATV users, and four-wheel drive users. While nominal costs (transportation, lodging, food and beverage) were similar between the three user groups, the fixed costs (OHV purchases, OHV maintenance, etc.) varied greatly between user groups. In addition, many OHV areas are specified for particular OHV users. Because different types of OHV recreation require different site characteristics, sites may be more suited for certain user groups. This leads to a variation in site quality between user groups in the form of satisfaction

with OHV opportunities and OHV management. To isolate these differences between user groups, the model was applied to all three user groups. The model is specified as follows:

$$\ln TRIPS = B_0 - B_1*TC - B_2*PUBRIDER + B_3*EXP + B_4*OHVOPP + B_5*OHVMNG + B_6*EDU + B_7*OHVGRP + B_8*INC + B_9*MILES \quad (7)$$

Where TRIPS is the estimated number of OHV trips taken; TC is travel costs for an OHV trip; PUBRIDER is a dummy variable to determine where the individual rides most often (1=public land, 0=private land); EXP is the individual's experience level measured in number of years riding; OHVOPP is the individual's satisfaction with OHV opportunities; OHVMNG is the individual's satisfaction with OHV management; EDU is the individual's education level; OHVGRP is whether the individual is a member of an OHV group or organization; INC is the individual's annual household income; and MILES is the average miles traveled for OHV recreation.

The inclusion of appropriate explanatory variables is important in modeling the demand for recreational areas, but existing travel cost literature provides little insight into selecting explanatory variables for modeling OHV recreation. Therefore, model variables were selected based on travel cost studies performed on similar types of recreation. The basis of any travel cost model is the travel cost variable itself. Based on previous research we would expect the coefficient on travel costs to be negative, inferring a negative relationship between travel cost and the number of trips (Loomis and Walsh 1997; Fix and Loomis 1997).

Because individuals make choices about recreation based on the quality of recreation at a particular site, previous literature has included various quality variables with great success (Morey 1981; Smith, Desvouges, and McGivney 1983a; Caulkins, Bishop, and Bouwes 1986; McConnell 1986). Quality variables can be based on scientific or quantitative data or can be represented by some measure of perceived quality derived from questions asked of recreation participants. For a single OHV site, quantitative quality variables might include number of trails, difficulty of trails, or a measure of congestion. However, when modeling recreation over numerous unspecified sites (as is the case in this study), these types of quality measurements are impossible to include due to variances in quality between OHV sites located throughout the state. Therefore, two measurements of perceived quality of OHV recreation were included in the model. OHVOPP and OHVMNG measure the respondent's satisfaction with OHV recreation opportunities and OHV site management in the state of Tennessee. It is assumed that the higher the individual's satisfaction level for these two variables, the more OHV trips that individual is likely to take. Therefore, it is hypothesized that these two variables should have positive coefficients.

Basic demographic variables (income, age, education, experience) were included in this model to coincide with previous travel cost studies (Morey 1981; Samples and Bishop 1985; Shaw and Jakus 1996; Grijalva et al. 2002). These variables are consistently found in various travel cost models. Because OHV groups and organizations sponsor numerous riding events annually, participation in such groups should reasonably lead to more OHV trips taken. In order to include this effect (which is expected to be positive) in trip taking behavior a variable was added to identify participation in OHV

groups. Additionally, public OHV areas are becoming difficult to find. Many have resulted to recreating on private land. However, finding private land where OHV recreation is allowed is just as difficult. To determine the effect (if any) that this situation may have on the number of tips taken, a variable indicating the type of land ownership most often used (private versus public) was included.

The value of access equals the area under the expected demand curve. For the exponential demand function, the price at which no OHV trips will take place or the choke price (C^*) is infinite. Assume a simple demand specification: $x=e^{\beta_0+\beta_1 C}$ where C is the travel cost, and β_0 can be a constant or a function of covariates other than own price. For any finite C, $x= e^{\beta_0+\beta_1 C}>0$. Defining C^0 as the current travel cost, consumer surplus for access is

$$WTP = \left[(e^{\beta_0+\beta_1 C})/\beta_1\right] = -x/\beta_1 \quad (8)$$

where x represents the number of trips taken by the individual and β_1 is the parameter estimate for travel costs. In the Poisson expression for sample mean WTP, one can use the mean of observed trips or mean of the expected trips because the Poisson model has the property that it is mean fitting (Haab and McConnell 2002).

Contingent valuation has been defined as any approach to valuation of a commodity, which relies upon individual responses to contingent circumstances posited in an artificially structured market. This study used a payment card method to elicit

consumer surplus estimates from respondents. The good being valued was an average OHV trip in Tennessee. Since many respondents were not surveyed on-site, the good in question was forced to be an average trip instead of a trip to a particular OHV site. Two payment vehicles were also evaluated. One question was posed as if the payment vehicle were a daily fee:

- How much would you be willing to pay **per vehicle per day** to use an OHV area if those fees go back into maintenance and management of the area?

The second question was posed as if the payment vehicle were a yearly fee:

- How much would you be willing to pay **per vehicle for a yearly fee** to use an OHV area if those fees go back into maintenance and management of the area?

The five payment options ranged from $5 to $20 for the daily fee and $20 to $75 for the yearly fee. A $0 estimate was also provided for each payment card. These bid amounts were estimated based on predicted estimates of the cost of an OHV management plan in Tennessee. The probability that a respondent picks a particular payment t_k, can be modeled by the probability that WTP lies between t_k and some upper bound t_{k+1}:

$$\Pr(\textit{choose } t_k)=\Pr(t_k \leq \text{WTP} \leq t_{k+1}). \quad (9)$$

Responses to the payment card are treated in a parametric model by specifying willingness to pay as $\text{WTP}=\mu+\varepsilon$. If we let $\varepsilon \sim N(0, \sigma^2)$, then

$$\Pr(\textit{choose } t_k)=\pi((t_{k+1}-\mu)/\sigma)- \pi((t_k-\mu)/\sigma) \quad (10)$$

where $\pi((t_{k+1}-\mu)/\sigma)$ is the standard normal CDF evaluated at $(t_{k+1}-\mu)/\sigma$. We can then form the log-likelihood function for the responses:

$$\ln L=\Sigma \ln[\pi((t_{k+1}(i)-\mu)/\sigma)-\pi((t_k(i)-\mu)/\sigma)] \quad (11)$$

where individual *i* picks payment $t_k(i)$. This is a form of an interval model, in which every individual picks some payment and takes into account zero values by treating them as a discrete response that assigns zero to the WTP function. This is also known as a form of a spike model or a limited dependent model (Haab and McConnell 2002).

Mean willingness to pay was calculated from respondent responses in a standard payment card manner using the Turnbull upper bound estimate

$$WTP_{UB,PC}=\Sigma t_k f_{k+1} = \frac{T_1t_1+T_2t_2+\ldots T_Mt_M}{T} = \Sigma t_k(i)/T \quad (12)$$

where $f_{k+1} = F_{k+1}-F_k$, and F_k is the proportion that will pay less than t_k. To calculate F_k with the payment card approach, define T_k as the number of respondents who pick t_k. Then we define $F_{k+1}=1-(T_M+T_{M-1}+\ldots=T_{k+1})/T$. This implies that $f_{k+1}=F_{k+1}-F_k=T_k/T$. Consequently treating the payment card mechanism in the standard conservative way is equivalent to the Turnbull upper bound mean (Haab and McConnell 2002).

A utility-theoretic logit regression model (Hanneman 1984) was used to predict probabilities of *Yes* responses as a function of other variables to both payment vehicles (daily fee and annual fee). The general model is specified as follows:

$$\text{Logit}[\pi:\Pr(1=\text{Yes})] = \alpha + \beta_1 TC + \beta_2 TRIPS + \beta_3 EXP + \beta_4 AGE + \beta_5 EDU + \beta_6 OHVGRP + \beta_7 INC \quad (13)$$

These probabilities were used to calculate the percent effect of each variable in contributing to a *Yes* response. Both payment vehicles were modeled for each user group to identify differences in *Yes* responses between user groups.

Survey and Sampling Methodology

This research is an extension of the study conducted at the request of the Study Committee on Off-Highway Vehicles for the state of Tennessee. Information gathering techniques included a combination of on-site, telephone, and mail surveys developed and conducted by the Human Dimensions Research Lab of the Department of Forestry, Wildlife, and Fisheries at the University of Tennessee, Knoxville. Three subpopulations were identified and surveyed, including OHV special event participants, Tennessee sportsmen, and the general population.

Event riders consisted of participants in four OHV special events. These events included the Dixie Run and the Appalachian Jeep Jamboree in the Cherokee National Forest of Tennessee and Nantahala National Forest of North Carolina, the Gateway to the Cumberlands in south-central Kentucky, and the VSTA off-road motorcycle event in

Middle Tennessee. These respondents filled out a short on-site survey and were asked if they could be contacted in the future. Participants in those events who live in Tennessee and who agreed to be contacted were sent a mail survey. Of those 340 participants, 169 completed and returned mail surveys for a response rate of 49.7%.

Tennessee sportsmen interviewed during the Fall 2000 Tennessee Wildlife Resources Agency (TWRA) hunting and fishing survey were asked if they owned or used an OHV for recreational purposes. Those who responded "yes" were then asked if they could be contacted for a follow-up mail survey. A random sample of those sportsmen who agreed to be contacted was selected to receive an OHV mail survey. Of those 587 sportsmen, 180 completed and returned mail surveys resulting in a response rate of 31.7%.

For the general population survey, individuals were contacted by a randomly generated sample of Tennessee telephone numbers. The person answering the phone was asked if anyone in the household had driven or ridden an OHV in the past 12 months. If the response to this question was affirmative, then the person administering the survey asked to speak with the primary OHV user in that household. Using Random Digit Dial (RDD), 721 households were contacted, and 411 interviews were completed by telephone for an RDD Telephone response rate of 57.0%. A follow-up mail survey was then sent to 158 OHV users identified in the RDD Telephone survey. Of those follow-up surveys, 60 were completed and returned for a 38.0% response rate.

Survey responses from the event surveys, the TWRA surveys, and the general population surveys were then aggregated. Out of the 409 surveys that were returned from all three survey procedures, 271 were usable. Because of significant differences in costs,

these 271 usable surveys were broken down by the type of OHV user. The three types of OHV users identified were off-highway motorcycle users (n=86), ATV users (n=89), and four-wheel drive users (n=96).

Results of Travel Cost Analysis

A Poisson model is used in a standard travel cost application by modeling the number of trips taken based on travel costs and a number of other variables. All variables are defined in Table 9. The number of OHV trips an individual takes in Tennessee was modeled in the following way:

$$number\ of\ OHV\ trips_i = e\text{^}(\alpha + \sum \beta_{ji} x_{ji} + u_i) \qquad (14)$$

This model was duplicated for the three different user groups to identify differences in trip taking behavior between the three groups. Poisson regression results can be seen in Table 10.

Off-highway Motorcycles

Means and standard deviations for characteristics of off-highway vehicle survey participants are presented in Table 11. The results of the Poisson regression for the off-highway motorcycle user group revealed that the model fit the data well (Chi-squared probability <0.0001). Model results reveal that travel costs and number of miles traveled were significant at the 1% level, and experience and the quality variable OHVOPP were

Table 9. Definition of Regression Variables

Variable	
TC	Expenditures incurred while visiting OHV site
PUBRIDER	Dummy variable = 1 if majority of OHV riding time is on public land
EXP	Years of OHV riding experience
OHVOPP	Dummy variable = 1 if satisfied with OHV riding opportunities
OHVMNG	Dummy variable = 1 if satisfied with OHV management
EDU	Education level of respondent
OHVGRP	Dummy variable = 1 if member of an OHV group or organization
INC	Annual household income of the respondent
MILES	Average roundtrip miles traveled to recreation area

Table 10. Results of Poisson Regression for Travel Costs

	Off-Highway Moto		ATV		4-Wheel Drive	
Variable	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Intercept	5.8552**	0.4128	6.8823**	0.3211	6.1201**	0.4055
TC	-0.0163**	0.0016	-0.0217**	0.0020	-0.0181**	0.0018
PUBRIDER	0.0953	0.0992	-0.0252	0.0824	0.2043**	0.0778
EXP	0.0102*	0.0048	-0.0009	0.0080	0.0012	0.0039
OHVOPP	0.3249*	0.1644	-0.1520	0.1010	0.2115*	0.1166
OHVMNG	-0.1810	0.1842	-0.0267	0.1165	-0.2927*	0.1160
EDU	0.0483	0.0348	-0.0107	0.0427	0.0735**	0.0271
OHVGRP	0.1545	0.1382	-0.0149	0.1151	-0.0890	0.0931
INC	-0.3382	0.0308	0.063*	0.0300	0.0073	0.0248
MILES	-0.0008**	0.0002	-0.0012**	0.0005	-0.0016**	0.0005

*significant at the 5% level of probability
** significant at the 1% level of probability

Table 11. Characteristics of Off-Highway Motorcycle User Group

Variable	Mean	Std Dev
Travel Cost	$228.28	94.0017
Trips	21.05	20.8354
Percentage of riding time on public land	43.02%	0.4980
Years of OHV experience	23.22	9.8940
Percent satisfied with OHV opportunities	18.60%	0.3914
Percent satisfied with OHV management	12.79%	0.3359
Consumer surplus per trip	$61.19	-
Age	39.53	8.6046
Percent involved in sportsmens group	20.93%	0.4092
Percent involved with OHV group	87.21%	0.3359
Price elasticity for OHV trips	-3.73	-

significant at the 5% level. As expected, travel costs and miles traveled were negatively related to the number of off-highway motorcycle trips taken and more off-highway motorcycle experience tended to lead to more trips taken. The choke price, or the price at which no off-highway motorcycle trips will take place, was estimated to be $367.05. Consumer surplus per trip was estimated at $61.19, the largest of the three user groups included in this study. However, there are much fewer off-highway motorcycle users in Tennessee, which translates into a relatively modest annual consumer surplus estimate statewide (roughly $27 million). As expected, the price elasticity of demand was found to be negative and highly responsive to travel costs. Specifically, as the price of off-highway motorcycle trips increased by 10%, the demand for these trips decreased by 37.3%.

