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Estimating the Economic Value of National Parks with Count Data Models Using On-Site, Secondary Data: The Case of the Great Sand Dunes National Park and Preserve

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Abstract We estimate an individual travel cost model for Great Sand Dunes National Park and Preserve (GSD) in Colorado using on-site, secondary data. The purpose of the on-site survey was to help the National Park Service better understand the visitors of GSD; it was not intended for a travel cost model. Variables such as travel cost and income were estimated based on respondents' Zip Codes. Following approaches found in the literature, a negative binomial model corrected for truncation and endogenous stratification fit the data the best. We estimate a recreational benefit of U.S. $89/visitor/year or U.S. $54/visitor/24-h recreational day (in 2002 U.S. $). Based on the approach presented here, there are other data sets for national parks, preserves, and battlefields where travel cost models could be estimated and used to support National Park Service management decisions.

Keywords Travel cost model · On-site sampling · National Parks · Consumer surplus

This paper estimates the economic value of outdoor recreation to visitors of Great Sand Dunes National Park and Preserve in Colorado using on-site, survey data. Public land management agencies, such as the National Park Service (NPS) and the Federal Highway Administration, Office of Federal Lands Highway, can use the economic values of outdoor recreation to improve management and investment decisions. This information can be used to help quantify the trade-offs (i.e., gains and losses) of land management decisions, efficiently target infrastructure investments, and support budget allocation decisions.

The NPS (2000, p. 11) has an interest in nonmarket valuation studies stemming from their mission, which states that they must make decisions by "integrating social, economic, environmental, and ethical considerations into the decision-making process." Economic valuations, such as the present study, integrate all these considerations as demonstrated by the behavior of park visitors. Providing a federal agency like the NPS with benefit estimates of outdoor recreation helps support analyses related to Natural Resource Damage Assessments, as well as proving the effectiveness of federal programs related to the Government Performance and Results Act of 1993 (Kaval and Loomis 2003). Of course, a study focused on park visitors cannot produce a complete value of the park. It excludes nonrecreational ecological services and the value of the park to the many people who may never visit, but enjoy the park's existence.

Unfortunately, surveys of national park visitors appropriate for this type of analysis are rare (e.g., see NPS [2002] for conducting surveys at national parks). Lacking such surveys, the NPS has combined the limited number of outdoor recreation studies conducted at various national parks and applied them to the valuation of national parks in general using the benefit transfer method (Kaval and Loomis 2003; Kaval 2007). Kaval and Loomis (2003) estimated the outdoor recreation values by activity and region per person per day using 1239 estimates from 539

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studies. Of those 1239 estimates, 49 were for national parks (3 in Alaska, 29 in the Intermountain Region, 11 on the Pacific Coast, 6 in the Southeast, and 0 in the Northeast).

Benefit transfer uses existing economic value studies and applies them to new sites (Desvousges and others 1998). It is often used by economists facing time and budget constraints or restrictions on primary data collection. However, benefit transfer studies sometimes can be deceiving when applied to a unique resource that is not comparable to the resource for which the original studies were conducted. This may be the case with national parks since, by definition, they are unique national treasures. Since there are a limited number of studies for national parks, the NPS benefit transfer results may be biased (Kaval and Loomis 2003).

Another approach employed when facing time and budget constraints is to use secondary data and develop models to estimate the economic value of a national park, but finding secondary data that include all the relevant variables is difficult. However, the NPS already has a vehicle for gathering information on visitors to national parks. We propose that existing data sets on the opinions and characteristics of visitors to national parks provide enough information to estimate a travel cost model, a revealed preference method for estimating use values related to outdoor recreation.

