Modeling Visitor Acceptance of a Shuttle System in the Great Smoky Mountains National Park

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Prepared for Submission to:
Journal of Park and Recreation Administration

August 2005

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Acknowledgements: Thanks to Christian Vossler of the Department of Economics at the University of TN for helpful comments on model functional form. Thanks to Kelley Segars for providing insight into the transportation management process that faces the Great Smoky Mountains National Park. Partial funding for the study was provided by the Tennessee Agricultural Experiment Station, National Parks Conservation Association, Tennessee Environmental Council, American Rivers, and Tennessee Clean Water Network.
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Executive Summary

Visitation to the Cades Cove area of the Great Smoky Mountains National Park has grown approximately 300 percent in the last 20 years and has doubled since 1990. Approximately 2 million people visited Cades Cove in 2000, with 57 percent of this use occurring in the peak months of June-August and October (National Park Service, 2003). The 11-mile one-way loop road through the Cove is operating in a near gridlock condition through much of this time. Covering the 11 miles through the cove can take up to 4 to 6 hours as visitors block traffic by stopping in the middle of the road to view flora and fauna and take pictures. The impact of this high level of visitation on the quality of visitor experience, park resources, and facility capacity are of significant concern to park officials.

Other national parks faced with similar issues have opted for greater access restrictions in favor of quality improvements resulting from less traffic congestion. Acadia National Park, Grand Canyon National Park, Yellowstone National Park, and Zion National Park have all instituted various shuttle systems to alleviate traffic congestion common during certain parts of the year. However, based on public perception of how national parks are visited, the establishment of such shuttle systems could potentially result in greater impact on visitor experience than that resulting from the increase in traffic congestion.

While public sentiment to reduce traffic congestion in Cades Cove has been great, transportation management has been a key point of contention, especially the proposed mandatory shuttle alternative. Some have argued that the cost of the proposed shuttle system is too great and that access to the area by private vehicles should not be limited. Others counter
that the value they receive from their visit is being compromised due to increased traffic congestion. This study attempts to model the acceptance of a proposed shuttle system by Tennessee residents to determine how many/who supports a mandatory shuttle system in Cades Cove and the value residents place on reduced traffic congestion by way of a shuttle system. A random digit dial telephone survey was conducted to garner opinions on the use of a mandatory shuttle system to alleviate traffic congestion in Cades Cove. In addition, a dichotomous choice contingent valuation question was also posed to survey respondents to determine the value of reduced traffic congestion in Cades Cove. Results indicate that support for a mandatory shuttle system may be higher than first thought and that the value of reduced traffic congestion is significant.

KEYWORDS: shuttle system, contingent valuation, dichotomous choice, traffic congestion
Introduction

The U.S. National Park Service (NPS) is charged with protecting and preserving this nation’s natural and cultural resources for future generations. However, protection and preservation of these areas is becoming increasingly difficult as more and more visitors flock to national parks. For example, in 2002, there were over 275 million recreational visits to the national park system (National Park Service, 2003). This increasing popularity presents substantial management challenges as park managers are forced to balance visitor access with resource protection.

During peak seasons at many national parks, visitors attempting to view the park are met with gridlock on the roads and lack of parking at popular destinations. As a result, time spent visiting a national park is often spent sitting in traffic or searching for nonexistent parking. Lack of parking often results in visitors parking along the road or in grassy areas creating a safety concern for park officials and damage to potential sensitive habitats. Such a situation is increasingly commonplace in many of the “crown jewels” of the national park system. National Park Service units such as Acadia National Park in Maine, Grand Canyon National Park in Arizona, Yosemite National Park in California, and Zion National Park in Utah are all experiencing increased visitation coupled with outdated infrastructure needed to accommodate these additional visitors. While road improvements and increased parking facilities would surely ease traffic congestion problems in the short term, many national parks are unwilling or unable to accept this solution and are looking for a more long term answer. For example, the limited size of Acadia National Park led park officials to decline a road improvement strategy. Other larger parks experience traffic congestion problems in one geographic area of the park, such as
Yosemite Valley, which limits expansion of roads and parking facilities that service that heavily visited area.

One answer to the traffic congestion problem facing many national parks is visitor transportation systems. Visitor transportation systems (VTS) utilize buses, light rail, and water-based transportation to provide access to heavily used areas and/or gateway communities. Yosemite has instituted a bus service in the heavily used Yosemite Valley area to alleviate gridlock and parking shortages. During the peak season, around 6,000 vehicles enter the valley per day (Dona, 1999). Acadia National Park faces a slightly different situation. Acadia is the only national park in the heavily populated New England area. It is also relatively small by NPS standards; containing only about 46,000 acres spread over three geographic units (Bobinchock, 1999). In addition, unlike many national parks in the western U.S., visitor services are provided by surrounding gateway communities instead of the NPS. This results in visitors entering and leaving the park numerous times a day. Because of these conditions, Acadia has employed both Intelligent Transportation Systems and a voluntary bus system to serve the needs of visitors, the gateway community, and the park itself.\(^2\) Zion National Park has gone as far as banning private vehicles from the park during the historically high visitation periods. Visitor access is maintained through the use of propane-powered vehicles during the peak tourist season.