ATVs

Mean and standard deviations for characteristics of ATV survey participants are presented in Table 12. The results of the Poisson regression for the ATV user group revealed that the model fit the data well (Chi-squared probability <0.0001). The variable for travel cost and miles traveled was significant and as expected was negatively related to the number of ATV trips taken. A one dollar increase in the cost of an ATV trip resulted in a 2.2% decrease in the number of such trips taken. Income is also found to be significant (alpha=.05) and as expected is found to have a positive influence on the number of trips taken with a marginal effect of 1.33. The choke price for ATV recreation in Tennessee was estimated at $333.55. Consumer surplus per trip was found to be $46.17, the lowest of the three user groups. However, with 153,211 ATV users, this

Table 12. Characteristics of ATV User Group

Variable	Mean	Std Dev
Travel Cost	$211.83	64.2903
Trips	20.92	21.7617
Percentage of riding time on public land	46.07%	0.5013
Years of OHV experience	19.03	9.2053
Percent satisfied with OHV opportunities	19.10%	0.3953
Percent satisfied with OHV management	16.85%	0.3765
Consumer surplus per trip	$46.17	-
Age	39.87	9.7003
Percent involved in sportsmens group	32.58%	0.4713
Percent involved with OHV group	62.92%	0.4858
Price elasticity for OHV trips	-4.59	-

translates into approximately $99 million in annual consumer surplus statewide. The price elasticity of demand reveals that as the price of ATV trips increase by 10% the demand for ATV trips decreased by 45.9%. This is comparable to the price elasticity for the off-highway motorcycle user group.

Four-wheel Drives

Mean and standard deviations for characteristics of four-wheel drive survey participants are presented in Table 13. The results of the Poisson regression for the four-wheel drive user group revealed that the model fit the data well (Chi-squared probability <0.0001). Highly significant variables include travel cost, PUBRIDER, education, and miles traveled. As expected the variable on travel cost and miles traveled was negatively related to the number of four-wheel drive trips taken with a one dollar increase in the cost of a four-wheel drive trip resulting in a 1.8% decrease in the number of trips taken and a one mile increase in the travel time resulting in 0.16% decrease in the number of trips taken. The two quality variables were found to be significant at the 5% level with the

Table 13. Characteristics of Four-Wheel Drive User Group		
Variable	Mean	Std Dev
Travel Cost	$228.37	132.4829
Trips	22.77	21.77371
Percentage of riding time on public land	50.00%	0.502625
Years of OHV experience	20.04	10.96014
Percent satisfied with OHV opportunities	29.17%	0.456916
Percent satisfied with OHV management	18.75%	0.392361
Consumer surplus per trip	$55.20	-
Age	39.76	10.39306
Percent involved in sportsmens group	28.13%	0.451969
Percent involved with OHV group	56.25%	0.498683
Price elasticity for OHV trips	-4.137	-

number of OHV opportunities positively influencing the number of four-wheel drive trips taken. However, the variable on OHV management was negatively related to the number of trips taken which leads to the conclusion that an increase in satisfaction with OHV management at a specific area would result in less four-wheel drive trips to that area. This is a strange result considering that many four-wheel drive groups have made a contribution to OHV management in many OHV areas across the region. The choke price for four-wheel drive recreation in Tennessee is $356.12. Consumer surplus per trip was estimated at $55.20. Considering the estimate of 324,050 four-wheel drive participants, this translates into roughly $181 million in annual consumer surplus statewide. The price elasticity of demand for this group was estimated at –4.12. This estimate for price elasticity is comparable to results from the other user groups.

Results of Contingent Valuation Analysis

Binary logistic regression was used to calculate the probability of an individual's acceptance of two different payment vehicles established to raise funds for an OHV

management program in Tennessee. The probability of a "Yes" response to two payment vehicles for access to OHV recreation areas was modeled as:

$$\Pr[\pi_i:(1=\text{Yes})] = \alpha + \Sigma\beta_{ji}x_{ji} + u_i \qquad (15)$$

Model 1 estimates the probability of a yes response to a daily fee payment vehicle while Model 2 estimates the probability of a yes response to an annual fee payment vehicle. The probability of a yes response to each payment vehicle is modeled for each user group to isolate differences in willingness-to-pay behavior.

For Model 1, travel costs were found to have no effect on participation rates in an OHV daily fee program. Number of OHV trips was found to be significant at the 5% level in determining participation rates for the four-wheel drive user group but was not significant for all other user groups. OHV experience, age of respondent, and education level of respondent were all found to be significantly related to participation in a daily OHV fee program for the off-highway motorcycle user group. However, none of these variables were found to be highly significant in explaining fee program participation for any other user group. As a whole, participation in an OHV group was significantly related to participation in a fee program for off-highway motorcycle users and ATV users. Marginal effects of this variable for off-highway motorcycle users and ATV users were 0.042 and 0.089 respectively. In other words, as percent participation in an OHV group rises by one percentage point, the probability of participation in a daily OHV user fee increases by 4.2% for off-highway motorcycle users and 8.9% for ATV users. The

variable on income was only significant for the ATV user group and only at the 5% level. Parameter estimates and standard errors for Model 1 are presented in Table 14.

Similar trends in significant variables found in Model 1 (daily fee) were also found in Model 2 (annual fee) with a few exceptions. Once again travel cost exhibited no relationship to participation rates. However, significance of the TRIPS variable moved from the four-wheel drive group in Model 1 to the off-highway motorcycle group in Model 2. The variable OHVGRP also became highly significant for the other two user groups in Model 2. All parameter estimates and marginal effects for OHVGRP were positive as well, implying that members of an OHV group or organization were much more likely to participate in an OHV fee program. Specifically, as percent participation in an OHV group rises by one percent, the probability of participation in an annual OHV

Table 14. Results of Logit Regression Estimation:
Model 1: Daily Fee

	Off-Highway Moto		ATV		4-Wheel Drive	
Variable	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Intercept	-11.3827**	3.192	-1.408	2.451	1.4193	1.924
TC	0.00355	0.009	0.002	0.009	0.000699	0.002
TRIPS	0.0428	0.027	-0.0298*	0.015	-0.0312*	0.014
EXP	-0.8407**	0.194	0.040	0.040	-0.0087	0.033
AGE	0.684**	0.164	0.012	0.032	0.0271	0.032
EDU	1.032**	0.326	0.068	0.198	0.1253	0.187
OHVGRP	5.0569**	1.138	2.2433**	0.832	13.1511	117.200
INC	0.2907	0.214	0.3333*	0.157	-0.0707	0.211
Observations	86		89		96	
% Concordant	96.51%		94.38%		94.79%	
Chi-Square	13.28		11.27		13.12	
Log Likelihood	-9.54		-16.34		-15.89	
McFadden's R^2	0.411		0.260		0.297	

*significant at the 5% level of probability
** significant at the 1% level of probability

user fee increase by 68.6% for off-highway motorcycle users, 17.3% for ATV users, and 20.9% for four-wheel drive users. In addition, income becomes highly significant for the off-highway motorcycle user group in Model 2. The marginal effects of income on participation rates in an annual OHV fee program were –0.007 for the off-highway motorcycle group and 0.018 for the ATV user group. As a whole, income was marginally important in the decision to participate in an OHV fee program depending on the user group. Parameter estimates and standard errors for Model 2 are presented in Table 15.

The individual mean WTP for a daily OHV fee ranged from $9.56 for the off-highway motorcycle users to $7.79 for the four-wheel drive users. The mean individual WTP for an annual OHV fee was estimated between $37.92 and $44.59. Off-highway

Table 15. Results of Logit Regression Estimation:
Model 2: Annual Fee

	Off-Highway Moto		ATV		4-Wheel Drive	
Variable	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error
Intercept	-43.9996**	11.194	-4.204	2.776	0.2543	1.973
TC	0.0352	0.019	0.0098	0.010	0.00426	0.004
TRIPS	-0.04*	0.019	0.00154	0.020	-0.00143	0.015
EXP	-0.2672**	0.082	0.015	0.041	-0.0594	0.033
AGE	1.149**	0.265	0.0246	0.030	0.0138	0.034
EDU	0.6025	0.317	-0.0282	0.194	-0.1376	0.196
OHVGRP	19.2218**	4.432	2.2888**	0.763	3.1462**	0.897
INC	-1.335**	0.359	0.3342*	0.149	0.2003	0.199
Observations	86		89		96	
% Concordant	95.35%		86.52%		89.58%	
Chi-Square	17.14		12.88		16.98	
Log Likelihood	-13.19		-24.84		-25.69	
McFadden's R^2	0.394		0.233		0.249	

*significant at the 5% level of probability
** significant at the 1% level of probability

Table 16. Mean Statistics for Model 1 and Model 2

	Model 1 - Daily Fee		Model 2 - Annual Fee	
	WTP/vehicle/day	% "yes"	WTP/vehicle/year	% "yes"
Off-Highway Motorcycle	$9.56	92.86%	$44.59	92.50%
ATV	$8.12	92.77%	$38.31	87.34%
Four-wheel drive	$7.79	93.33%	$37.92	87.06%

motorcycle users exhibited the highest WTP estimates for both payment vehicles, while the four-wheel drive users had the lowest WTP estimates for both payment vehicles. Predicted probability of a "yes" response to a daily fee was estimated around 93% for all user groups. The predicted probability of a "yes" response to an annual fee ranged from 87% to 93%. Four-wheel drive users exhibited the least support for this payment vehicle while off-highway motorcycle users showed the largest probability of a "yes" response. Mean estimates of WTP and percent "yes" responses for Model 1 and Model 2 are presented in Table 16.

Policy Implications for OHV Management

With average consumer surplus for all user groups calculated at $598, it is evident that OHV recreation has a significant effect on state and local economies. Considering the estimate 553,000 OHV users in Tennessee, OHV recreation generates over $330 million in consumer surplus in the state of Tennessee. Off-highway motorcycle users, ATV users, and four-wheel drive users are responsible for 8%, 30%, and 55% of this total respectively.

With such large consumer surplus estimates, the question becomes should more OHV recreation areas be added in Tennessee. With the information gathered in this

research, an exact answer is difficult to obtain; however, some insight can be generated. The first step is to analyze the coefficients on the quality variables. For the ATV group, neither quality variable was found to be significant in predicting the number of trips taken therefore no conclusions can be drawn about this user group. For the off-highway motorcycle user group, the quality variable OHVOPP was found to be positive and significant indicating more individual satisfaction with the number of OHV opportunities would lead to more OHV trips taken. At the current level of 16.8% satisfaction, consumer surplus was estimated at $591. If this level of satisfaction for the off-highway motorcycle user groups is increased to 50%, consumer surplus is increased by 11% for this user group or $2.9 million dollars statewide. In other words, if $2.9 million were spent to create new OHV areas, statewide satisfaction with OHV opportunities for the off-highway motorcycle user group would have to reach 50% for this to be economically feasible. For the four-wheel drive user group, current satisfaction with OHV opportunities is at 29.2%, which translates into $558 in consumer surplus. If this level of satisfaction were increased to 50%, consumer surplus would be increased by 4.5% or over $8 million statewide. When the two groups are combined this could yield a potential increase of $11 million in consumer surplus. While it is difficult to make any specific recommendations regarding the expansion of OHV recreation in Tennessee, it does seem reasonable that $11 million invested into new OHV areas would result in a 50% statewide satisfaction level in regards to the number of OHV opportunities.

In terms of funding expansions of such services, our results indicate a great deal of support for the possibility of raising revenue through increased user fees. The daily user fee (Model 1) appears to be most popular, enjoying a "yes" response rate around

93%. This is most likely due to the flexibility that comes from a daily user fee. If an individual becomes busy and cannot participate in OHV recreation as much as they would like they do not feel obligated to find time to recreate just to get use out of an annual user fee. Likewise, if someone buys an annual user fee and suffers an injury or for some other reason is not able to participate in OHV recreation, they will not loose money in an annual fee that may go unused.

However, when the total annual costs of these two payment options are added to travel cost expenditures and the Poisson model is re-estimated, significant changes in consumer surplus occur. For example, when the average daily willingness to pay for the off-highway motorcycle user group was aggregated to an annual amount based on average annual OHV recreation days the total amount spent on OHV recreation fees was $146.29. When this number was added to the average travel cost expenditures and the Poisson model was re-estimated at this new level of travel costs, there was a 91% decrease in consumer surplus. This translates into nearly $25 million dollars in consumer surplus loss statewide. When this same procedure was replicated for the annual user fee ($44.59 was added to average travel cost estimates), a smaller 52% decrease in consumer surplus was found. Similar trends were noted when this procedure was applied to the other user groups with a daily user fee creating approximately a 90% reduction in consumer surplus and the annual user fee roughly a 50% drop in consumer surplus. Thus, when making a decision on the type of fee program to implement, it is important to decide what the reason is for implementing the user fee. If revenue is the only concern, the daily fee may, at first glance, appear more effective ($146.29 vs. $44.59). However,

if the goal is to raise revenue while maximizing consumer surplus, the annual user fee would be the preferred choice.

While consumer surplus measures the willingness to pay on the part of the consumer to maintain the service rather than foregoing it, the amount of revenue raised depends on the price elasticity of the new demand curve. With highly elastic price elasticities estimated for all three user groups, the ability of a fee program alone to raise sufficient funds for OHV improvements is suspect. A fee program used in conjunction with either a flat tax on OHV purchases and/or an OHV fuel tax appears to be the most likely solution to funding an OHV program in the state of Tennessee.

Another primary concern has been the over-use of existing OHV facilities. As previously stated, increasing OHV users combined with limited land resources to participate result in high demand for the OHV areas that do allow use. Efficient demand management through use of prices and/or fees is a commonly accepted practice in the case of a public good such as an OHV area. The use of this approach for OHV management is supported by highly significant, negative parameter estimates for the travel cost variable in the Poisson regression analysis. In addition, highly elastic, negative price elasticities indicate that a 10% increase in travel costs, through use of various fee approaches, could result in a 38.4% to 46.4% decrease in OHV trips. It is important to note that an increase in user fees to curtail demand will limit the ability of the fee amount to produce adequate funding.

Conclusions

In comparing the results of the travel cost and contingent valuation methods, two points should be noted. First, the travel cost method provides estimates of the Marshallian consumer's surplus, whereas the contingent valuation method provides a Hicksian measure of welfare change. However, when the income effect is small, the difference should be minimal (Willig 1976). Second, the travel cost method gives estimates of consumer's surplus for the total recreation experience, whereas the contingent valuation methods provide estimates of consumer's surplus for just the OHV portion of that experience. For this reason we expect the travel cost method to provide a larger estimate of consumer's surplus.

To our knowledge, this paper provides the only estimates of a model of the demand for OHV recreation. While these numbers are useful as the first model estimates of OHV recreation, it is important to pinpoint possible sources of bias. Due to survey information limitations, substitute prices and quality as well as on-site time were ignored in this analysis. The omission of substitute prices will bias the WTP estimate upwards as well as affecting estimates of price elasticity. If the correlation between the two travel cost variables is positive, then omitting the substitute prices biases the own price elasticity toward zero. But if the two travel costs are inversely correlated, the estimated own price coefficient is subject to a negative bias and the price elasticity of demand for visits is biased upwards. While it is reasonable to assume that the effect of substitutes is relatively small for OHV recreation, this could be the source of possible bias. In most cases, ignoring on-site time leads to much lower benefit estimates. Improvement of the framing and presentation of the contingent valuation questions could also reduce possible

bias in the reported WTP values. Due to these survey data limitations and misspecifications, more regional studies should be performed. Until these areas are improved upon, this study contains one of the few if not the only available estimates of the benefits of OHV recreation.