The travel cost model uses travel expenditures as a proxy for the market price to estimate the demand for outdoor recreation (Hanley and Spash 1993; Freeman 1993). It was initially developed as a way to estimate the value of national parks in a 1947 letter by Harold Hotelling (Hanley and Spash 1993; Haab and McConnell 2002). The first travel cost model used a zonal approach (Haab and McConnell 2002). This approach defines zones or political units around the site, with each zone represented by aggregate data (Hellerstein 1995). For example, visitation rates for each zone are related to average travel costs and other zonal variables (e.g., average income based on Zip Code or county). The individual travel cost model, as opposed to the zonal approach, uses the number of trips a visitor or individual takes to a particular site for a set time period as the dependent variable in the model. The number of trips is assumed to be a function of travel expenditures, time, and socioeconomic variables. The individual travel cost model offers several advantages: it improves statistical efficiency and it does not require the restrictive assumption of homogeneous populations in each zone (Bowker and others 1996; Haab and McConnell 2002). However, as Herath and Kennedy (2004) point out, the individual travel cost model requires significant variation in trips. The data needed for the individual travel cost model are typically more difficult and expensive to collect (Hellerstein 1995).

We chose Great Sand Dunes National Park and Preserve (GSD) in Colorado to illustrate the travel cost model using secondary data. This research supports an ongoing U.S. Environmental Protection Agency (U.S. EPA) project related to sustainability issues in the San Luis Valley, CO. This park began as a national monument in 1932. The monument was created to preserve the tallest dunes in North America from gold and sand mining (NPS 2007b). The Great Sand Dunes National Park and Preserve Act of 2000 nearly quadrupled the size of the original Great Sand Dunes National Monument. The preserve was created from ~16,187 ha (40,000 acres) of wilderness transferred from the U.S. Forest Service to protect the natural system that affects GSD (NPS 2007a).

While we follow the standard methodology for estimating travel cost models, this paper adds to the limited valuation literature for U.S. national parks. We also present an approach that potentially increases the amount of economic information available for NPS decision-making. Although the U.S. EPA focus is on GSD, economists could take advantage of approximately 183 similar, in-depth visitor surveys that are publicly available online (VSP 2007; Margaret Littlejohn, personal communication) for different units of the NPS (e.g., national preserves, monuments, historic sites, and battlefields).

The paper proceeds as follows: first, we describe the survey and data collected by the Visitor Services Project (VSP). Then we present the travel cost model and its related issues. Next we describe the variables for the model specification and limitations when using the data source, then present the results. The Discussion and Conclusion follows.

Data Collection

To better understand the visitors at units of the NPS, it started the VSP at the University of Idaho Cooperative Park Studies Unit in 1982 (VSP 2007). The project has conducted many similar visitor studies for units of the NPS across the country. Questions can include demographics (e.g., age, Zip Code, number of trips), travel expenditures, activities, opinions, etc. Decisions on the final questions are based on an on-site workshop with park staff (VSP 2007). The results of the questionnaires provide visitor information that improves the management of the parks.

During June 23–29, 2002, the VSP surveyed visitor groups at GSD (Le and Littlejohn 2003). The VSP used a systematic random sample as visitors entered the park entrance station. Participants heard a description of the project through 2-min interviews (Le and Littlejohn 2003). Group size, group type, and age of the adult who would complete the questionnaire were recorded during the interviews; this allows for examining nonresponse bias (see Le and Littlejohn 2003). A reminder/thank you postcard was sent to the adult 2 weeks after the survey. At 4 and 7 weeks after the initial survey recruitment, replacement questionnaires were sent to those who had not returned a completed survey. A total of 479 surveys were distributed, with respondents returning 364 questionnaires for a 76% response rate (Le and Littlejohn 2003).

The survey asked visitors where they received their information about the park, how the visit fit into their travel plans, the purpose of the trip, access points of the park, their awareness of the "Great Sand Dunes National Park and Preserve Act of 2000," and other places visited in addition to the park. It also asked about how much time was spent at the park, overnight stays and location, type of personal group, characteristics of group members including age, Zip Code, number of visits in the past 12 months, lifetime visits to the park, number of visitors in group, disabilities of group members, race, safety concerns, the use of visitor services and facilities by the group, and the quality of these services and facilities. The purpose of this survey was not to estimate a travel cost model, but by supplementing these data and managing responses we are able to estimate the value of national park visits without having to develop and implement new surveys.