However, the implementation of such VTS systems is contradictory to the way visitors have been experiencing the national park system in the past (Percival, 1999). Visitors are accustomed to being able to experience the national parks with the freedom provided by the automobile. Requiring visitors to access national parks by means of a shuttle bus causes visitors to change their expectations of how the park is to be accessed. Such a change in expectations

\(^2\) Intelligent Transportation Systems (ITS) utilize traffic detectors, weather sensors, computer databases, and variable message signs to alert park visitors to road conditions, closures, travel times, and available parking.
can cause visitors to resist such changes in access. The Great Smoky Mountains National Park (GSMNP) is a good example of such a change in visitor expectations. As the most visited national park in the country, park managers are faced with a transportation problem that includes approximately 12 million visitors annually, a large amount of local traffic traveling through the park, and a number of large gateway communities each of which have their own traffic congestion problems. An alternative fuel bus system is currently being considered to alleviate traffic problems in and around the most popular areas of the park and is meeting some resistance from local residents accustomed to visiting the park by automobile (Butler, 2003; O’Briant, 2002).

As the NPS establishes formal programs and mechanisms for the implementation of VTS in the national park system, a number of questions arise. First, where is VTS truly needed and appropriate? Second, how will visitor expectations of a park experience affect its acceptance and therefore its successful implementation? Finally, what will visitors expect of the VTS? The purpose of this paper, therefore, is to evaluate visitor acceptance of a proposed shuttle system in and around the heavily visited Cades Cove area in the Great Smoky Mountains National Park. Using a random household telephone survey of Tennessee residents, we obtained opinions on the use of a shuttle system in the Cades Cove area. We also utilized a basic contingent valuation scenario to value the use of a shuttle system in an overall traffic management plan. Contingent market behavior was modeled for households in an attempt to identify patterns of shuttle acceptance. In addition, a traditional measure of consumer surplus was estimated. We argue that

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3 Due to a recent Memorandum of Understanding between the Department of Transportation and Interior, funding and planning for transportation projects in the national parks have significantly increased. The current authorization bill, known as the Transportation Equity Act for the 21st Century (TEA-21), provides $940 million for park roads and parkways in addition to requiring more comprehensive transportation planning.
acceptance of a shuttle system may be higher than previously thought and that some visitors may even place a value on having a shuttle system present.

**Great Smoky Mountains National Park – A Case Study**

According to the National Park Service, the Great Smoky Mountains National Park, located in Eastern Tennessee and Western North Carolina, is the most visited national park in the country. Home to some of the greatest diversity of flora and fauna in the continental United States and conveniently located amidst large urban areas, the Great Smoky Mountains National Park has become one of the most popular tourist destinations in the United States. With visitation to national parks on the rise, the Great Smoky Mountains National Park faces the difficult task of preserving cultural and natural resources while providing positive visitor experiences for an increasing number of visitors. Park officials are particularly concerned about crowding issues in the most heavily used Cades Cove area.

Cades Cove is a large valley surrounded by tall ridges that provides both a natural experience as well as an opportunity to visit numerous historical sites located throughout the valley. The Cades Cove area is preserved as a time capsule of historic resources and structures that represent the early settlement period of the 19th through early 20th centuries. Visitors are encouraged to drive through Cades Cove by way of an 11 mile one way road that allows visitors to view the natural beauty of the area, wildlife, and historic resources such as cemeteries, cabins, cantilever barns, and a gristmill.

If Cades Cove were considered its own National Park, it would be in the top ten most visited national parks in the country according to GSMNP spokesperson Bob Miller. Visitation in Cades Cove has grown approximately 300 percent in the last 20 years and has doubled since
1990. Approximately 2 million people visited the Cove in 2000, with 57 percent of this use occurring in the peak months of June-August and October (National Park Service, 2003). Due to this influx of visitors, the 11-mile one-way loop road through the Cove is operating in a near gridlock condition through much of this time. The impact of this high level of visitation on the quality of visitor experience, park resources, and facility capacity are of significant concern to park officials.