CHAPTER 4

TRAVEL COST MODELING OF THE DEMAND FOR ROCK CLIMBING: AN APPLICATION TO THE OBED WILD AND SCENIC RIVER

Introduction

Recreational rock climbing use has grown considerably over the past decade. In 1995, it was estimated that 100,000 people try rock climbing each year in the United States (Economist 1995). Based on results from the National Survey of Recreation and the Environment (NSRE) conducted by the USFS, annual rock climbing and mountain climbing participation in 1994-1995 was predicted to be 7 to 9.5 million, respectively (Cordell et al. 1997). By comparison, based on a national telephone survey conducted by the Institute for Public Policy (IPP) at the University of New Mexico in 1998 the potential number of rock climbers in the United States may be as high as 21 million. Rock climbing use on public lands is clearly a highly viable public land management issue.

Recently, the management of rock climbing on public lands has caused a great deal of national debate and controversy. On June 1, 1998, the USDA Forest Service (USFS) announced their intent to implement a policy restricting the way climbers could recreate in wilderness areas (USDA 1998). Other federal and state and public land agencies, including the National Park Service (NPS) and the Bureau of Land Management (BLM), have proposed similar rules regarding rock climbing access on public lands. In addition, many agencies that manage public lands that experience a high volume of rock climbing use have begun to draft climbing management plans prohibiting

recreational rock climbing activities in these areas. Many of these plans are based on little or no information regarding rock climbing use levels or rock climbing demand. One example is the Obed Wild and Scenic River (OWSR).

The OWSR, located in Morgan County, Tennessee, is a nationally known rock climbing area. While climbing in the area can be traced back as far as the 70s much of the development of the area did not take place until the early 90s (Watford 1999). With a wide range of difficulty present for climbers, the Obed has developed a large following of beginning and advanced climbers alike. As climbing at the Obed became more popular and more climbers began to visit the area, many believed that official management action must be implemented to protect the recreational experience of climbers and other visitors as well as protecting the natural characteristics of the area. Previously, much of the climbing had occurred place inconspicuously and therefore warranted no management by park officials. While this self-management by the climbers resulted in relatively little impact to other visitors and the natural integrity of the area, the NPS determined that a climbing management plan needed to be developed for the park. In August 2000, the NPS placed a moratorium on establishing fixed anchors at Obed WSR until park managers could gain an understanding of the impacts of climbing on natural and cultural resources and prepare a plan to manage future climbing activities (National Park Service 2002). In February 2002 a draft climbing management plan was submitted for public revue. That management plan was finalized in July 2002.

The climbing management plan placed a moratorium on developing new routes and limited climbing to six areas designated as either a bouldering area or a rock climbing zone. The plan also outlined issues related to trails, parking, access, equipment

usage, and route "top-outs" which is the act of climbing a route all the way to the cliff top, which can damage rare cliff-dwelling species of vegetation. The management plan also called for a number of research studies in order to support the plan. One study outlined in the management plan is inventorying and mapping climbing and bouldering routes. Another is an inventory of sensitive habitats and rare species. The final study that is outlined in the management plan is researching the rock climbing use levels (National Park Service 2002). This final required study is the foundation of this research. These three studies and the information gained from them will be the basis for future management prescriptions in the Obed Wild and Scenic River.

Little information is known about rock climbing use levels in the Obed Wild and Scenic River. The management plan itself states, "There is a recognized lack of information regarding rock climbing at Obed WSR. Specifically, little is known about rock climbing use levels or the plant and animal communities that are affected by climbing activities." (National Park Service 2002). Managers will use this research as input into their management prescriptions, making the information gained from this proposed research invaluable to managers in the Obed.

Survey and Sampling Methodology

Rock climbing surveys and interviews took place over a 12-month period and were disaggregated into 7 recreation sites that were divided into 3 survey units. The recreation sites in this area include private lands, Nature Conservancy holdings, and National Park Service administered lands. The research team contacted visitors at the climbing access points within the OWSR and administered a short (< 2 minutes)

interview to identify where they are climbing, the duration of their visit, and their place of residence. At the end of the on-site interview each climber was asked if they would complete a more detailed survey and return the completed survey via mail. If they agreed to complete the survey, they were given a packet with a cover letter reiterating the purpose of the study, a survey form, and a return envelope with postage attached. The mail survey collected data from the user concerning detailed trip costs and purpose(s), attributes that the user considers when selecting a site for recreational rock climbing, and additional demographic information. Trip cost data included estimates of the distance traveled, expenditures for food, lodging or camping, transportation, equipment and recreation-related costs, and miscellaneous expenses. The data were also collected in a manner that allowed the cost estimates to be disaggregated into expenditures made in the immediate vicinity of the recreation site, on the trip to the recreation site, and at home before or after the trip.

The on-site interviews were conducted on 96 days over a 12-month period beginning November 1, 2002 and ending October 31, 2003. The 96 days represents approximately 25 percent of the days during the survey period. The interview days were spread uniformly over the 12 months (8 days per month) among weekdays (Monday – Thursday) and weekends (Friday – Sunday). Although the majority of use during the fall and winter months is likely to occur on weekends, sampling throughout the month will allow for more accurate use estimates on a daily basis.

Interviewing was allocated proportionally among six climbing areas identified within the OWSR based on the use patterns provided by the Obed rangers. Interviews for users of Lilly Boulders were conducted each day that the research team was at the

OWSR. One member of the research team walking through the boulder field for approximately two hours and contacting the boulderers on-site accomplished this. Three main access points were identified within the area for the remaining six climbing sites: Lilly Bluff Parking Area (LB), Lilly Bridge (LBR), and a parking area located on private land that provides access to climbing areas owned by The Nature Conservancy (TNC). Two climbing areas are accessed by the Lilly Bluff Parking Area (Obed and Y-12), two at Lilly Bridge (Lilly Bluff and Little Clear Creek), and two by the TNC area (North and South Clear Creek). Over the 12-month study period, 13 days were allocated to interviewing at the Lilly Bluff Parking area, 28 at Lilly Bridge, and 55 at the TNC area.

The survey process followed procedures similar to those outlined by Dillman (2000). All users who agreed to complete the mail survey received a postcard reminder one week after the on-site interview. Two weeks after the postcard reminder, all non-respondents received a second copy of the survey and a cover letter urging them to complete the survey and stressing the importance of their response. Three weeks after the second copy mailing, a sample of the remaining non-respondents was contacted by phone to determine why they did not respond and check for non-response bias.

To ensure that the questions elicit answers to the intended purpose, the survey instruments underwent an extensive pre-testing procedure. Initial copies of the survey instruments were forwarded to local climbers that frequent the Obed to secure critiques of question format and structure as well as suggestions for alternative means of obtaining the required data. The survey instruments were revised based on the "expert" reviews and administered to rock climbing organizations in the study area. After the organization members completed the surveys, they were interviewed to ascertain how they interpreted

each question and how the questions may be reworded to elicit the desired information. Three hundred and two interviews of rock climbers were conducted and, 292 agreed to complete the mail survey. Of those 292, 140 returned the survey for a response rate of 48%.

Travel Cost Method and Model Specification

A model of a recreational rock climber's choice of the number of visits to make to the OWSR was modeled using a traditional individual travel cost model (TCM). The basis of the TCM is that visitors will choose the annual number of trips to a recreation site based on the cost of traveling to the site. The number of trips will be inversely related to the travel cost (Loomis and Walsh 1997). This feature is critical because this inverse relationship allows for estimation of a demand curve based on travel costs and the number of trips taken. Once the demand curve is estimated, calculating the net willingness to pay or consumer surplus simply entails adding up the areas below the demand curve and above the price for the various users (Rosenthal et al. 1984).

The first issue that should be addressed in the specification of a travel cost model is the price variable. Several assumptions must hold for travel costs to be a proxy for price in the TCM (Freeman 1999). The first of these is that the visitor is on a single-destination, single-purpose trip. For our purposes this would be a trip in which the only destination was the OWSR for the sole purpose of rock climbing. Mendelsohn et al. (1992) have proposed a method for including multiple destination trips in the TCM, however it was for a zonal, linear application. For this paper, this assumption will be addressed through survey design. Individuals indicating a multipurpose trip were asked

to report the number of days spent for rock climbing in relation to the total number of days for the trip. A percentage of days spent for rock climbing at the OWSR was calculated and this percentage was applied to total travel cost estimates for the trip.

As is well known (Cesario 1976; McConnell and Strand 1981), travel time as well as travel cost should be included in a travel cost model. Another assumption is that the opportunity cost of travel time to the OWSR for the purpose of rock climbing is some how related to the individuals wage rate. Some researchers treat travel time as an endogenous variable (Shaw and Ozog 1999; Desvouges and Waters 1995). Others have included a proportion of the wage rate as an additional factor in the travel cost measurement (Randall 1994; Englin and Shonkwiler 1995). When calculating consumer surplus, only actual monetary expenditures incurred are to be used. The inclusion of travel time, as an additional factor in the travel cost variable will bias travel cost estimates. Therefore, the cost of travel time will be included as an endogenous variable represented as a function of the miles traveled from origin to the OWSR for rock climbing.

The monetary cost of a trip to the OWSR for rock climbing is composed of two parts: the admission fee f and the monetary cost of travel including the opportunity cost of travel time. Since the OWSR charges no admission fee to the area, total cost is comprised of the cost of travel (Freeman 1999). The monetary costs of travel have been split into five parts: lodging, food and beverage, transportation, activities and entertainment, and other expenses. Since rock climbing requires substantial equipment purchases to begin participation (high fixed costs) and it is reasonable to believe that these purchases may play a significant part in travel choice behavior, additional rock

climbing expenditures are needed to supplement the marginal costs experienced by rock climbers on each trip. Based on previous research we would expect the coefficient on travel costs and miles to be negative, inferring a negative relationship between travel costs and the number of trips (e.g. Loomis and Walsh 1997; Fix and Loomis 1997).

The second issue that must be addressed through model specification is that of substitute sites. In a traditional single site travel cost model, the value an individual places on that particular site is significantly affected by neighboring sites that may provide similar recreational experiences. These substitution effects are critical for precise model specification, as their exclusion may overstate the estimates of consumer surplus (Rosenthal 1987). Possible substitute sites for rock climbing at the OWSR were identified through focus groups composed of OWSR rock climbers. When asked what other rock climbing areas they had visited in the past 12 months, popular rock climbing sites in Tennessee, Georgia, North Carolina, Kentucky, and West Virginia were named. Effects of these substitute sites were incorporated into the model by calculating the average travel costs to these sites as a function of miles traveled.

Because individuals make choices about recreation based on the quality of recreation at a particular site, previous literature has included various quality variables with great success (Morey 1981; Smith, Desvouges, and McGivney 1983a; Caulkins, Bishop, and Bouwes 1986; McConnell 1986). While site characteristics are important in modeling the demand for a recreational area, existing travel cost literature provides little insight into selecting appropriate site characteristics for rock climbing areas. In order to determine which site attributes are important, survey respondents were asked to rank site attributes on their importance in affecting site choice. Survey respondents indicated that

the five most important site attributes that in choosing a climbing site were rock quality, number of climbs, availability of sport climbing, availability of good protection, and difficulty of climbs. Since measures of rock quality, availability of sport climbing, and availability of good protection do not change across the survey sample, an appropriate site quality characteristic is the number of climbing routes available to the climber, where the limiting factor is the individual's technical ability (Shaw and Jakus 1996). This site characteristic is similar to the ability-specific characteristic Morey (1985) constructs for skiers and ski area choice. The site quality variable of interest in modeling rock climbing trips to the OWSR is the number of climbs in the climber's ability range. We hypothesize that as the number of climbs in the climber's ability range increases, more rock climbing trips to the OWSR are likely. Therefore, it is hypothesized that this variable should have positive coefficients.

A Poisson model (travel cost model) was used to model the demand for rock climbing trips at the OWSR. The Poisson distribution is far more consistent with a data generating process producing only a few trips per visitor. Hellerstein (1992) shows that when the estimated number of trips is small (such as this data set, where the average is 40) the Poisson is a much closer approximation than regression techniques based on the normal distribution. In addition, the Poisson model is one in which the maximum likelihood estimator (MLE) is robust to certain misspecifications of the model, such as the failure to incorporate latent heterogeneity in the mean. In order to correct for this misspecification, a robust covariance matrix was used. The model estimated has a Poisson distribution with the general specification being:

$$Y_i = \exp(\text{PRICES}_i, \text{QUALITY}_i, \text{DEMOGRAPHICS}_i, \text{error term}) \quad (15)$$

The model estimated also corrects for endogenous stratification, which occurs with onsite sampling. With on-site sampling, the likelihood of a person being sampled is related to the frequency of their visits. In the Poisson specification, subtracting one from the reported number of trips adjusts the annual number of trips downward to reflect the fact that those who take a higher number of annual trips are more likely to be sampled (Englin and Shonkwiler 1995). The specific model specification is as follows:

$$\ln TRIPS = B_0 - B_1*TC + B_2*RCGRP + B_3*INC + B_4*MILES + B_5*BLDR + B_6*DAY + B_7*CLIMBS + B_8*SUB \quad (16)$$

where TRIPS is the estimated number of rock climbing trips taken; TC is travel costs for a rock climbing trip to the OWSR; RCGRP is a dummy variable to represent membership in a rock climbing club or group (1=Yes, 0=No); INC is the individual's annual income before taxes; MILES is the miles traveled to the OWSR; BLDR is a dummy variable to determine whether the individual is a boulderer (1=Yes, 0=No); DAY represents whether the trip taken was a day trip (1=Yes, 0=No); CLIMBS represents the number of climbs in the climber's ability range; and SUB is the travel cost measured in miles to all relevant substitute sites.

Basic demographic variables (INC, RCGRP, BLDR) were included in this model to coincide with previous travel cost studies (Morey 1981; Samples and Bishop 1985; Shaw and Jakus 1996; Grijalva et al. 2002). These variables are consistently found to be

significant in various travel cost models. Because rock climbing groups and organizations sponsor numerous climbing events annually, participation in such groups should reasonably lead to more rock climbing trips taken. In order to include this effect (which is expected to be positive) in trip taking behavior a variable was added to identify participation in rock climbing groups.

Survey data indicated that the majority of climbing taking place at the OWSR is sport climbing followed by bouldering. A dummy variable (BLDR) was included to determine differences in trip taking behavior between these two user groups as bouldering requires significantly less equipment to begin recreating. In addition, DAY was included to determine what effect these trip characteristics may have on the number of trips taken.