Methods

The VSP elicited the number of trips taken to GSD in the past 12 months and over a lifetime. The number of trips is always a nonnegative integer, or count data, and we follow the standard approach for estimating the individual travel cost model (e.g., Shaw 1988; Englin and Shonkwiler 1995; Hellerstein and Mendelsohn 1993; Cameron and Trivedi 1998). This approach is not new; many examples of this method can be found in the literature. For example, Poor and Breece (2006) estimate the value of charter fishing on the Chesapeake Bay, Hesseln and others (2003) examine the demand for mountain biking in New Mexico, and Loomis and others (2000) study the demand for whale watching trips in California. Examples of studies focused on national parks include those by Haspel and Johnson (1982) and Mendelsohn and others (1992), who both use the same data set for Bryce Canyon National Park; Kerkvliet and others (2002), who value the trout fishery in Yellowstone National Park; and Martínez-Espiñeira and Amoako-Tuffour (2007), who estimate the value of Gros Morne National Park in Newfoundland.

Travel Cost Model

The travel cost model is defined as

$$Trips_i = f(\mathbf{s}_i; \boldsymbol{\beta}) + \epsilon_i \qquad (1)$$

where $Trips_i$ is the number of observed trips that the ith visitor would take to the national park in a specific time period; $\mathbf{s}_i$ is the vector of explanatory variables for the ith visitor including travel costs to the site, income, age, type of trip, group size, travel costs to substitute sites, etc.; $\boldsymbol{\beta}$ is a vector of unknown parameters; and ϵ_i is the error term.

The most recognized models for count data are the Poisson regression model and negative binomial regression model (Greene 1992; Cameron and Trivedi 1998). For the Poisson,

$$\Pr(TRIPS_i = Trips_i) = \frac{e^{-\lambda_i}\lambda_i^{Trips_i}}{Trips_i!}, \quad Trips_i = 0, 1, 2, \ldots \qquad (2)$$

$Trips_i$ is drawn from a Poisson distribution with conditional mean and variance equal to $\lambda_{\mathrm{i}} = \exp(\mathbf{s}_i\boldsymbol{\beta})$ (i.e., conditional on $\mathbf{s}_i$, the vector of explanatory variables). The equality of the mean and variance suggests a type of heteroskedasticity; because data are typically not equidispersed, other models are sometimes needed (Cameron and Trivedi 1998).

Negative binomial models are based on different variance functions to avoid the assumption of equidispersion (i.e., presence of overdispersion in the data). Multiple versions of the negative binomial model can be estimated depending on the relationship of the mean to the variance (Haab and McConnell 2002). For example, LIMDEP estimates the NB2 model under its preprogrammed analysis (Greene 1998). The variance function has a quadratic relationship to the mean under this model

$$Var[Trips_i|\mathbf{s}_i] = \lambda_i + \alpha\lambda_i^2 \qquad (3)$$

where α is a scalar parameter to measure dispersion. As $\alpha \to 0$, the NB2 collapses to a Poisson model.

There are several statistical issues to consider when using on-site data. Since all respondents are actual visitors to the park, their number of trips taken in the past 12 months is always greater than 0 or zero-truncated. Zero-truncation is a problem because it causes biased and inconsistent estimates and overstated consumer surplus estimates (Shaw 1988; Creel and Loomis 1990; Grogger and Carson 1991). In addition, visitors who take more trips to the park are more likely to be sampled (Shaw 1988; Englin and Shonkwiler 1995). This is a problem of endogenous stratification that, if uncorrected, would create inference problems and lead to overstated welfare estimates (Ovaskainen and others 2001; Haab and McConnell 2002; Martínez-Espiñeira and others 2006; Martínez-Espiñeira and Amoako-Tuffour 2007). To correct for truncation and endogenous stratification in the Poisson model, the dependent variable is transformed to equal $d_i = Trips_i - 1$ (for details see Shaw 1988; Haab and