Public sentiment to reduce traffic congestion and preserve Cades Cove is strong; however, opinions on the use of a shuttle system have been divided (O’Briant, 2002). While many feel that private automobiles should be prohibited from Cades Cove in order to enhance the natural area and reduce air and noise pollution, others feel that a shuttle system would be unnecessary and restrictive and prefer other courses of action such as improved signage and road widening. Based on focus groups conducted by the NPS and the Knoxville Regional Transportation Planning Organization, many local residents have a strong attachment to the area and are opposed to any proposal that limits their ability to visit the area privately. In addition, the costs of implementing a shuttle system for Cades Cove are great. The inclusion of a shuttle system in an overall traffic management plan is expected to increase costs by at least three times (National Park Service, 2003). Local residents have created the Coalition to Save Cades Cove, which is opposed to many of the proposed management changes in Cades Cove. The group insists that local residents are opposed to the management changes including the proposed transit system and that such changes are unnecessary (Butler, 2003).4

At this time the first round of public hearings concerning the future management of Cades Cove have concluded. Based on public input, each alternative is currently being outlined

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4 An opinion survey distributed by the Coalition to Save Cades Cove reports that 98% of respondents oppose the use of a shuttle system in Cades Cove. One purpose of this study was to determine if opposition to the shuttle was as high as reported and if opposition was largely local.
in greater detail. The next step is the development of a Draft Environmental Impact Statement. Public input will again be sought and will be incorporated into a Final Environmental Impact Statement.

**Contingent Valuation and Non-market Goods and Services**

Natural resources (forests, river systems), environmental attributes (air and water quality), and environmental services (nitrogen cycling, carbon sequestration) are valuable assets in that they provide goods and services to the public. In a normal market setting these goods and services would have a price that the public would be required to pay in order to enjoy their benefits. However, because these environmental goods all exhibit public good characteristics, the public is free to consume these goods freely without the restrictions imposed by a representative price. Because the supply and demand of goods and services in our society is controlled by the invisible hand of market influences, the absence of price results in an inefficient allocation of these resource and environmental goods. Economists often use the term negative externality to describe such a misallocation. Thus, these goods are referred to as non-market goods in that the supply and demand of these goods is not controlled by a representative market. It is the failure of the market system to allocate and price resource and environmental goods and services correctly that creates the need for economic measures of values to guide policymaking.

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5 A public good is nonexcludable and nondepletable. In other words, once the good has been provided to one individual, others cannot be prevented from making use of the good, and one person’s use does not diminish use by another individual.
6 According to Freeman (1993), externalities arise when a real variable chosen by one individual affects the utility or production function of another individual and there is no requirement or incentive for the first individual to take the effect on others into account when making choices.
Contingent valuation (CV) is one of the most widely used methods for measuring values associated with non-market commodities (Bateman & Turner, 1993; Mitchell & Carson, 1989). The basic premise of contingent valuation is that the individual possesses clearly defined preferences for goods and services. Therefore, an individual’s response to a hypothetical market scenario (if truthful) reveals direct expressions of value and would be interpreted as a measure of compensating surplus. These measures can then be used as a representative price in policy evaluation. One of the goals of this research is to identify a price for reductions in traffic congestion that can then be used to fully evaluate transportation policy in the GSMNP.

While the National Park Service has recently encouraged management to reduce traffic congestion in national parks, previous literature has not attempted to value such traffic reductions in a national park setting. However, an abundance of research has been undertaken to value traffic reductions in an urban setting. For example, Killi and Samstad (2002) employed an open-ended contingent valuation approach to value reductions in traffic congestion and driving time among various transportation corridors in and around Oslo, Norway. Participants were intercepted at random along designated transportation corridors and were asked to participate in a contingent valuation survey over the internet. Calculated willingness to pay (WTP) for reductions in travel time totaled 28 Norwegian Kroner (NOK) or approximately $4. Willingness to pay for reductions in traffic congestion was estimated at 42 NOK or approximately $6. Due to the abundance of protest responses and the nature of web-based surveys, the authors’ conclude that their sample of survey respondents have a lower WTP for reduced traffic congestion than the population average.

Painter et al. (2000) administered a CVM questionnaire to a panel of local Washington state residents in order to determine the value of rural transit. Willingness to pay was estimated

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7 Compensating surplus is a measure of the value of an environmental change based on substitutability.
for improvements in the existing transit system as well as an estimate of willingness to accept (WTA) for the removal of the existing transit system. In addition, Tobit analysis was performed to test for relationships between relevant explanatory variable and the perceived benefit. As is the case with many public goods, income was found to be insignificant in the formulation of perceived benefits. Willingness to pay per month for an improved transit system was found to be $9.30 while the value of the existing system was found to be $7.06. Willingness to accept if the transit system were no longer provided was estimated at $45.42.