The value of access equals the area under the expected demand curve. For the exponential demand function, the choke price (C*) is infinite. Assume a simple demand specification: $x= e^{\beta_0+\beta_1 C}$ where C is the travel cost, and β_0 can be a constant or a function of covariates other than own price. For any finite C, $x=e^{\beta_0+\beta_1 C} >0$. Defining C^0 as the current travel cost, consumer surplus for access is

$$WTP = \left[(e^{\beta_0+\beta_1 C})/\beta_1\right] = -x/\beta_1 \qquad (17)$$

where x represents the number of trips taken by the individual and β_1 is the parameter estimate for travel costs. In the Poisson expression for sample mean WTP, one can use the mean of observed trips or mean of the expected trips because the Poisson model has

the property that it is mean fitting (Haab and McConnell 2002). The mean of observed trips was used for calculations in this study. Consumer surplus estimates generated through this procedure provide an estimate of the individual value of rock climbing recreation at the OWSR.

Results

Survey Information

Demographic results can be found in Table 17. Personal demographics of climbers surveyed indicate that the average recreational rock climber visiting the OWSR was a single male between the ages of 20 and 30 years old, had some college education, and earned between $25,000 and $35,000 annually. The average rock climber visiting the OWSR indicated that his/her skill level lies somewhere between 5.10 and 5.11 based on the U.S. sport climbing rating system.[10] In previous travel cost studies, participation in a club or group related to the recreation pursuit has found to have a positive influence on the number of trips taken. Survey responses indicate that 46.27% of rock climbers at the OWSR were members of a climbing-related group or club. Of those, 75% indicated that they paid yearly dues, membership fees, or had made a contribution to that group with an average amount paid of $60 annually.

Table 17. Demographics of Rock Climbers at OWSR

	Percent Male	Age	Income	Education	Skill	Group Member
Average	70.90%	20-30 years old	$25K-$35K	Some college	5.10-5.11	46.27%

[10] The grade is based on the respondents best climbing and bouldering redpoint achievement. Redpoint is defined as completing a climb without a fall regardless of the number of tries.

Individual trip statistics reveal that sport climbing, traditional climbing, and bouldering all occurred at the OWSR with over 81% of total use being sport climbing. The average annual number of recreational rock climbing trips to the OWSR was nearly 32. On average trips to the OWSR constituted approximately 56% of the total number of rock climbing trips taken per year by the respondents. The average day trip lasted approximately 6 hours and the average multi-day trip lasted 3 days. Nearly 74% of total use was day use activities. While the majority of users traveled less than 50 miles to reach the OWSR, a small group traveled much further. Visitors were noted from as far away as Colorado, California, Oregon, and even Canada. Results of individual trip statistics can be found in Table 18.

Analysis of travel cost data revealed that total expenditures for the average rock climbing trip to the OWSR totaled $46.70.[11] A breakdown of spending behavior revealed that the greatest percent of this cost resulted from food and beverage costs as well as costs of transportation to and from the area. Compared to these costs, lodging expenses were significantly smaller likely due to the large proportion of individuals that camped on

Table 18. Individual Trip Statistics

	Percent Sport Climber	Percent Traditional Climber	Percent Boulderer	Annual OWSR Trips	Percent Day Use	Miles Traveled
Average	81.34%	2.99%	28.36%	31.72	73.88%	93.90

[11] This estimate does not include the cost of travel time and depreciated equipment costs.

both public and private property. Of the $46.70 in expenditures incurred, $17.97 (38.47%) occurred in Morgan County. Expenses incurred in Morgan County were comprised primarily of food and beverage purchases.

Information was also collected regarding user attitudes and preferences. When asked which site attributes were most influential in choosing a rock climbing site to visit, respondents indicated that rock quality, number of routes, availability of sport climbing, difficulty of routes, and availability of good climbing protection were all important to very important factors in their decision of which climbing site to visit. Walking distance from the car and the availability of traditional climbing and bouldering were considered the least important. A complete list of site attributes as well as average responses and standard deviations can be found in Table 19.

Survey respondents were also asked for their attitudes about particular visitor issues. Respondents indicated how much they felt that each issue was a problem for rock

Table 19. Importance of Site Attributes in Selecting Sites
1=Very Important; 5=Very Unimportant

Site Attribute	Average Response	Std Dev
Difficulty of routes	1.92	0.73
Length of routes	2.75	0.92
Number of routes	1.74	0.67
Availability of good protection	1.81	0.88
Availability of information about area	2.56	0.97
Rock quality	1.63	0.69
Bouldering availability	2.93	1.24
Traditional (Trad) climbing availability	3.19	1.28
Sport climbing availability	1.77	0.79
Walking distance from car	3.36	1.04
Scenery	2.05	0.73
Solitude	2.34	0.80

climbers at the OWSR. While respondents did not indicate that any issue constituted a serious problem, lack of suitable campsites was noted as a moderate problem. While one camping site is provided at the OWSR, it is located 10 miles downstream of the climbing areas. Because there is no direct route between the climbing areas and the campsite this translates into a considerable drive for climbers. Another often-used area for out-of-town visitors is nearby Frozen Head State Park; however, this is also a considerable distance away. Other issues that were noted as minor problems were impacts to soil and vegetation as well as litter. A complete list of visitor issues as well as average responses and standard deviations can be found in Table 20.

In addition, motivations for rock climbing at the OWSR were also obtained. Visitors were presented with a list of reasons for rock climbing at the OWSR and were asked to rate their level of agreement with each reason. The most popular reasons for

Table 20. Perceptions of Visitor Issues at OWSR
1=Not a Problem; 5=Serious Problem

Visitor Issue	Average Response	Std Dev
Too many rules and regulations	1.67	1.12
Too few rules and regulations	1.63	1.03
Poor communication of rules and regulations	2.11	1.24
Lack of adequate protection	1.73	1.54
Impacts to vegetation	2.23	1.09
Impacts to soil	2.20	1.07
Poor access	1.54	0.87
Traffic around climbing area	1.85	1.11
Litter	2.19	1.17
Availability of parking at access points	1.58	0.84
Lack of facilities at access points	1.73	1.10
Lack of designated routes	1.30	0.65
Crowds or long lines	1.87	1.07
Vandalism	1.85	1.26
Lack of suitable campsites	2.86	1.52

rock climbing at the OWSR were to "do something challenging", "develop and test my skill and abilities", and "enjoy natural scenery". The least popular was "to be alone". A complete list of possible reasons as well as average responses and standard deviations are presented in Table 21.

According to the OWSR climbing management plan developed by the National Park Service, rock climbing is only allowed on six sites. In addition, climbers have also been known to make use of another nearby cliff face located on private property (Little Clear Creek). Respondents indicated that South Clear Creek and Lilly Bluff were the most popular sites. Because the Lilly Bluff site is located in a shaded area, climbers use the area most heavily during the hot summer months while South Clear Creek (an exposed south facing site) is used the rest of the year. March and September were the times of greatest use; however, rock climbing is very dependent on weather. Rainy

Table 21. Reasons for Rock Climbing at the OWSR
1=Strongly Agree; 5=Strongly Disagree

Reason	Average Response	Std Dev
Get away from crowds	2.77	1.00
Enjoy natural scenery	1.65	0.64
Be with others with similar interests	1.95	0.81
Do something challenging	1.38	0.53
To be alone	3.56	0.89
Explore places where I have not been	2.42	0.92
Keep physically fit	1.71	0.70
Experience excitement	1.71	0.77
Rest mentally	2.20	0.93
Get away from everyday life	1.86	0.83
Talk to new and varied people	2.26	0.83
Develop and test my skills and abilities	1.42	0.54
Experience a sense of personal freedom	1.81	0.84
Be with my friends	1.68	0.69
Feel more self-confident	2.32	0.79

conditions make climbing impossible and climbers prefer moderate temperatures to extremes of hot and cold. Therefore, peak use should be expected to change from month to month depending on the weather. Figure 5 presents climber use per month by site.

Use numbers were collected eight days a month at all three survey sites depending on the time of year. It was assumed that these eight days represented the climbing use for that month. Use for the entire month was aggregated by the percentage of the month that those eight days represented. For example, for the month of October those eight days represented 25.8% of the use for that month (8 survey days/31 days in October). This procedure was duplicated for each month and summed over the course of the year to reveal that the OWSR is responsible for over 2,500 rock climber user days per year.

Travel Cost Model

Definitions of Poisson regression variables are listed in Table 22. The results of the Poisson equation are listed in Table 23. As hypothesized, the price variable, TC, was

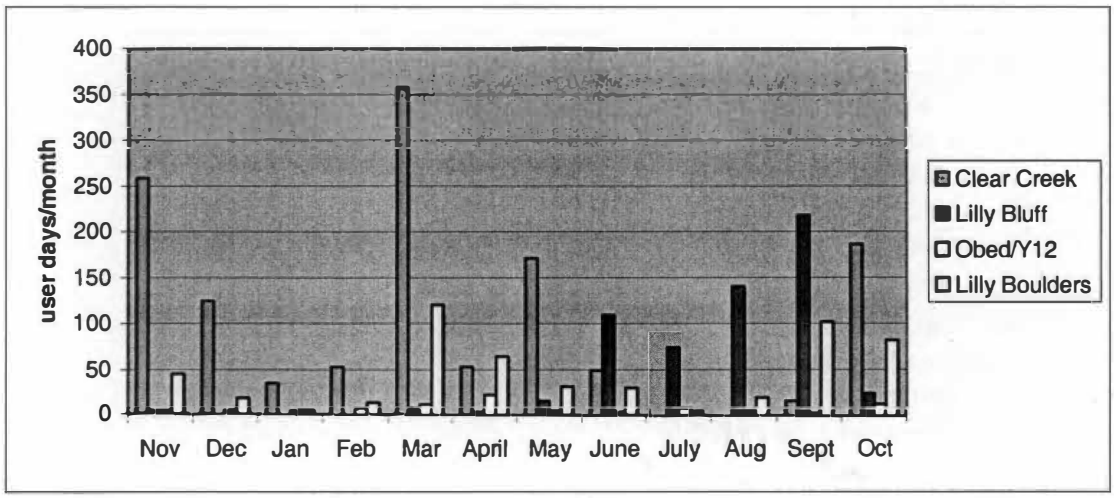

Figure 5. Monthly climber use by site

Table 22. Definition of Poisson Regression Variables

Variable	
TC	Expenditures incurred while visiting the OWSR
RCGRP	Dummy variable = 1 if member of a rock climbing group or organization
INC	Annual personal income of the respondent
MILES	Miles traveled to climb at the OWSR
BLDR	Dummy variable = 1 if respondent participates in bouldering
DAY	Dummy Variable = 1 if respondent was on a day trip
CLIMBS	Number of climbs in climber's ability range
SUBS	Average travel costs measured in miles for traveling to substitute sites

Table 23. Results of Poisson Regression

Variable	Coefficient	Std Error
Constant	1.0253*	0.6235
TC	-0.0059**	0.0018
RCGRP	0.2616*	0.1339
INC	0.0614*	0.0264
MILES	-0.0022	0.0015
BLDR	0.2129	0.1280
DAY	1.0111**	0.2498
CLIMBS	-0.0007	0.0009
SUBS	0.0068**	0.0028

N=140
R-Square=0.4389
Chi-Squared=1839.80
Restricted Log Likelihood=-1960.26
** significant at the 1% level
* significant at the 5% level

negative and significant at the 1% level. A 10% rise travel costs would decrease the number of climbing trips taken to the OWSR by 3.5%. The respective substitute price variable coefficient was positive and significant at the 1% level as well. Thus, even a fairly unique rock climbing site like the OWSR is considered by users to have substitutes. An increase in income resulted in more trips being taken to OWSR. Specifically the income elasticity of demand for rock climbing trips to the OWSR was 0.17. Indicating that a 10 percent increase in income would increase rock climbing trips taken to the OWSR by 1.7%. Survey results also revealed a positive relationship between day use and number of trips. This is most likely attributed to the fact that day users often live closer to the area resulting in more trips taken through the course of the year. The explanatory power of the regression was reasonably good given the individual cross-section data.

When using the Poisson model, per trip consumer surplus can be calculated by $-1/B_{TC}$ (Creel and Loomis 1990; Englin and Shonkwiler 1995). Per-trip refers to the economic benefits received per person from an average trip. This assumes that each member of the group receives equal benefits. Estimates of consumer surplus are listed in Table 24. The value per-trip of rock climbing in the OWSR was estimated at $170.62. Individual consumer surplus per season was found to be $6,903.58. This is obtained by multiplying the per-trip estimate by the estimated number of trips per year.

The above estimates are individual-based values; however, it may also be useful to estimate a measure of annual use value for the OWSR as a whole and not just for the average visitor. The first step required dividing per-trip consumer surplus by the average days spent in the OWSR, in order to estimate the consumer surplus attributable to one

Table 24. Consumer Surplus for Rock Climbing at the OWSR

Annual Individual Consumer Surplus	Individual Per-Trip Consumer Surplus	Per-Day Consumer Surplus	Annual Consumer Surplus OWSR
$6,903.58	$170.62	$113.75	$284,366.05

climbing day at the OWSR. This value was then multiplied by the annual visitor days at the OWSR, which was estimated at 2500. The estimate of annual consumer surplus experienced by rock climbing visitors to the OWSR is listed in Table 24. As can be seen, the estimate of over $284,000 is quite large considering the number of user days.

Conclusions

The rock climbing areas in the OWSR area provided a considerable amount of consumer surplus to the users. The annual value of rock climbing at the OWSR of approximately $284,000 is quite large also. Although these estimates of consumer surplus may not be easily transferable to other areas, it is still useful for land managers to note that there are large benefits resulting form land being used for recreational rock climbing.

NPS officials placed a moratorium on fixed climbing anchors in August 2000, until the possible impacts to natural and cultural resources could be determined. The consumer surplus estimates discussed above measure visitors' willingness to pay for rock climbing recreation currently furnished as well as the possible expansion of these services. Hints about the possible direction of such an expansion abound throughout the survey results. An analysis of the importance of various visitor issues, reveals possible expansions in campsite availability as well measures to prevent impacts to soil and

vegetation. The importance of site characteristics like number of routes and the availability of sport climbing indicate a desire for additional bolted routes.

Rock climbing is only one activity, which can be done at the OWSR, and, therefore, rock climbing is only part of the total economic value associated with the OWSR. This areas total economic value will consist of all use values such as hiking, swimming, fishing, whitewater boating, and sightseeing as well as existence, option, and bequest values. Rock climbing will have different values at different sites depending on the characteristics of the site and visitors. Nonetheless, it appears that participants in rock climbing receive substantial benefit per-trip and it may be an economically competitive use of public lands.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Prior research has estimated welfare and trip demand behavior for a variety of recreational pursuits. Activities that have received the most attention include lake recreation, hunting, hiking, camping, and fishing. Little attention has been given however to specialized recreational pursuits such as rock climbing and OHV recreation. This is most likely due to the small number of participants relative to more popular forms of recreation such as hunting and lake recreation. This leads many to the false interpretation that if a recreational pursuit does not attract a large number of participants it can be ignored.