McConnell 2002). Englin and Shonkwiler (1995) developed the truncated, endogenous stratified negative binomial model. The log-likelihood function is

$$\ln L = \sum_{i=1}^{n} [\ln Trips_i + \ln(\Gamma(Trips_i + \alpha^{-1})) - \ln(Trips_i!) - \ln(\Gamma(\alpha^{-1})) + Trips_i \ln \alpha + (Trips_i - 1)\ln \lambda_i - (Trips_i + \alpha^{-1})\ln(1 + \alpha\lambda_i)] \quad (4)$$

where $E[Trips_i|\mathbf{s}_i] = \lambda_i + 1 + \alpha_i\lambda_i$ and $Var[Trips_i|\mathbf{s}_i] = \lambda_i(1 + \alpha_i + \alpha_i\lambda_i + \alpha_i^2\lambda_i)$. The model is not easily estimable (Haab and McConnell 2002) and a number of approaches exist for estimating the scalar factor, α.

We consider three models that are corrected for truncation and endogenous stratification (using the terminology of Martínez-Espiñeira and Amoako-Tuffour [2007]): (1) the Poisson model (TSP), (2) a standard negative binomial model where α does not vary with the visitors' characteristics (TSNB), and (3) a generalized negative binomial approach developed by Martínez-Espiñeira and Amoako-Tuffour (2007), where α is a function of demographic variables (GTSNB). Shaw (1988) proposed and Englin and Shonkwiler (1995) first applied the generalized negative binomial used by Martínez-Espiñeira and Amoako-Tuffour. Although the models are corrected for truncation and endogenous stratification, we still need to consider the presence of overdispersion. We expect that the TSP will overestimate the significance of the variables and underestimate consumer surplus because the data are not equidispersed (similar to Martínez-Espiñeira and Amoako-Tuffour 2007).

Model Specification

Before we estimate the count data models, limitations of the data set require us to create new variables. Like other national parks, GSD has many one-time or infrequent visitors. Thus, most observations of $Trips_i$, the standard dependent variable in these types of models, are equal to 1. However, each survey represents a decision by a group to visit the park (only 7% of the respondents traveled alone). In order to accurately represent the number of trips reflected by the surveys, we multiply trips by group size to calculate the dependent variable, $Persontrips_i$. Therefore, one trip by a group of three visitors would be the same as three trips by one visitor. This transformation also has the benefit of adding variation to the dependent variable (e.g., Bowker and others 1996; Bhat 2003; Martínez-Espiñeira and Amoako-Tuffour 2007).

To create independent variables that are required for this type of model, we rely on respondents' Zip Codes. In effect, we combine individual data from the original survey with zonal information. First, travel costs were not asked in the questionnaire and we must estimate costs based on round-trip distance and entrance fees. We follow the approach used in the computer program ZipFip to calculate distance (Hellerstein and others 2003). The "great circle algorithm" is used to estimate the direct or straight-line distance between the latitude and the longitude of the center of the Zip Code provided in the questionnaire. Next, we use a circuitry factor to convert the straight-line distance to road distance, where we average the circuitry factors of the starting state and Colorado based on the ZipFip approach (Hellerstein and others 2003). For visitors who traveled from a Colorado Zip Code, we use a factor of 1.28.

Round-trip distance is multiplied by U.S. \$0.227/km (U.S. \$0.365/mile), which is based on the reimbursement rate for 2002 set by the Internal Revenue Service (IRS 2001). No information is available on how the visitor traveled to the national park, so we assume that all travelers face the same cost per kilometer. Additional variation could be created by making an assumption about the distance traveled and the type of transportation used (e.g., see Bhat 2003). There is also a U.S. \$3 entrance fee to enter the national park that we include in *Travel Cost*. Additional variation could be created by using other entrance fees based on assumptions such as an annual pass based on the number of trips or senior pass based on the respondent's age.

Like *Travel Cost*, the traveler's income was not asked in the questionnaire. We supplement the data set using the mean household income (in 10,000 U.S. dollars) calculated by Zip Code for the 2000 U.S. Census. *Income* is adjusted for inflation to 2002 U.S. dollars using the consumer price index.