Another related vein of research has been the role of congestion in the valuation of recreation benefits. Cichetti and Smith (1973, 1976) were the first to use the contingent valuation approach to measure the effect of congestion on WTP. A negative relationship between congestion and recreational benefits has been found in several subsequent studies using variations of this model (Berrens et al., 1993; McConnell, 1977; Prince & Ahmed, 1988). In one such study, Walsh et al. (1983) estimated a willingness to pay function for ski resort access in which congestion was treated as a quality variable. The survey, comprised of 236 responses at three different ski resorts in Colorado, asked skiers to report their maximum WTP for lift tickets contingent on changes in lift line wait and slope congestion. Responses were solicited using an iterative bidding process in which respondents are presented with bid amounts based on positive or negative responses to previous bid amounts. Willingness to pay functions were estimated using both lift line wait and slope congestion as quality variables. With no lift line wait or slope congestion, WTP was found to range between $15 to $22 with all other variables held at their means. Such a drastic change in measurable quality is comparable to complete reductions in traffic congestion posited under a shuttle system in Cades Cove. Furthermore, these results
demonstrate the significant increases in WTP, which are possible with such drastic changes in perceived quality.

Survey Design

The survey was designed to obtain opinions on various issues concerning air and water quality in Tennessee. Pre-testing of the survey instrument was performed by completing an initial phone survey to check for clarity and understanding of the survey questions. Based on the results of this pre-test, wording of specific survey questions was altered to increase understanding; however, no questions were omitted. Eight questions were devoted entirely to water quality issues while thirteen questions focused on air quality in the state. Of these, three were devoted to air pollution concerns in the GSMNP. In addition, five questions were devoted entirely to the issue of traffic congestion in the Cades Cove area of the park. While the primary focus of this research is based on these five questions, other questions were used to develop attitudinal and socio-demographic variables.

Once respondents reached the section on traffic congestion, they were asked when they last visited the park. This was done to identify users and non-users of the park. Following this question, respondents were read a short description of the traffic congestion problem in Cades Cove along with a short description of the proposed shuttle system:

*Traffic congestion is a major problem in the Great Smoky Mountains National Park, particularly on the Cades Cove Loop Road. One alternative to reduce congestion is an alternative fuel shuttle system that would transport visitors around the Loop Road, allowing them to stop at any point to view the Cove, hike, or participate in a number of other activities.*

The shuttle description was kept purposefully vague for two reasons. First, details of the proposed shuttle have not yet been finalized. Second, the good being valued is the quality
improvements resulting from a reduction in traffic not the shuttle itself. By stating that the shuttle is mandatory, the shuttle’s effect on traffic congestion in Cades Cove is apparent, thereby giving the respondent a clear picture of the good being valued. The shuttle in this instance is merely the payment vehicle. Exposing the respondent to specific details of the shuttle risks “no” responses to the WTP question that may be based on protest to specific shuttle attributes. In order to keep any bias associated with the payment vehicle to a minimum, specific details of the shuttle were omitted from the survey. Opinions on shuttle details were solicited in a later question.

In order to determine the overall support for a shuttle system, respondents were then asked if they would support a shuttle system if it cost them nothing. Responses from this question were intended to supplement the contingent valuation question by adding a $0 bid amount and identifying the presence of possible negative WTP. However, many respondents that answered “no” to the $0 bid amount answered “yes” to higher bid amounts. These inconsistencies are likely due to respondents expressing a preference for a preferred alternative and do not necessarily represent a $0 willingness to pay. For instance, this question could easily be answered “no” if a respondent preferred an alternative method to traffic reduction such as road improvements or a reservation system. It is likely that some respondents do not support a shuttle (no answer to the $0 bid question) but do place a value on reduced traffic congestion by way of a shuttle system (yes to higher bid amounts). Responses to the $0 bid question clearly indicate public support for a shuttle system. However, it is unclear whether these same responses really represent $0 WTP for a shuttle since it is possible for a respondent to prefer another alternative while still having a positive WTP for the reduction in traffic congestion that would occur under the proposed shuttle plan. Due to these inconsistencies and the unclear intent
of these responses in the dichotomous choice framework, $0 bid amount responses were omitted from the formation of WTP estimates thereby eliminating the possibility of negative WTP.

Respondents were then posed a single-bounded dichotomous choice contingent valuation question to value aggregate benefits resulting from reduced traffic congestion as a result of the proposed shuttle system. Four bid amounts ($5, $10, $15, $20) were randomly assigned to subsets of the survey sample. Previous research provided little insight into the selection of bid amounts for reduced traffic congestion in a national park. However, a great deal of literature is available on the value of travel-time savings (although this remains controversial) and reduced traffic congestion in municipal areas. Therefore, bid amounts were based on value estimates of reductions in various transportation attributes from previous research (e.g., Killi & Samstad, 2002; Painter et al. 2000). Under the current plan, the NPS would collect fees for a shuttle system on a per vehicle basis (National Park Service, 2003). Respondents were asked to choose the bid amount that best represented their willingness to pay per vehicle. Therefore, bid amounts and WTP were calculated on a per vehicle basis as opposed to the standard WTP per person. Those that indicated they would be willing to pay nothing were then asked to indicate why in order to identify protest bids.