As many land management agencies are realizing, these less "popular" forms of recreation require just as much if not more natural resource management than do the more mainstream forms of recreation. The Forest Service, Bureau of Land Management, and the National Park Service have all proposed a fixed anchor ban for rock climbing and many sites have created climbing management plans that outline accepted practices for recreational rock climbing. Many states have created OHV management plans that dictate how OHV recreation is to be managed throughout the state. Consequently, as needed management increases, the amount of knowledge concerning these recreational pursuits must also increase. This study was conducted to provide such information on recreational rock climbing and OHV recreation in Tennessee.

The OHV portion of the study, included participants throughout the state of Tennessee. Results revealed that more than 550,000 people in Tennessee have ridden an

OHV. Additionally, there were more than 500,000 OHVs in Tennessee, comprised of more than 300,000 four-wheel drives, more than 150,000 ATVs, and almost 50,000 off-highway motorcycles. The largest numbers of OHV users were found in middle and east Tennessee.

Survey results also provided a great deal of demographic information concerning OHV users. The average OHV user in Tennessee was primarily middle-aged, with the most frequently reported age groups being 40-49, followed closely by 30-39. The majority (+80 percent) of OHV users in Tennessee were male, Caucasian (+90 percent), and married (+70 percent). Almost 30 percent of OHV users in Tennessee completed high school, more than 20 percent have some college education, and more than 20 percent are college graduates. The most frequently reported range of income among survey respondents was $50,000-$75,000, followed closely by the over $75,000 range.

Trip characteristics identified in the Tennessee OHV user survey revealed that OHV participants spent $215 per trip and took an average of 12 OHV trips per year. Most OHV trips in Tennessee lasted less than a day while approximately 20 percent of respondents said that their typical OHV trip lasted more than a day. Multiple day trips typically involved three days and a total of six or seven hours per day riding. Satisfaction with OHV opportunities in Tennessee was very low. Across vehicle types, more people were dissatisfied than satisfied with OHV opportunities and management in Tennessee.

The estimated economic impacts from OHV activities in 1998 dollars were approximately $3.43 billion in total economic activity, $2.33 billion in value added, and over 52 thousand full- and part-time jobs. Approximately $1 billion were spent by those participating in off-highway activities. Initially, these dollars were used to purchase

inputs, creating another $300 million dollars of economic activity. However, another $1.3 billion dollars of economic activity was induced through these expenditures.

The results of the Poisson regression for the off-highway motorcycle, ATV, and four-wheel drive user groups revealed that the model fit the data well (Chi-squared probabilities <0.0001 for all models). Model results reveal that travel costs were significant at the 1% level in all models. As expected, travel costs negatively influenced the number of OHV trips taken. Specifically, a one dollar increase in the price of an OHV trip resulted in a 1.6% to 2.2% decrease in the number of trips taken. The choke price, or the price at which no OHV trips will take place, was estimated to be approximately $350 for all user groups. Average consumer surplus for an average OHV trip in Tennessee was calculated as the area under the demand curve and above the expenditure level, at the mean level of visits. Estimated average consumer surplus per trip ranged from $46.17 for the ATV user group to $61.19 for the off-highway motorcycle user group. As expected, the price elasticity of demand was found to be negative and highly responsive to travel costs.

Binary logistic regression was utilized to calculate the probability of an individual's acceptance of two different payment vehicles established to raise funds for an OHV management program in Tennessee. For a daily fee program, travel costs were found to have no effect on participation rates. Number of OHV trips were found to be significant at the 5% level in determining participation rates for the four-wheel drive user group but were insignificant for all other user groups. OHV experience, age of respondent, and education level of respondent were all found to be highly significant in explaining participation in a daily OHV fee program for the off-highway motorcycle user

group. However, none of these variables were found to be highly significant in explaining fee program participation for any other user group. As a whole, participation in an OHV group was highly significant for off-highway motorcycle users and ATV users. For the annual fee program, travel cost showed no influence in the participation rates. However, significance of number of OHV taken was found in the off-highway motorcycle group. The variable OHVGRP also became highly significant for all user groups. All parameter estimates and marginal effects for OHVGRP are positive as well implying that members of an OHV group or organization are much more likely to participate in an OHV fee program. As a whole, income appears to be marginally important in the decision to participate in an OHV fee program depending on the user group. While the daily fee enjoyed a slightly higher stated percent participation rate, the annual user fee was found to be the preferred method for maximizing consumer surplus.

Results from the rock climbing portion of the study indicate that the average recreational rock climber visiting the OWSR was a single male between the ages of 20 and 30 years old, had some college education, and earned between $25,000 and $35,000 annually. On average trips to the OWSR constituted approximately 56% of the total number of rock climbing trips taken per year for an individual. Nearly 74% of total rock climbing use was day use activities.

When asked about average annual use of seven climbing sites located in the OWSR, respondents indicated that South Clear Creek and Lilly Bluff were the most popular sites. Survey results also reveal that the OWSR is responsible for over 2500 rock climber user days per year, with most of this use occurring in the spring and fall.

Analysis of travel cost data revealed that total expenditures for the average rock climbing trip to the OWSR totaled $46.70 with 38% of this occurring in Morgan County. As expected by theory, the price variable, TC, was negative and significant at the 1% level. A 10% rise travel costs decreased the number of climbing trips taken to the OWSR by 3.5%. The respective substitute price variable coefficient was positive sign and significant at the 1% level. An increase in income led to more trips being taken. The value per-trip of rock climbing in the OWSR was estimated at $170.62. Individual consumer surplus per season was found to be $6,903.58. Average annual use value attributed to rock climbing at the OWSR is estimated at $327,000 based on 2500 user days per year.

In addition to demographics and travel cost expenditures, information was also collected regarding user attitudes and preferences. Respondents indicated that rock quality, number of routes, availability of sport climbing, difficulty of routes, and availability of good climbing protection were all important to very important factors in their decision of which climbing site to visit. A lack of campsites as well as impacts to soil and vegetation were all noted as minor problems by the rock climbers surveyed. The most popular reasons for rock climbing at the OWSR were to "do something challenging", "develop and test my skill and abilities", and "enjoy natural scenery".

As previously stated, increasing recreational users combined with limited land resources to participate result in high demand for the recreational areas that do allow use. Efficient demand management through use of prices and/or fees is a commonly accepted practice in the case of a public good such as a recreational area. The use of this approach for OHV and rock climbing recreation management is supported by highly significant,

negative parameter estimates for the travel cost variable in the Poisson regression analysis. However, highly elastic, negative price elasticities indicate that a 10% increase in travel costs, through use of various fee approaches, could result in a 37.3% to 45.9% decrease in OHV trips. It is important to note that an increase in user fees to curtail demand will decrease the number of trips taken significantly reducing the consumer surplus produced by OHV recreation. The price elasticities associated with rock climbing at the OWSR were inelastic, making the use of fees to control overuse a reasonable alternative. However, since overcrowding was not indicated as a serious problem by survey respondents, this practice may not be necessary.

This study provided important demographic information that could be of significant use to land managers in management of these recreational activities. In addition, this study also reveals the value attached to each of these recreational pursuits. However, comparing the value of two recreational pursuits can be difficult. First, the estimates of consumer surplus for OHV recreation presented in this study represent behavior and preferences exhibited by people of the state of Tennessee; therefore, caution should be used when applying these results to OHV recreation in other areas. Likewise, the estimates of consumer surplus for rock climbing may not be applicable to areas other than the OWSR. Comparison of recreational value for the purpose of providing the most efficient form of land management is difficult unless the survey sample is based on the same area. Second, consumer surplus estimates represent a measure of value per person. Consumer surplus per day must be calculated and aggregated based on the total number of user day or seasonal consumer surplus must be multiplied by the total number of users to provide a clear picture of the overall value of each recreational activity. Regardless,

the calculations presented herein will undoubtedly be of direct use to land managers responsible for management of a two clearly beneficial forms of recreation.

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Appendix

Appendix 1: Climbing Interview

Obed Climbing Interview Form
University of Tennessee

Date: *Weather:*
Time: *Interviewer:*
Location: *Number in group:*

How long have you been participating in recreational rock climbing?

- ❑ <1 year
- ❑ 1-5 years
- ❑ >5 years

How would you rate your skill level?

- ❑ Less than 5.6 level
- ❑ 5.6 to 5.7 climber
- ❑ 5.8 to 5.9 climber
- ❑ 5.10a to 5.11d climber
- ❑ 5.12a to 5.13d climber
- ❑ greater than 5.13d level

What type of climbing will you be participating in today?

- ❑ Sport climbing
- ❑ Trad climbing
- ❑ Bouldering
- ❑ Other_____

Approximately how many times a year do you participate in outdoor rock climbing?

- ❑ <10 days/year
- ❑ 11-20 days/year
- ❑ 21-30 days/year
- ❑ 31-40 days/year
- ❑ 41-50 days/year
- ❑ >50 days/year

Approximately how many times a year do you participate in rock climbing in the Obed?

- ❑ <10 days/year
- ❑ 11-20 days/year
- ❑ 21-30 days/year
- ❑ 31-40 days/year
- ❑ 41-50 days/year
- ❑ >50 days/year

Which of these sites in the Emory/Obed system do you/did you plan to climb at today? *check all that apply*

- ❑ Lilly Boulder Field
- ❑ Lilly Bluff
- ❑ North Clear Creek
- ❑ Middle Clear Creek
- ❑ South Clear Creek
- ❑ Obed
- ❑ Y12
- ❑ Little Clear Creek
- ❑ Other_____
- ❑ Don't know

Which of these sites in the Emory/Obed do you have any climbing experience? *check all that apply*

- ❑ Lilly Boulder Field
- ❑ Lilly Bluff
- ❑ North Clear Creek
- ❑ Middle Clear Creek
- ❑ South Clear Creek
- ❑ Obed
- ❑ Y12
- ❑ Little Clear Creek
- ❑ Other_____
- ❑ Don't know

How long is your current recreational rock climbing trip?

- ❑ Less than a day. If so, how many hours? _____
- ❑ More than a day. If so, how many days? _____

If you did stay for more than one day, do you: (please check all that apply)

____camp ____stay in a hotel/motel ____stay with friends

Would you be willing to participate in a take home survey in order to obtain more detailed information about your recreational climbing trip?

- ❑ Yes Survey # _____
- ❑ No

What is your home address? _____

_____

Appendix 2: Obed Survey Cover Letter

Dear Climber:

Thank you again for agreeing to participate in the climbing study and to complete the enclosed questionnaire. As you were told when contacted at the Obed, the results of this study will be used by the National Park Service to manage the Obed in a way that will protect the natural resource and provide a range of climbing opportunities. Your answers are important to developing recommendations that reflect the opinion of the climbers using the Obed.

Confidentiality will be maintained in the study. Names will not be attached to survey answers and responses will be examined only in aggregate form. Completed questionnaires will be kept in a locked office and destroyed once the information has been processed. If you prefer not to answer some of the questions, we certainly understand, but would appreciate you completing the rest of the survey.

We appreciate your assistance in this study. Please feel free to contact us at cbsims@utk.edu or dhodges2@utk.edu or call 865-974-2706 if there are any questions. We would be happy to provide you with a copy of the preliminary results when they become available. Simply check the box labeled "yes" on the back of the questionnaire. Thank you very much.

Sincerely,

Charles Sims
Graduate Research Assistant

Don Hodges
Associate Professor

Appendix 3: Obed Climbing Survey

WE NEED YOUR HELP

Fellow Climber,

On behalf of The Access Fund I want to encourage you to take the time to complete the following rock climbing survey. The Access Fund is pleased and excited to support this effort and appreciates the efforts of all involved; climbers, researchers and National Park Service (NPS) personnel.

This research effort by the University of Tennessee (UT) Department of Forestry, Wildlife and Fisheries will aid greatly in the implementation of the new Obed Climbing Management Plan (CMP) which, in turn, will help preserve climbing and our climbing resources in this beautiful area. From user preferences, to site and economic impacts, the information collected should paint an accurate picture of climbing at the Obed.

Either as part of this survey effort, implementation of the CMP, or both, The Access Fund, UT, and the NPS may turn to climbers to assist in further climber use study. Please consider lending a hand if asked! Thanks for your help.

Sincerely,
Frank Harvey
Access Fund Obed Regional Coordinator

Dear Obed Climber:

The National Park Service, along with out partners the Access Fund and the University of Tennessee, encourages you to fill out the following rock climbing survey. The information gathered from this survey is critical to the future management of rock climbing in the Obed Wild and Scenic River (WSR). The recently completed climbing management plan for Obed WSR calls for research to determine the types, amount, frequency, and seasonality of rock climbing that occurs at Obed WSR, and socio-demographic information on rock climbers using the area. This information will assist in understanding the economic contributions of climbers to the region, the relationship of climbing to resource impacts, and the opinions of climbers about the resource.

The Obed WSR is one of the most important stretches of wild river in the country from a recreational and biological perspective. Considering the external development pressures that have already been experienced in the watershed, it is important that those that appreciate such an area get involved and show just how important this area is. Since rock climbers are one of the main user groups in the area, knowing how many climbers frequent the area along with an estimation of the money brought to the region from climbing is important information that will undoubtedly help enhance the future of climbing in the Obed WSR. Therefore, it is critical that every climber fills out one of these surveys in order to get an accurate estimation of climber use and economic impact.

Sincerely,

Reed E. Detring,
Superintendent

Participation/Preference Survey

The purpose of this section of the survey is to get an idea of your climbing experience at the Obed Wild and Scenic River (WSR) and to get opinions on your participation and preference in regard to climbing at the Obed Wild and Scenic River (OWSR). Please answer the following questions based on your personal experiences and preferences for climbing.

1. A number of factors can affect your choice of which climbing area to visit. How important are each of these factors when choosing which site to climb at? *(Circle one number for each factor).*

	Very Important	Important	Neutral	Unimportant	Very Unimportant	Don't Know
Length of routes	1	2	3	4	5	DK
Availability of good protection	1	2	3	4	5	DK
Availability of information about area	1	2	3	4	5	DK
Rock quality	1	2	3	4	5	DK
Traditional (Trad) climbing availability	1	2	3	4	5	DK
Driving distance from home	1	2	3	4	5	DK
Scenery	1	2	3	4	5	DK

2. How much experience do you have at each of these climbing sites in the Emory/Obed watershed? Check the category that best describes the number of days you have climbed at each site during your climbing career. If you have climbed at a site in the Emory/Obed watershed other than the ones listed below, write in the name or location of that spot in the space marked "other site". Refer to the map in the center of the booklet if you are unclear about the names of the specific sites.

Site	0 days	1-10 days	11-20 days	21-30 days	31-40 days	>40 days
Lilly Boulder Field						
Lilly Bluff						
North Clear Creek						
South Clear Creek						
Obed						
Y-12						
Little Clear Creek						
Other Site:						

3. The following is a list of climbing sites at the Obed WSR. Compare the rock climbing at the following sites in relation to the factors listed in the first column using the 1 through 5 scoring system listed below. If you have not climbed at a particular site, check the box in the row labeled "No experience at this site" for the corresponding site and simply leave that column blank. Base your comparison solely on your experiences at the OWSR and do not compare your opinions and experiences at other climbing sites like Foster Falls or Tennessee Wall to your rating of the following sites in the OWSR. Base all ratings only on sites located in the Obed WSR. If you have not climbed at any site in the Obed WSR other than those identified below, simply leave the "Other Site" column blank. If you have climbed at another site, please identify the site in the "Other Site" Column and evaluate it.

Score using the following system:
1= **Very Desirable**
2= **Desirable**
3= **Neutral**
4= **Undesirable**
5= **Very Undesirable**

	Lilly Boulder Field	Lilly Bluff	North Clear Creek	South Clear Creek	Obed	Y-12	Little Clear Creek	Other Site: _____
No experience at this site								
Example: Difficulty of routes								
Difficulty of routes								
Length of routes								
Availability of good protection								
Availability of information about the area								
Rock quality								
Bouldering availability								
Traditional (Trad) climbing availability								
Sport climbing availability								
Driving distance								
Walking distance								
Scenery								
Solitude								
Overall								

4. To what extent is each of the following a problem for you at the Obed Wild and Scenic River? *Circle one response for each visitor issue.*

	Not a Problem	Minor Problem	Neutral	Moderate Problem	Serious Problem	Don't Know
Too many rules and regulations	1	2	3	4	5	DK
Too few rules and regulations	1	2	3	4	5	DK
Lack of adequate protection	1	2	3	4	5	DK
Impacts to soil	1	2	3	4	5	DK
Traffic around climbing area	1	2	3	4	5	DK
Lack of parking at access points	1	2	3	4	5	DK
Lack of designated routes	1	2	3	4	5	DK
Vandalism	1	2	3	4	5	DK
Lack of suitable campsites	1	2	3	4	5	DK

5. Below is a list of possible reasons for rock climbing in the Obed Wild and Scenic River. Please indicate your level of agreement with each statement. *Circle one response for each reason.*

I go climbing at the Obed to:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
Enjoy natural scenery	1	2	3	4	5	DK
Do something challenging	1	2	3	4	5	DK
Explore places where I have not been	1	2	3	4	5	DK
Experience excitement	1	2	3	4	5	DK
Get away from everyday life	1	2	3	4	5	DK
Develop and test my skills and abilities	1	2	3	4	5	DK
Be with my friends	1	2	3	4	5	DK

Trip Expenditure Survey

In the following section of this survey you will be asked about the expenses of your recreational climbing trip. These expenses include lodging, food and beverage, transportation, activities/entertainment and other miscellaneous expenses such as film and souvenirs. Please report information only from the trip during which you were interviewed. Please be as accurate as possible with your answers. Your answers are completely voluntary and confidential and will not be associated with you or anyone else in your household.

Please answer the following questions based on the expenses incurred on the trip during which you were interviewed:

6. On the trip during which you were interviewed, did you (check one):
   ___ pay all of your expenses

   ___ split expenses with other people
   *If you split expenses with other people, on the following pages report only those trip expenses you paid for yourself

7. On the trip during which you were interviewed, did you also pay expenses for (check one):
   ___ Just yourself
   ___ Yourself and others in your group
   *If you paid expenses for other people, on the following pages report the total amount expenses you paid for yourself and others. In the space below write-in how many people you paid expenses for, including yourself.

   _____ (number of people you paid expenses for, including yourself)

8. Was your recreational climbing trip to the Obed WSR the primary purpose of your trip?
   ___ Yes (if yes, skip to **next page**)
   ___ No (if no, proceed to **question 9**)

9. While not the main reason for your visit, were you aware of the rock climbing recreation potential in the Obed WSR and its vicinity to your destination?

   ___Yes (if yes, proceed to **question 10**)
   ___ No (if no, skip to the **next page**)

10. In column 1 below please list the total length of the trip, which included your trip to the Obed WSR. This should include travel time, the amount of time spent participating in other activities, the amount of time you spent visiting other sites, and the time you spent at the Obed WSR rock climbing. In column 2 please enter the percentage of time from column 1 that you spent rock climbing at the Obed WSR.

Column 1	Column 2
Total length of trip in days: _____ days	Percentage of time spent rock climbing at the Obed WSR:_____%

11. **Please read the following instructions:**
The following is a list of expenses that may be incurred as a result of a recreational trip along with a classification of where these expenses occurred.

- In column 1, check all applicable expenses that you experienced in relation to your trip.
- In column 2, write in the amount spent *while preparing for or after returning from trip* for the expenses checked in column 1.
- In column 3, write in the amount spent *traveling to and from the site* for the expenses checked in column 1.
- In column 4, write in the amount spent *while at or near the recreation area* for the expenses checked in column 1.

If you are a Morgan County resident, simply report all expenses in column 4. **Please make sure that you include all trip related expenses that you incurred. List each expense once even if it may fall under two categories listed in column 1. Include expenses paid by cash, check, and charge cards. Round all numbers to the nearest whole dollar (for example, round $5.40 to $5.00 and $21.85 to $22).**

Column 1: Type of Expense	**Column 2:** Amount spent while preparing for or after returning from trip	**Column 3:** Amount spent traveling to and from site	**Column 4:** Amount spent while at or near recreation area (or in Morgan County)
Lodging:			
❑ Hotels, motels, bed/breakfast, cabin	_____	_____	_____
❑ Public campgrounds for RV, tent, camper	_____	_____	_____
❑ Private campgrounds for RV, tent, camper	_____	_____	_____
❑ Rental home, cottage	_____	_____	_____
Food and Beverages:			
❑ Food and drinks at restaurants	_____	_____	_____
❑ Food and drinks purchased at convenience stores	_____	_____	_____
❑ Groceries from food store	_____	_____	_____
Transportation:			
❑ Gasoline and oil	_____	_____	_____
❑ Parking fees, tolls	_____	_____	_____
❑ Auto or RV repair and service	_____	_____	_____
❑ Taxi fares	_____	_____	_____
❑ Bus fares	_____	_____	_____
❑ Airline fares	_____	_____	_____
Activities/Entertainment:			
❑ Entrance fees or admission (theaters, bowling, billiards, golf, video games)	_____	_____	_____
❑ Guide services, tours, or outfitters	_____	_____	_____
❑ Other_____	_____	_____	_____
❑ Other_____	_____	_____	_____
Miscellaneous Expenses:			
❑ Film purchases	_____	_____	_____
❑ Film developing	_____	_____	_____
❑ Retail items other than food	_____	_____	_____
❑ Souvenirs, gifts	_____	_____	_____
❑ Personal services (barber, laundry)	_____	_____	_____
❑ Health services	_____	_____	_____
❑ Other_____	_____	_____	_____
❑ Other_____			_____
❑ Other_____			

Equipment Checklist:

Please list all rock climbing equipment that was used (that you brought personally) on the recreational trip during which you were interviewed in column 1. In column 2, check the box that best represents the length of ownership of that piece of equipment. In column 3, indicate the number of that specific piece of equipment that was used.

Column 1: Item	Column 2: Ownership	Column 3: Quantity used
____________	☐ Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rented	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______
____________	Bought more than 12 months ago Bought within last 12 months Bought specifically for this trip Rental	______

Personal Demographics

In the following section of this survey you will be asked questions to help us interpret the results. Your answers are completely voluntary and confidential and results will not be associated with you or anyone in your household.

Please answer the following questions to the best of your ability:

13. What is your current marital status?

- ❑ Single
- ❑ Married
- ❑ Living with life partner
- ❑ Divorced
- ❑ Widowed

14. Are you: ____Female? or ____Male?

15. How many people, other than yourself, currently live in your household? _____

16. Which category best represents your age?

- ❑ Less than 20 years old
- ❑ 20-30 years old
- ❑ 31-40 years old
- ❑ 41-50 years old
- ❑ 51-60 years old
- ❑ more than 60 years old

17. Which category best represents your personal average annual income before taxes in 2001?

- ❑ $0-$9,999
- ❑ $10,000-$19,999
- ❑ $20,000-$29,999
- ❑ $30,000-$39,999
- ❑ $40,000-$49,999
- ❑ $50,000-$59,999
- ❑ $60,000-$69,999
- ❑ $70,000-$79,999
- ❑ $80,000-$89,999
- ❑ $90,000-$99,999
- ❑ More than $100,000
- ❑ Unemployed

18. Which of the following best represents your current educational level?

- ❑ Some high school
- ❑ High school graduate
- ❑ Vocational or Technical School
- ❑ Some college
- ❑ College graduate
- ❑ Graduate degree

19. Are you a member of any rock climbing related clubs or organizations?

- ❑ Yes (if yes, proceed to **question 20**)
- ❑ No (if no, skip to **next page**)

20. Do you pay any yearly dues or membership fees or have you made any other types of contributions to rock climbing related club within the past 12 months?

- ❑ Yes. If so how much per year $_____
- ❑ No

Appendix 4: OHV Mail Survey

TENNESSEE OFF-HIGHWAY VEHICLE SURVEY

THE UNIVERSITY OF TENNESSEE

Human Dimensions Research Lab
Department of Forestry, Wildlife and Fisheries
P. O. Box 1071
Knoxville, Tennessee 37901-1071

YOUR PARTICIPATION in OFF-HIGHWAY VEHICLE USE

1a. Have you or anyone in your household driven or ridden an Off-Highway Vehicle (such as ATV's or 4-wheelers, dirt bikes or dual sport motorcycles, 4-wheel drive trucks and jeeps, sport utility vehicles and rail buggies or dune buggies) for **work or recreational** purposes in the past 12 months?

____ NO→Thank you for your time. Please return the survey in the envelope provided.
____ YES

b. IF YES, how **many people** in your household have used an OHV in the past twelve months, including yourself? _____

c. How many OHV users are **18 years of age or older**? _____

2. Please indicate how many of the following vehicles you **personally own** by whether or not the vehicle is **registered for highway** use:

(Please use "**0**" if none)	# Registered for Highway Use	# Not Registered for Highway Use
a. Off-Highway Motorcycle	_____	_____
b. ATV	_____	_____
c. 4-wheel drive vehicle or truck	_____	_____
d. Rail buggy or dune buggy	_____	_____

3. Please indicate how many of the following vehicles the **other OHV users in your household own** by whether or not the vehicle is **registered for highway** use: (This does not include vehicles listed in Question 2 above that you own.)

(Please use "**0**" if none)	# Registered for Highway Use	# Not Registered for Highway Use
a. Off-Highway Motorcycle	_____	_____
b. ATV	_____	_____
c. 4-wheel drive vehicle or truck	_____	_____
d. Rail buggy or dune buggy	_____	_____

4. Do you use your OHV that you personally own for **work** purposes? (Please **do not** include driving to and from work.)

_____ NO

_____ YES If Yes, what percent of the time do you use your OHV for work/recreation?

_____ % Work _____ % Recreation

5a. Have you **driven or ridden** in an off-highway vehicle in Tennessee for **recreational** purposes during the last 12 months on roads not regularly maintained for public use or over any trails or open terrain?

_____**NO** IF NO, go to **Question 5c then to DEMOGRAPHICS, Q45.**

_____YES

5b. How many **times** have you driven or ridden in each of the following vehicle(s) off-highway for **recreational purposes** during the **last 12 months**?

		# of Times Driven or Ridden
a.	Off-Highway motorcycle	_____
b.	ATV	_____
c.	4- wheel drive vehicle or truck	_____
d.	Rail buggy or dune buggy	_____

5c. Of the **other OHV users** in your household, how many have driven or ridden in this/these vehicle(s) "off-highway" in Tennessee for **recreational** purposes during the last 12 months on roads not regularly maintained for public use or over any trails or open terrain?

_____ # of people or _____ Check if no other OHV users in household.

6. What **places** in Tennessee have you ridden your OHV for recreational purposes in the last **12 months**? List up to **five places** and for the last 12 months please give:
the number of **trips** taken to each site,
the number of **miles you travel** to that site, and
the **average number** of **days per trip** for each place listed.

Area name/trail name	**County**	**#trips**	**#miles**	**# days**
1. _____	_____	_____	_____	_____
2. _____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____
4. _____	_____	_____	_____	_____
5. _____	_____	_____	_____	_____

7. For the OHV area listed above with the most trips, **why do you use it most often**? (Check all that apply.)

_____ It is easy to get to.

_____ It is one of my favorite places to ride.

_____ There is no other place to ride.

_____ I can afford to go there. _____ Other: _____

8. Is there an area where you would **prefer to ride more often** (including areas listed above, areas not listed, or areas that might be closed)?
____Yes ___No (IF NO, go to Q9)

IF YES, What is the **name** of the OHV area?_____

What **county** is this area in? _____

How many **miles** do you live from this area? _____ # miles

Why would you **prefer** to ride this area? _____

9. During the last 12 months, what percent of all your OHV riding was **in Tennessee** versus other states?

Percent of OHV riding in Tennessee? _____%
Percent of OHV riding in other states? _____% (Together they should equal 100%)

10a. For your OHV riding trips, what is your **average length of stay** per trip? (Check one.)

_____ Less than a day. If so, how many hours? _____

_____ More than a day. If so, how many days? _____

b. If you **stay for more than one day** per trip, do you usually:

_____ Camp
_____ Stay in a motel/hotel
_____ Stay with friends

c. If you **camp**, do you usually stay in a: (Please check one.)

_____ Dispersed camping area (essentially no facilities provided)

_____ Private campground (like KOA)

_____ Public campground

11. During a typical trip where you use your OHV for recreational purposes, about how many **hours each day** do you actually ride your OHV? _____ # of hours

12. About what percent of your OHV riding is on **public land versus private land**?

_____% of time on public land _____% of time on private land _____ Don't Know

13. When you ride your OHV on private land, do you **pay a fee**? (Check only one.)

____Never ____Sometimes ____Usually ____Always ____Ride on own land

14. If you own an **ATV** or **off-highway motorcycle**, what **type of riding** do you do? Check all that apply. Please **circle** the type of riding you do **most often.**

___ Do not own an ATV or off-highway motorcycle.

_____ Recreational trailrider, non-competitive
_____ Enduro
_____ Hare scrambles
_____ Track/Motorcross
_____ Trails
_____ Dual sport

15. Please identify the approximate percent of the **time** that you use your Off-Highway vehicles in the general activities listed below. (Each vehicle type you use should add up to 100%.)