As stated earlier, one of the main concerns over the use of a shuttle system is how the shuttle would operate. Some of the main points of contention have been i) should park service employees provide interpretive information along the trip, ii) how often and where should the shuttle stop, and iii) should the shuttle operate all year or only during peak seasons. In order to address public opinion on these issues, respondents were asked to rate the importance of these issues.
Survey data for the study was collected from randomly chosen households throughout the state of Tennessee. The random digit dial (RDD) survey was conducted via telephone from September 15 to September 24, 2003. Telephone numbers for the survey were purchased from Survey Sampling, Inc. in Fairfield, CT. The use of RDD survey methods reduces possible sampling error by including non-listed numbers. Respondents 18 years of age or older were randomly chosen from the household using the most recent birthday method. A total of 403 interviews were completed for a 15.6% response rate. Such a low response rate indicates the possible presence of non-response bias and sample selection bias. Treatments for these possible forms of bias will be discussed in the following section.

Research Methods

The dichotomous choice value elicitation method was used to elicit WTP values for reduced traffic congestion as a result of a shuttle system in the Cades Cove area. This procedure asks individuals to indicate whether or not they would be willing to pay a specified amount to reduce traffic congestion by using a shuttle system to access the Cades Cove area. The model for analyzing the dichotomous choice data is based on the willingness to pay function (Cameron & James, 1987). This function can be derived from the expenditure function as follows:

\[ W(q^0, q^l, u^0, X) = e(q^0, u^0, X) - e(q^l, u^0, X) \]

where \( q^0 \) represents quality at the current level of traffic congestion, \( q^l \) represents quality at the reduced level of traffic congestion, \( X \) is a vector of individual characteristics and utility is held
constant at \( u_0 \). The individual will respond yes to the dichotomous choice question given a bid level of \( Z \) if

\[
W(q_0^0, q_1^1, u_0^0, X) \geq Z
\]

and will respond no otherwise. The probability of accepting the offer of reduced traffic congestion (\( q_1^1 \)) at the given bid level \( Z \) can be expressed as such

\[
\Pr(Yes) = \Pr[W^*(q_0^0, q_1^1, u_0^0, X) - Z > \nu]
\]

where \( W^* \) is the observable component of the bid function and \( \nu \) is the unobservable random component of WTP. By varying bid amounts equally among individuals, a cumulative density function (CDF) of bid amounts can be estimated by specifying a functional form (Kanninen, 1995; Alberini, 1995).

Common econometric problems such as omission of relevant explanatory variables and misspecification of the functional relationship between the dependent and explanatory variables can lead to formation of questionable conclusions. A number of demographic explanatory variables were included in model specification including age, education, gender, and income. All were found to be insignificant at the 5% level and were excluded from the final model. In addition to demographic information, a number of attitudinal variables concerning air pollution in the GSMNP were also tested for significance in the regression model. The threat of air pollution on visitor’s health (rated from 1=Not a threat to 4=High threat) was the only
attitudinal variable found to be significant and was the only explanatory variable other than the bid amount included in the model.

In order to gain insight for the appropriate functional form, the nonparametric approach suggested by Kristöm (1990) was employed for the dichotomous choice data. Such nonparametric approaches estimate dichotomous choice data without specifying a functional form by assuming the distribution function is piece-wise linear between price points. These results provide valuable insight into the selection of a parametric distribution but are limited in their interpretation of the data. Likewise, various parametric approaches including logistic, log-logistic, and Weibull were also employed to estimate the dichotomous choice data and determine the most appropriate functional form. Comparison of the three parametric distributions and the nonparametric distribution can be seen in Figure 1.

The nonparametric welfare estimates suggest that the distribution of WTP is asymmetric (mean > median). Therefore, common distributions such as normal and logistic may not fit the data well. Welfare estimates based on a log-logistic approach produced mean WTP estimates that were unrealistically large. The Weibull distribution was finally settled on because it is asymmetric and produced mean and median WTP results similar to those of the nonparametric estimates. The probability of a yes response based on the Weibull distribution is

$$\Pr(\text{yes}) = e^{-\alpha} e^{\beta \ln(bid)} e^{\beta \text{health}}$$

where $\alpha$ is the intercept and $\beta$ is the coefficient on the covariates. The resulting likelihood function can be expressed as
\[ \ln L = \sum \left\{ Y_i \ln\left(e^{-e^{-\alpha - \beta \ln(bid_i)} - \beta \text{health}} \right) + (1-Y_i)\ln\left(1-e^{-e^{-\alpha - \beta \ln(bid_i)} - \beta \text{health}} \right) \right\} \]

where \( Y_i = 1 \) if \( \text{WTP}_i \geq bid_i \) (Poe and Vossler, 2002).