Activity	% Off-Highway Motorcycle	% ATV	% 4-Wheel Drive
Competition (racing)	_____	_____	_____
Organized Events	_____	_____	_____
Work	_____	_____	_____
Recreational Trail Riding	_____	_____	_____
Hunting/Fishing	_____	_____	_____
	100%	100%	100%

YOUR PAST EXPERIENCE LEVEL WITH OFF-HIGHWAY VEHICLES

16. In what year did you **first ride** an OHV for recreational purposes? _____ year

17. When did you **purchase your first OHV**? _____ year or _____ I never purchased one.

18. About how many **different places/areas** have you driven an OHV for recreational purposes in your life?
____ 1– 5 ____ 6–10 ____ 11– 25 ____ 26–50 ____ 51–100 ____ more than 100

19. How do you rate your **skill level** in driving an OHV? (Circle the approximate #.)

Novice		Intermediate		Advanced
1	2	3	4	5

20. Have you completed a **safety education** program on off-highway driving?

____ YES ____ NO

IF YES, **In Tennessee**? ____YES ____NO

IF NO, Which state:_____

What **organization** conducted the safety education program?

_____

YOUR OFF-HIGHWAY RECREATIONAL TRIP CHARACTERISTICS

21. Would you say that you "never, sometimes, or always" **ride your OHV:**

(Circle one answer for each statement.)

	Never	Sometimes	Always
Alone	1	2	3
With friends	1	2	3
With family members	1	2	3
With a club	1	2	3
In OHV races	1	2	3
In OHV rides for fund raisers	1	2	3
In other OHV events	1	2	3

22a. On average, how **many people** are usually with your group when you ride your OHV, including yourself? _____ # of people

b. On average, how **many vehicles** are usually with your group when you ride your OHV?

_____ # of vehicles

23. On your OHV riding trips, about **how many** of your group are:

_____ Children 12 and under?

_____ Youth ages 13 to 16?

24. Below is a list of possible **reasons for OHV riding**. Please tell us **how important** each one is to you when you go OHV riding. (Circle the number that best describes how important each reason is to you.)

The OHV allows me to:	Not at all Important	Slightly Important	Somewhat Important	Moderately Important	Extremely Important
Get away from crowds of people.	1	2	3	4	5
Enjoy natural scenery.	1	2	3	4	5
Be with other people who enjoy the same thing as I do.	1	2	3	4	5
Do something challenging.	1	2	3	4	5
To be alone.	1	2	3	4	5
Explore places where I have not been.	1	2	3	4	5
Keep physically fit.	1	2	3	4	5
Meet other people in the area.	1	2	3	4	5
Maintain a desired image of myself.	1	2	3	4	5
Do things my own way.	1	2	3	4	5
Experience excitement.	1	2	3	4	5
Rest mentally.	1	2	3	4	5
Test my vehicle's performance.	1	2	3	4	5
Get away from the demands of life.	1	2	3	4	5
Talk to new and varied people.	1	2	3	4	5
Help me know who I am.	1	2	3	4	5
Learn more about nature.	1	2	3	4	5
Develop my skills and abilities.	1	2	3	4	5
Experience a sense of personal freedom.	1	2	3	4	5
Help me escape from everyday stresses.	1	2	3	4	5
Test my driving skills.	1	2	3	4	5
Be with my friends.	1	2	3	4	5
Share what I have learned with others.	1	2	3	4	5
Reduce depression or anxiety.	1	2	3	4	5
Feel more self confident.	1	2	3	4	5
Feel free.	1	2	3	4	5

25. On any of your OHV trips in the last 12 months have you or anyone riding in your group experienced an **OHV related injury**?

_____ NO

_____ YES, briefly describe the injury:

_____

_____

25a. IF YES, Did any of these injuries require **medical attention** from:

a. Doctor or health care facility? _____ YES _____ NO

b. An emergency evacuation? _____ YES _____ NO

YOUR PREFERENCES FOR OFF-HIGHWAY VEHICLE ACTIVITIES

26. When you use your OHV for recreational purposes, which of the following are **you most interested** in: (Check only one.)

_____ Enjoying the OHV activity itself.

_____ Enjoying the place you are visiting.

_____ Using your OHV as part of another recreational activity.

27. When making a choice of where to drive off-highway do you **generally prefer**: (Please choose one answer in each pair.)

_____ to visit the same area or

_____ to seek different areas?

_____ to be in relatively flat open terrain such as a field or

_____ to be in hilly, mountainous terrain?

_____ to drive on roads and trails with few obstacles or

_____ to drive on rugged steep, rocky roads and trails?

_____ to be on roads and trails that are marked or

_____ to be on roads and trails that are unmarked?

_____ to be on designated roads and trails or

_____ to be off roads and trails?

28. During a typical year when you take OHV trips in Tennessee, do you **participate** in any of the following recreation activities? (Check all that apply.)

_____ Hunting	_____ Picnicking
_____ Animal/bird watching	_____ Swimming
_____ Fishing	_____ Photography
_____ Camping	_____ Horseback riding
_____ Hiking/backpacking	_____ Sightseeing
_____ Just the fun of OHV driving	_____ Mountain Biking

_____ Other: _____

_____

29. Below is a list of **specific management actions** that might be taken to increase OHV opportunities and experiences in Tennessee. Please keep in mind that some management actions will cost more than others. (Circle one number for each item.)

Actions:	Strongly *Oppose*	Somewhat *Oppose*	Neutral	Somewhat *Support*	Strongly *Support*
Provide safe drinking water at OHV access points.	1	2	3	4	5
Provide toilet facilities at OHV access points.	1	2	3	4	5
Provide long distance, overnight OHV riding opportunities.	1	2	3	4	5
Provide OHV play areas.	1	2	3	4	5
Provide signs at trailhead and trail junctions indicating trail length.	1	2	3	4	5
Provide signs at trailheads and trail junctions indicating level of difficulty of trail.	1	2	3	4	5
Require that all OHVs be licensed.	1	2	3	4	5
Use all OHV license fees for an OHV program and management.	1	2	3	4	5
Provide maps of OHV areas and trails at access points.	1	2	3	4	5
Provide more ranger patrols at OHV areas.	1	2	3	4	5
Provide for patrol of OHV areas by local OHV clubs.	1	2	3	4	5
Improve the maintenance of OHV areas and trails.	1	2	3	4	5
Collect a nominal fee from OHV users to support the provision and management of OHV opportunities.	1	2	3	4	5
OHV use on public land should be free.	1	2	3	4	5
Provide OHV loading ramps at parking lot access points.	1	2	3	4	5
Provide parking lots for OHV support vehicle at access points.	1	2	3	4	5
Permit primitive camping at appropriate places along long distance OHV trails.	1	2	3	4	5
Develop additional campsites designed specifically for OHV users.	1	2	3	4	5

YOUR ECONOMIC BENEFITS OF OFF-HIGHWAY VEHICLE USE

30. An important aspect of the public discussion about Off-Highway Vehicle (OHV) use concerns the local economy and the effects different policies may have on it. To improve our understanding, we need to know **what you spend on average** on your OHV trips in Tennessee. The information will be used to calculate the economic effects of "off-highway vehicle use" on state and local economies. Please write down your best estimate of the average of what you spend for each kind of item.

ITEM	**Total for Average Trip**
Lodging:	
Hotels, motels, bed/breakfast, cabin	$_____
Public campgrounds for RV, tent, camper	$_____
Private campgrounds for RV, tent, camper	$_____
Rental home, cottage, camper	$_____
Food & Beverages:	
Food and drinks at restaurant meals (including tips)	$_____
Food and drinks purchased at a convenience store	$_____
Groceries at a food store	$_____
Transportation to OHV Site:	
Rental fees for: RV, trailer, motorcycle, etc.	$_____
Gasoline and oil	$_____
Repair and service for automobile, RV, motorcycle	$_____
Parking fees, tolls	$_____
Other transportation:_____	$_____
Off-Highway Vehicle:	
OHV rental fees	$_____
OHV repairs and service	$_____
Trail use, entry, or parking fees on public land	$_____
Trail use, entry, or parking fees on private land	$_____
Gasoline and oil for OHV	$_____
Other Expenses:	
Entertainment (refreshments, dancing, amusement, etc.)	$_____
Retail goods other than groceries	$_____
Fishing supplies	$_____
Hunting supplies	$_____
Other types of equipment rentals	$_____
Souvenirs	$_____
Other (please list):_____	$_____
_____	$_____

31. How many people, including yourself, do you financially support on an average trip?
____ # of children under 18 _____ # of adults 18 and older

32. Please estimate the amount of money you spent on OHV related expenditures **in Tennessee** during the **last 12 months** for:

OHVs purchased (ATV's/4-wheelers, dirt bikes/dual sport motorcycles, 4-WD Trucks/jeeps, sport utility vehicles and rail buggies/dune buggies) $_____

Repairs $_____

Modifications/upgrades *(special tires, mufflers, controls, engine, etc.)* $_____

Routine maintenance *(engine, shocks, forks, tires, filters, etc.)* $_____

Support vehicles purchased exclusively for OHVs *(trailer, car carrier, etc.)* $_____

Other support equipment purchased exclusively for OHVs *(air compressor, pressure washer, welder, etc.)* $_____

Riding apparel purchased exclusively for OHV activities $_____

Insurance $_____

Membership in OHV clubs or organizations $_____

Other (Please List):_____ $_____

Total OHV Related expenditures in Tennessee in the last 12 months (Add all expenditures listed under this Question (#32) above): $_____

YOUR PROBLEMS IN OFF-HIGHWAY VEHICLE USE AREAS

33. To what extent do you think each of the following is a **problem** in the OHV areas you most frequently use. (Circle one response for each statement.)

Statement:	Not a Problem	Minor Problem	Moderate Problem	Serious Problem
Too many rules and regulations.	1	2	3	4
Too few rules and regulations.	1	2	3	4
Poor communication of rules and regulations.	1	2	3	4
OHV impacts to vegetation.	1	2	3	4
OHV impacts to soil.	1	2	3	4
OHV impacts to wildlife.	1	2	3	4
Temporary closure of the area you most frequently use due to damage.	1	2	3	4
OHV impacts on water.	1	2	3	4
Noise from OHVs.	1	2	3	4
Litter.	1	2	3	4
OHVs travelling too fast.	1	2	3	4
Lack of suitable campsites.	1	2	3	4
Availability of parking places for your support vehicle at access points.	1	2	3	4
Inadequate facilities at campsite.	1	2	3	4
OHV "play" activities like "mudding".	1	2	3	4
Other problems, please list:	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4
_____	1	2	3	4

34. Below is a list of management actions that have been taken in other recreation areas to **reduce visitor conflicts and some environmental impacts**. For each management action, please indicate your level of support or opposition. (Circle one response for each statement.)

Management Actions:	Strongly *Oppose*	Somewhat *Oppose*	Neutral	Somewhat *Support*	Strongly *Support*
Accommodate OHV use on designated and maintained travel routes.	1	2	3	4	5
Educate the visitor on low impact practices.	1	2	3	4	5
Reduce OHV user numbers in recreation areas.	1	2	3	4	5
Modify OHV's design, weight, and/or size to reduce their impact.	1	2	3	4	5
Influence where OHV visitors go.	1	2	3	4	5
Influence time (e.g. season of year) of OHV visitor use.	1	2	3	4	5
Provide regular opportunities for OHV users to meet with recreation management staff about OHV management issues.	1	2	3	4	5

SATISFACTION OF OFF-HIGHWAY VEHICLE USERS

We would like to know your **satisfaction** with OHV opportunities, management, and experiences in Tennessee. Please consider all of your visits, not one particular place or day.

35. Please circle the response which best describes your own feelings about **OHV opportunities** in Tennessee.

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
1	2	3	4	5

36. Please circle the response which best describes your own feeling about **OHV management** in Tennessee.

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
1	2	3	4	5

37. Please circle the response which describes your own feelings about your **OHV experiences** in Tennessee.

Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied
1	2	3	4	5

ENVIRONMENTAL AWARENESS

38. We would like to get your opinion on a wide range of **environmental issues**. For each of the following statements, please indicate the extent to which you **agree or disagree**. (Circle your appropriate answer for each statement.)

Statements:	Strongly Agree	Somewhat Agree	Unsure	Somewhat Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	1	2	3	4	5
Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
When humans interfere with nature it often produces disastrous consequences.	1	2	3	4	5
Human ingenuity will insure that we do NOT make the earth unlivable.	1	2	3	4	5
Humans are severely abusing the environment.	1	2	3	4	5
The earth has plenty of natural resources if we just learn how to develop them.	1	2	3	4	5
Plants and animals have as much right as humans to exist.	1	2	3	4	5
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	1	2	3	4	5
Despite our special abilities humans are still subject to the laws of nature.	1	2	3	4	5
The so-called "ecological crisis" facing humankind has been greatly exaggerated.	1	2	3	4	5
The earth is like a spaceship with very limited room and resources.	1	2	3	4	5
Humans were meant to rule over the rest of nature.	1	2	3	4	5
The balance of nature is very delicate and easily upset.	1	2	3	4	5
Humans will eventually learn enough about how nature works to be able to control it.	1	2	3	4	5
If things continue on their present course, we will soon experience a major ecological catastrophe.	1	2	3	4	5

POTENTIAL STATE OFF-HIGHWAY VEHICLE PROGRAM

Next, we would like to know your opinions about a **POTENTIAL** State Off-highway Vehicle Program in Tennessee.

39. Do you support or oppose:

	Strongly *Oppose*	Somewhat *Oppose*	Neutral	Somewhat *Support*	Strongly *Support*
a. One-time OHV operator safety certification?	1	2	3	4	5
b. Annual Off-Highway Vehicle registration fee?	1	2	3	4	5
c. A state government program to develop and maintain OHV areas?	1	2	3	4	5
d. A state government program to encourage agreements by the private sector to open some of their lands to OHV use?	1	2	3	4	5
e. Public/private partnerships to develop and manage OHV opportunities in Tennessee?	1	2	3	4	5
f. A non-governmental body or organization facilitating and managing the provision of OHV opportunities in Tennessee?	1	2	3	4	5

40. How much would you be willing to **pay per vehicle per day** to use an OHV area if those fees go back into maintenance and management of the area?

____Nothing at all _____$5.00 _____$7.50 _____$10.00 _____$15.00 ____$20.00

41. How much would you be willing to **pay per vehicle for a yearly fee** to use an OHV area if those fees go back into maintenance and management of the area?

___Nothing at all ___ $20.00 ___ $30.00 ___ $40.00 ___ $50.00 ___ $75.00

42. How much would you be willing to **pay for an annual license fee** for your OHV if those fees were earmarked to develop OHV areas and an OHV safety training and education program in Tennessee?

___Nothing at all ___ $20.00 ___ $30.00 ___ $40.00 ___ $50.00 ___ $75.00

43. We are interested in learning **where** you believe **money for a POTENTIAL** Off-Highway Vehicle Program should be spent. Please indicate whether each of the following items should be a Low, Medium, or High priority.