The Kolmogorov-Smirnov goodness of fit test (Smirnov Test) is often used to test for differences in underlying distributions and is a good procedure for testing the applicability of specific parametric distributions when a nonparametric distribution is known (Conover, 1980). This test was employed to determine if the Weibull and nonparametric distributions were indeed equal. The test is based on the Kolmogorov-Smirnov D-statistic

\[ D_{K-S} = \max \left| N(x) - W(x) \right| \]

where \( N(x) \) and \( W(x) \) depict the nonparametric and Weibull distributions, respectively. In applying the Kolmogorov-Smirnov goodness of fit test to the two distributions, the approximation for the critical \( D \) value is 0.0852. Based on these findings, we accept the hypothesis of equal distributions beyond the 5% significance level further supporting the use of a Weibull distribution.

Mean and median WTP estimates were calculated by integrating under the empirical CDF. Based on the Weibull distribution, mean and median WTP was calculated in the following manner

\[ \text{Mean WTP} = e^{\alpha/\beta} \Gamma\{1-(1/\beta)\} \]
\[ \text{Median WTP} = e^{\alpha/\beta}(\ln 2)^{-1/\beta} \]

\(^8\) The test was performed using only the densities at survey bids.
Summing over all offered prices yields the estimate of mean WTP for the nonparametric specification

\[
\text{Mean WTP} = \sum (t_{j+1} - t_j)(1 - \{(F_j + F_{j+1})/2\})
\]

where \( t \) represents the bid level and \( F \) represents the probability of a no response. Median WTP for the nonparametric approach is found by solving the representative probability function for 0.5. Bounds on mean and median WTP estimates for the parametric specification were calculated using the Krinsky and Robb method (1986) with 1,000 random draws calculated at 95%. Under the Krinsky and Robb method, multiple random drawings of the regression coefficients are made from a multivariate normal distribution. Willingness to pay is calculated with the coefficients from each of these drawings and an empirical distribution is constructed from the set of WTP values. Confidence intervals for the nonparametric specification are calculated in the basic manner using standard errors (Haab & McConnell, 1997).

As stated earlier the survey barely exceeded a 15% response rate leading to concerns over non-response bias. Non-response bias stems from over- or under-representation of certain segments of the population. In other words, respondents and non-respondents are significantly different with respect to characteristics such as age, education, gender, and income. For this study, non-response bias would be present if the demographics of the randomly chosen sample differed from the population of the state of Tennessee. In order to alleviate the effects of non-response bias, data were weighed by age and gender to be representative of the population (Daleckiet al. 1993; Loomis, 1987). This approach computes a weighted average based on
population proportions. The weights used to correct for differences between sample and population proportions are

\[ W_i = \frac{N_i}{S_i} \]

where \( N_i \) is the population proportion of the \( i \)th stratum or the critical variable in question, \( S_i \) is the sample proportion of the \( i \)th stratum, and \( W_i \) is the weight applied to observations occupying the \( i \)th stratum. Overall results have a +/-5% margin of error calculated at a 95% confidence interval.

An additional concern attributed to a low response rate is the presence of sample selection bias and in particular avidity effects. Avidity effects occur when households with high interest in an issue are more likely to respond to a survey about that issue even though their observable demographic characteristics do not differ from the rest of the population (Mitchell & Carson, 1989; Loomis & King, 1994). In our case, this may occur, as frequent visitors to the park are more likely to complete the survey than are non-visitor. In order to test for this bias, an additional dummy variable was included in the regression analysis to determine if visitor responses differed from non-visitor responses. This variable was found to be insignificant and was excluded from the final model.

Due to the perceived local opposition to a shuttle system in Cades Cove, it is important to determine how this local group’s responses may differ from other residents of the state. This can in turn be considered an additional form of sample selection bias as local residents may be more willing to take the time to complete the survey than nonlocal residents. In order to identify this “local resident” effect, respondents who lived in a seven county area around the Great Smoky
Mountains National Park were identified through use of a dummy variable (1=local resident; 0=not local resident). This variable was found to be insignificant in the determination of WTP responses indicating that local resident support for a shuttle system was no different than support statewide. Thus, this variable was omitted from the final model.

**Results**

From this sample of Tennessee residents, over 86% indicated that they had visited the park at some time. Exactly 75% of those surveyed indicated they supported a free mandatory shuttle system and over 51% indicated they would pay a fee to use a mandatory shuttle system. Results from questions concerning the implementation of the shuttle system are presented in Table 1. Respondents were also asked about the importance of various shuttle attributes. Many opponents of the shuttle system have indicated they feel a great sense of personal freedom from being able to visit Cades Cove in private vehicles and that a shuttle system would limit their ability to enjoy Cades Cove. This sentiment was reflected in survey responses. Having the shuttle stop at designated sites along the Loop Road appears to be the most important aspect of the shuttle system to survey respondents. In response to this public input, the National Park Service has indicated that any shuttle system in Cades Cove will be constructed so as to allow visitors to exit the shuttle at any time. Careful attention to public input on shuttle attributes can do a great deal to increase acceptance of a shuttle system if such an alternative is deemed appropriate. Results of questions concerning shuttle attributes can be seen in Table 2.

Table 3 shows the results of the Weibull maximum likelihood regression. As can be seen, the dichotomous choice bid amount is highly significant in explaining WTP responses at

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9 Residents of Blount, Cocke, Jefferson, Knox, Loudon, Monroe, and Sevier counties are all within an hours drive of the Great Smoky Mountains National Park and are considered local residents.
the 1% level. As expected, the coefficient is also negative meaning that as the bid amount increases respondents are less likely to answer yes to the WTP question. The coefficient on visitor health was also found to be significant at the 1% level indicating that respondents that felt that air pollution was a threat to visitor health were more likely to answer yes to the WTP question.

Median WTP for various quality improvements resulting from the implementation of a shuttle system in Cades Cove was estimated to be $12.86 per vehicle for the nonparametric approach and $14.76 per vehicle assuming a Weibull distribution. The mean WTP was found to be higher at $17.10 per vehicle for the nonparametric approach and $19.87 assuming a Weibull distribution. The significant magnitude of the mean value in relation to the median value indicates the presence of a large tail at the upper end of the distribution. In fact, only 58% of those surveyed responded no to the highest bid amount. These extreme values at the upper end of the distribution are likely due to hypothetical bias in that “hypothetical questions, particularly about donations to generally desirable goods, seem to engender overestimates of actual WTP.” (Brown et al. 1996). The finding of no significant income effects supports the presence of hypothetical bias even further. In other words, respondents were likely to report a higher WTP than they would have under the budget constraints present in an actual market scenario. This would place more validity in the median WTP value as this measure is less affected by these questionable extreme values. Mean and median WTP estimates can be found in Table 4.

The National Park Service estimates that the average number of people riding in each vehicle on the Loop Road is 2.55. This translates into a WTP per person for quality improvements from a shuttle system of approximately $5 to $6. Because our data have been weighed by age and gender to be representative of the general population, the resulting WTP
value can be generalized to the entire Tennessee population as characterized by the 2000 Census. This translates into over $32 million in consumer surplus for the quality improvements resulting from the implementation of a shuttle system. According to the National Park Service, initial cost estimates for the implementation of a shuttle system range from $66 to $72 million (National Park Service, 2003). Based on these limited findings and the addition of annual operating costs, it is difficult to conclude whether the benefits of the shuttle system would outweigh the costs. However, it is important to remember that these consumer surplus estimates represent only Tennessee residents and are likely to be much higher when all visitors are considered.

**Conclusions**

Three conclusions can be made from this study. First, a significant majority of individuals surveyed indicated support for a free, mandatory shuttle system along the Loop Road in Cades Cove. This support is assuredly much higher than anticipated and should encourage further discussion of the implementation of a shuttle system to alleviate traffic congestion in Cades Cove. Second, support for a shuttle decreased significantly when a fee was included. While the amount of support still constitutes a majority at over 51%, inclusion of the margin of error could potentially lower support even further. If the National Park Service were to charge a fee for a mandatory shuttle system, visits to Cades Cove could be expected to decrease substantially. Third, the potential benefits resulting from the implementation of a shuttle system were significant. If all residents of the state of Tennessee are assumed to potentially posses both use and/or nonuse values for Cades Cove, the total consumer surplus resulting from the implementation of a shuttle system in Cades Cove is around $32 million.
However, the exact impact of a shuttle system is unknown. While it is expected that a shuttle system would reduce cars in Cades Cove thereby reducing congestion, automobile exhaust and impacts to visitors and wildlife, it is impossible to know to what extent these problems will be reduced. Respondents are likely basing these estimates on the expectation that most if not all of these problems will be eliminated. Therefore, these estimates are based on the implementation of a shuttle system that effectively addresses these issues in Cades Cove.

Due to inconsistencies in survey responses noted earlier, it was necessary to truncate WTP at $0. Such an approach assumes that no respondent posses a negative WTP. In other words, the benefits gained from reduced traffic congestion outweigh any costs incurred as a result of the shuttle system. While this is a reasonable assumption based on the large amount of support for a shuttle system, this approach does effectively ignore respondents that place a higher value on unrestricted access over reduced traffic congestion, and potentially biases WTP estimates upwards. This issue highlights the importance of identifying potential negative WTP in valuation scenarios that involve a trade-off between access and quality improvements.

It is important to remember that these estimates do not represent the value of Cades Cove by respondents. Due to the payment vehicle, many respondents that do value the Cades Cove area are likely to have answered “no” to the WTP question because they are opposed to a shuttle system. These estimates merely estimate the value that respondents place on the quality improvements that they anticipate resulting from the implementation of a shuttle system. It is also important to note that these estimates are only for Tennessee residents. As the value of out-of-state visitors is included, the benefits of a shuttle system are likely to be much higher.