	Low Priority	Medium Priority	High Priority
Plan, develop and acquire land for new OHV area(s).	1	2	3
Maintain and restore existing OHV areas and trails.	1	2	3
Support facilities for OHV areas such as loading ramps, washing areas, parking lots, campgrounds, etc.	1	2	3
Information programs such as area/route maps, signing of trails and access points.	1	2	3
Safety and environmental education programs such as OHV driving, OHV safety inspection, low impact training, and environmental awareness.	1	2	3
Volunteer program.	1	2	3
Fee collection program.	1	2	3
Law enforcement/patrol.	1	2	3
Special event management.	1	2	3

44. Do you support or oppose:

	Strongly *Oppose*	Somewhat *Oppose*	Neutral	Somewhat *Support*	Strongly *Support*
a. The requirement that **children wear helmets** while driving/riding an ATV or motorcycle?	1	2	3	4	5
b. The requirement that **adults wear helmets** while driving/riding an ATV or motorcycle?	1	2	3	4	5

DEMOGRAPHICS

Finally, we would like to know some general information about you and your family in order to make comparisons among the many kinds of visitors to public lands in Tennessee. Remember that all information is voluntary and confidential and will not be identified with your name. You may refuse to answer any questions.

45. What county do you live in? _____ County

46. What is your zip code? _____

47. What is your age? _____

48. What is your gender? ____ Male ____ Female

49. Which of the following best describes your ethnic origin?

_____ White
_____ African-American
_____ Hispanic
_____ Native American
_____ Asian-American or Pacific Islander
_____ Other _____

50. What is your present marital status?

_____ Single _____ Married _____ Separated/Divorced _____ Widowed

51. How many children do you have under 18? _____ # of children

52. How many people live in your household in the following age groups?

_____ under 15 _____ 15-24 _____ 25-54 _____ 55 – 64 _____ 65 or older

53. What is the highest grade of school that you completed?

____ 8th grade or less
____ 9th - 11th grade
____ High school graduate or GED
____ Trade/vocational school
____ Some college
____ College graduate
____ Post-graduate degree
____ Other: _____

54. In which of the following kinds of places did you **spend the <u>most</u> time while growing up to age 18?** (Please check only <u>one</u> answer.)

_____ On a farm or ranch.
_____ In the country, but not on a farm or ranch.
_____ Small town (2,500 or fewer people).
_____ Town or small city (between 2,500 and 25,000 people).
_____ City (between 25,000 and 100,000 people).
_____ Suburb of a large city.
_____ Large city (over 100,000 people).

55. When you were growing up, did your **parents or close relative** use an Off-Highway Vehicle for transportation or enjoyment?
_____Yes _____No

56. Do you **own 10 acres** or more of land in Tennessee? _____Yes _____ No

Do you **allow OHV recreation** on your property? _____Yes _____ No

If YES, do you **charge a fee** for OHV recreation on your property? _____Yes _____ No

57. Do you currently belong to any of the following kinds of **organizations**?
(Please check all that apply.)

_____ Conservation-protection groups, such as the Audubon Society or the Sierra Club.

_____ Wildlife conservation groups, such as Ducks Unlimited.

_____ Fish conservation groups like Trout Unlimited.

_____ Rod and gun clubs.

_____ Motorcycle clubs.

_____ Dune-buggy clubs.

_____ Jeep and four-wheel drive owners' associations.

_____ ATV clubs.

58. From the list above, please write in the **name of the organization** in which you are most active. _____

59. In what type of community do you **now live**?

_____ On a farm or ranch.

_____ In the country, but not on a farm or ranch.

_____ Small town (2,500 or fewer people).

_____ Town or small city (between 2,500 and 25,000 people).

_____ City (between 25,000 and 100,000 people).

_____ Suburb of a large city.

_____ Large city (over 100,000 people).

60. What is your current **occupation**? (Mark only one.)

_____ Manager or executive	_____ Sales Worker
_____ Professional worker	_____ Service Worker
_____ Owner of business or farm	_____ Unemployed
_____ Skilled trade or craft	_____ Retired
_____ Semi-skilled worker, laborer	_____ Student
_____ Clerical or office worker	_____ Homemaker
_____ Permanently disabled	_____ Other (Please **List**):_____

61. What is your current **job title**? _____ ?

62. Do you consider yourself to be a:

_____ Republican _____ Democrat _____ Third-party _____ Independent

63. Which of these intervals includes your total **household income** from all sources before taxes during 2000. (Check the appropriate category.)

_____ under $10,000	_____ $10,000 - $19,999	_____ $20,000 - $24,999
_____ $25,000 - $29,999	_____ $30,000 - $39,999	_____ $40,000 - $49,999
_____ $50,000 - $74,999	_____ $75,000 - $100,000	_____ More than $100,000

Thank you for your participation in this survey!

If there are any further comments you wish to make, please use the space below.

Appendix 5: OHV Telephone Survey

OHV PHONE SURVEY
(Computer Programmed)

Hello, this is _____ calling from The University of Tennessee. We are conducting a study about Off-Highway Vehicle (OHV) recreational activities and their economic impact in Tennessee.

a. Have you or anyone in your household driven or ridden an Off-highway vehicle (such as ATV's or 4-wheelers, dirt bikes or dual sport motorcycles, 4-wheel drive trucks and jeeps, sport utility vehicles and rail buggies or dune buggies) for work or recreational purposes in the past 12 months?

_____ NO, Thank you for your time and have a good evening.
_____ YES

b. [IF YES] How many people in your household have used an OHV in the past twelve months including yourself? _____

c. Of those _____ people, how many are 18 years of age or older? _____

d. Of those _____ people, May I please speak to the person who is **the primary OHV user** in the household?

(IF ONLY 1) Are you 18 years of age or older? IF YES, continue?
IF NO, Thank you very much.

(IF NEW PERSON – REPEAT INTRODUCTION)

This study is being conducted for a Committee appointed by Governor Sundquist to develop recommendations for a potential OHV recreation program in Tennessee. Your participation in this study is very important to understanding the activities and views of people who use OHVs for work and recreational purposes. Your participation is voluntary. Your responses are confidential and will not be associated with your name. You may refuse to answer any question at any time.

First I would like to ask you some questions about you and your family's participation in Off-highway vehicle recreation activities in Tennessee.

(Off-highway vehicle is defined as an ATV or 4-wheeler, dirt bike or dual sport motorcycle, 4-wheel drive truck or jeep, sport utility vehicle, a rail buggy or dune buggy)

1. A. How many of the following OHV vehicles do you personally own, if any, that are: ____ None?
registered for highway use:
not registered for highway use:

(Please use "**0**" if none)	# Registered for Highway Use	# Not Registered for Highway Use
a. Off Highway Motorcycle	_____	_____
b. ATV	_____	_____
c. 4-wheel drive vehicle or truck	_____	_____
d. Rail buggy or dune buggy	_____	_____

2. How many of the following vehicles do the other ___(# Question b –1) OHV user(s) in your household own, if any, that are:

Registered for highway use: ____None ?
Not registered for highway use:

(Please use "**0**" if none)	# Registered for Highway Use	# Not Registered for Highway Use
a. Off Highway Motorcycle	_____	_____
b. ATV	_____	_____
c. 4-wheel drive vehicle or truck	_____	_____
d. Rail buggy or dune buggy	_____	_____

3. Do you use the OHV(s) that you personally own for work purposes? (Please do not include driving to and from work).

_____ NO

_____ YES If Yes, what percent of the time do you use your OHV for work/recreation?

___%Work

___%Recreation

---

4. Have you driven or ridden in an off-highway vehicle or OHV in Tennessee for recreational purposes during the last 12 months on roads not regularly maintained for public use or over any trails or open terrain?

_____NO IF NO, go to Question 4b then to Question 20.

_____YES

4a. (IF YES) How many times have you driven or ridden in each of the following vehicle(s) off-highway for recreational purposes during the last 12 months?

	Individual - # of times driven or ridden
a. Off-highway motorcycle	_____
b. ATV	_____
c. Four wheel drive vehicle or truck	_____
d. Rail buggy or dune buggy	_____

IF NO OTHER OHV USERS IN HOUSEHOLD, GO TO Q5.

IF ONLY ONE OTHER OHV USER IN HOUSEHOLD, SAY

4b. Did the other OHV user in your household drive or ride in an off-highway vehicle or OHV in Tennessee for recreational purposes during the last 12 months on roads not regularly maintained for public use or over any trails or open terrain?

___ YES ___NO ___Don't Know

IF THERE ARE THREE OR MORE OHV USERS IN THE HOUSEHOLD

4c. Of the other ___(# from Question b. in introduction) OHV users in your household, how many have driven or ridden in an off-highway vehicle in Tennessee for recreational purposes during the last 12 months on roads not regularly maintained for public use or over any trails or open terrain?

_____ # of people

5. What is the name of the OHV area that you use most often?

_____

6. What county is that in? _____
7. How many miles do you live from this area? _____ Miles
8. How many trips have you taken to this site in the last 12 months? _____ # of Trips
9. Why do you ride in this area most often? *(open ended)*

_____ It is easy to get to.

_____ It is one of my favorite places to ride.

_____ There is no other place to ride.

_____ I can afford to go there. _____ Other _____

10. Is there an area where you would prefer to ride more often, including areas that might be closed?

___Yes ___No

11. IF YES, What is the name of the OHV area that you would prefer to use? _____

What county is that in? _____

How many miles do you live from this area? _____ Miles

Why would you prefer to ride this area? _____

12. Overall, how many trips have you taken for OHV recreational purposes in the last twelve months where you traveled more than 25 miles to your OHV area? _____ number of trips

Next, I would like to ask you a few questions about the trips you take using your OHV for recreational purposes.

13. Would you say that you "never, sometimes, or always" ride your OHV:

	Never	Sometimes	Always
alone	1	2	3
with friends	1	2	3
with family members	1	2	3
with a club	1	2	3
in Off-Highway Vehicle races or events	1	2	3
in Off-Highway Vehicle rides for fund raisers	1	2	3

14. a. On average, how many people are usually with your group when you ride your OHV? _____ number of people

b. On average, how many vehicles are usually with your group when you ride your OHV?_____ number of vehicles

Now I would like to ask you a few questions about your OHV activity preferences.

15. When you use your OHV for recreational purposes, which of the following are you most interested in: *(Choose one)*

_____ Enjoying the OHV activity itself.

_____ Enjoying the place you are visiting.

_____ Using your OHV to get to another recreational activity.

16. During a typical year when you take OHV trips in Tennessee, do you participate in any of the following recreation activities? (yes/no)

_____ Hunting

_____ Animal/birdwatching

_____ Fishing

_____ Camping

_____ Hiking/backpacking

_____ Just the fun of OHV driving

_____ Picnicking

_____ Swimming

_____ Photography

_____ Horseback riding

_____ Sightseeing

_____ Other _____

17. When making a choice of where to drive off-highway do you generally prefer:(*Choose one in each pair)*

_____ to visit the same area or

_____ to seek different areas?

_____ to be in relatively flat open terrain such as a field, or

_____ to be in hilly mountainous terrain?

_____ to drive on roads and trails with few obstacles, or

_____ to drive on rugged steep, rocky roads and trails?

_____ to be on roads and trails that are marked, or

_____ to be on roads and trails that are unmarked/unknown?

_____ to be on designated roads and trails or

_____ to be off roads and trails?

Next, I would like to ask your opinions about a **POTENTIAL** State Off-highway Vehicle Program in Tennessee.

18. Do you support or oppose:

		Strongly *Oppose*	Somewhat *Oppose*	Neutral	Somewhat *Support*	Strongly *Support*
a.	One-time OHV operator safety certification?	1	2	3	4	5
b.	Annual Off-Highway Vehicle registration fee?	1	2	3	4	5
c.	A state government program to develop and maintain OHV areas?	1	2	3	4	5
d.	A state government program to encourage agreements by the private sector to open some of their lands to OHV use?	1	2	3	4	5
e.	Public/private partnerships to develop and manage OHV opportunities in Tennessee?	1	2	3	4	5

22. We are interested in learning where you believe money for a **POTENTIAL** Off-highway Vehicle Program should be spent. Please tell me whether each of the following items should be a low, medium, or high priority. (Rotate items below)

_____ Plan, develop and acquire land for new OHV area(s)

_____ Maintain and restore existing OHV areas and trails

_____ Develop support facilities for OHV areas such as loading ramps, washing areas, parking lots, campgrounds, etc.

_____ Information programs such as area/route maps, signing of trails and access points

_____ Safety and environmental education programs such as OHV driving, OHV safety inspection, low impact training, environmental awareness, low impact training

_____ Volunteer program

_____ Fee collection program

_____ Law enforcement/patrol and special event management

Finally, we would like some information about you and your family. This information will only be used for statistical purposes to make general statements about the types of people who are Off-highway recreationists. Remember that **all information is voluntary and confidential, and will not be identified with you name.**

23. What county do you live in? _____ County

25. What is your zip code? _____ Zip Code

25. What is your age? _____ yrs.

26. Gender? _____ Male _____ Female

27. Which of the following best describes your ethnic origin?

_____ White

_____ Black

_____ Hispanic

_____ American Indian

_____ Asian or Pacific Islander

28. What is the highest grade of school that you completed?

1 8 years or less
3 High school graduate (12)
4 Trade/vocational school
5 Some college (13-15)
6 College graduate (16)
7 Post-graduate (17+)
8 Other **(SPF)** _____
9 Refused

29. In what type of community **do you <u>now</u> live**?
_____ on a farm or ranch
_____ in the country but not on a farm or ranch
_____ a small town (2,500 or fewer people)
_____ a town or small city (between 2,500 and 25,000 people)
_____ a city (between 25,000 and 100,000 people)
_____ a suburb of a large city
_____ a large city (over 100,000 people)

30. I am going to read you a list of income categories for household income from all sources before taxes during 2000. Please stop me when I get to yours.

1	Under $10,000
2	$10,000 to $19,999
3	$20,000 to $24,999
4	$25,000 to $29,999
5	$30,000 to $39,999
6	$40,000 to $49,999
7	$50,000 to $74,999
8	$75,000 to $100,000
9	More than $100,000
10	Don't know **[DNT RD]**
11	Not reported/refused

31. That completes the OHV survey that we do by phone, however, the Tennessee OHV Committee needs additional information about your OHV activities and preferences for state OHV planning purposes. Would you be willing to participate in a mail survey for the OHV Planning Committee?
_____ NO
_____ YES - In order to send you our mail survey, I need to get your
Name:_____
Address:_____
City:_____ State_____

32. Do you have any additional comments for the Off-highway Vehicle Planning Committee about Off-highway Vehicle use in Tennessee? (Interviewer will type in comments)

Thank you for your participation in this survey.

Vita

Charles Boyd Sims was born in Knoxville, Tennessee on December 20, 1978 to Mr. Boyd and Alice Sims. Charles attended South-Doyle High School where he graduated in 1997. Charles entered the University of Tennessee, Knoxville in 1997 and graduated with a Bachelor of Science degree in Forest Resource Management in 2001. In January of 2002, he entered the Master's program at the University of Tennessee, Knoxville. Charles received his Master of Science degree in Forestry in 2004.