Readers are cautioned against applying these results to public lands in general or National Park Service lands as a whole. These results are based on perceptions of traffic congestion at a
heavily used area in a heavily used national park. It is unlikely that such values exist for reduced traffic congestion in less visited national parks. In these less visited areas, respondents would likely value unrestricted access over slight reductions in traffic; thus, reiterating the need to evaluate traffic management on public lands on a case-by-case basis. However, these results do provide a basis for the value of reduced traffic congestion in heavily used national parks.

In response to increased visitation and deteriorating infrastructure, recent efforts by the Departments of Transportation and Interior have resulted in increased funding for transportation alternatives on public lands. The Transportation Equity Act for the 21st Century has resulted in increased funding for the Parks Road and Parkways Program from $84 million to $165 million annually. However, only $5 million to $15 million per year out of this $165 million is allocated to alternative transportation planning such as VTS. Perhaps more importantly than the specific results, these research findings indicate a more general finding of increased acceptance of alternative transportation planning on public lands. With 75% of those surveyed indicating support for a free mandatory shuttle system, it appears as if visitors to popular public lands are accepting the idea of exceeded caring capacity under our current visitation trends and methods. While increased transportation funding for public lands is a step in the right direction, it appears that the accepted trend of more roads and more parking lots in our nations national parks may no longer be the preferred alternative by the visiting public.
References


Figure 1: Cumulative Density Function

- Nonparametric
- Weibull
- Log-logistic
- Logistic

Bid vs. Prob(No)
Table 1: Results of selected questions on a mandatory shuttle system in Cades Cove

"Would you support or oppose a mandatory shuttle system if there was no fee for parking and riding?"

<table>
<thead>
<tr>
<th></th>
<th>Support</th>
<th>Oppose</th>
<th>Other</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=401)</td>
<td>301</td>
<td>65</td>
<td>10</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>75.0%</td>
<td>16.1%</td>
<td>2.5%</td>
<td>6.2%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

"If a shuttle system was put in place and if a fee was necessary to help pay for the cost of operation, would you be willing to pay ($5, $10, $15, $20) per vehicle to use the shuttle system?"

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Other</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=401)</td>
<td>207</td>
<td>162</td>
<td>5</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>Percentage</td>
<td>51.6%</td>
<td>40.5%</td>
<td>1.2%</td>
<td>6.6%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

"People aren't willing to pay for several reasons. Why are you not willing to pay?"

<table>
<thead>
<tr>
<th></th>
<th>Cost too much</th>
<th>Should be free</th>
<th>Opposed to shuttle</th>
<th>Other</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=162)</td>
<td>68</td>
<td>8</td>
<td>11</td>
<td>66</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>42.0%</td>
<td>4.9%</td>
<td>6.8%</td>
<td>40.7%</td>
<td>4.9%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>
Table 2: Importance of Shuttle Attributes (1=Not at all important; 5=Extremely Important)

"Have someone on the shuttle to provide information and answer questions about Cades Cove."

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=392)</td>
<td>41</td>
<td>33</td>
<td>80</td>
<td>77</td>
<td>151</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>10.5%</td>
<td>8.4%</td>
<td>20.4%</td>
<td>19.6%</td>
<td>38.5%</td>
<td>2.3%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

"Make frequent stops at designated intervals for people to get on and off."

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=392)</td>
<td>10</td>
<td>24</td>
<td>51</td>
<td>91</td>
<td>207</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>2.6%</td>
<td>6.1%</td>
<td>13.0%</td>
<td>23.2%</td>
<td>52.8%</td>
<td>2.0%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

"Have a system that is implemented only during peak use periods, such as April thru October."

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Don't Know</th>
<th>Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (n=392)</td>
<td>30</td>
<td>36</td>
<td>91</td>
<td>97</td>
<td>123</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>7.7%</td>
<td>9.2%</td>
<td>23.2%</td>
<td>24.7%</td>
<td>31.4%</td>
<td>3.3%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>
Table 3: Weibull Regression Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Std Error</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.5617</td>
<td>0.1898</td>
<td>0.0000</td>
</tr>
<tr>
<td>Bid</td>
<td>-1.1000</td>
<td>0.5392</td>
<td>0.0000</td>
</tr>
<tr>
<td>Health</td>
<td>0.2754</td>
<td>0.0877</td>
<td>0.0017</td>
</tr>
</tbody>
</table>

n=346
Log Likelihood = -211.18
Likelihood Ratio = 48.20
Table 4: Willingness to Pay Estimates and Confidence Intervals*

<table>
<thead>
<tr>
<th></th>
<th>Nonparametric</th>
<th>Weibull</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>$12.86 ($11.67, $14.05)</td>
<td>$14.76 ($12.41, $17.10)</td>
</tr>
<tr>
<td>Mean</td>
<td>$17.10 ($15.91, $18.28)</td>
<td>$19.87 ($13.82, $25.92)</td>
</tr>
</tbody>
</table>

*confidence intervals calculated at 95% using Krinsky and Robb (1986) method