The remaining independent variables are based directly on the questionnaire responses. Although the travel cost model assumes a single purpose trip (Haab and McConnell 2002), there are approaches to avoid dropping multidestination trips or multipurpose trips. Martínez-Espiñeira and Amoako-Tuffour (2007) and Bhat (2003) drop multiple-purpose trips from their sample; however, given the small sample size, we do not have enough observations to drop. We include variables based on the work by Parsons and Wilson (1997), Loomis and others (2000), and Loomis (2006). The questionnaire specifically asks whether respondents traveled to the GSD as the primary destination, one of several destinations, or an unplanned destination. Following Loomis and others (2000), we use a dummy variable for several destinations (*SDT*) and a dummy variable for unplanned trips (*UNP*). Loomis (2006, p. 50) defines these incidental trips as "spur-of-the moment stops at the recreation site of interest as part of a trip taken for other purposes." We also create interaction variables with travel cost, *SDT_TC*, and *UNP_TC*. Using the interaction

Table 1 Definition of variables and mean values ($N = 314$)

Variable	Definition	Mean	SD
Persontrips	No. of trips to the national park in previous 12 months × *Group Size*	5.32	9.70
Group Size	No. of individuals in visitor's group	4.18	4.00
Travel Cost	((Round-trip road kilometers[a] × $0.227)/*Group Size*) + $3	194.68	229.50
Income	Visitor's income[a] (U.S. $10,000)	7.04	2.91
Age	Visitor's age	43.00	12.21
Family	=1 if personal group was family	0.68	0.47
MultDays	=1 if one or more days were spent on-site	0.23	0.42
OtherNP	=1 if respondent visited another national park on this trip	0.34	0.47
SDT	=1 if visit was one of several destinations	0.64	0.48
UNP	=1 if unplanned destination	0.16	0.37
SDT_TC	*SDT* interacted with travel costs	139.54	213.11
UNP_TC	*UNP* interacted with travel costs	40.38	140.68
Hike	=1 if respondent was on-site to hike or horseback ride	0.54	0.50
Aware	=1 if respondent was aware of Great Sand Dunes Preserve	0.38	0.49

[a] Respondent's Zip Code was used to estimate this variable

variables, we are able to calculate different consumer surplus estimates for these types of trips (Parsons and Wilson 1997; Loomis and others 2000).

Age is the respondent's age. The questionnaire also asked respondents who they were traveling with: family, friends, alone, or some combination. We use a dummy variable, *Family*, for family groups, assuming that they will take fewer trips compared to the other groups. Finally, the questionnaire asks how many days or hours were spent at the park. Using this information, we create a dummy variable for respondents who stay at GSD for multiple days, *MultDays*. This approach is similar to that of Bhat (2003), who creates a single-day dummy, and Martínez-Espiñeira and Amoako-Tuffour (2007), who include the actual number of days spent on-site. We assume that those visitors who stayed at the park for multiple days take fewer trips in a year. Finally, we include a dummy variable, *OtherNP*, for respondents who said they had visited other national parks on the trip, to determine if these visitors had different behavior.

To estimate the GTSNB based on Martínez-Espiñeira and Amoako-Tuffour (2007), we need variables to parameterize the overdispersion parameter, α. Those authors chose variables related to the age composition of the party, visitor's preferences for the park, and income. We use a dummy variable for a visitor who hiked or went horseback riding (*Hike*), a dummy variable for visitors aware of the creation of Great Sand Dunes Preserve prior to their visit (*Aware*), and *Income*. Table 1 presents summary statistics of the variables used in the travel cost model.

Two limitations should be discussed with our travel cost model. The first relates to travel costs and how best to incorporate the opportunity cost of time because the time traveling to the site could have been used for earning income or other activities. Some studies include the opportunity cost of time as another travel cost (e.g., Martínez-Espiñeira and Amoako-Tuffour 2007), while others estimate time as a separate variable in the model (e.g., Loomis 2006). We follow Ovaskainen and others (2001) and Bhat (2003), who do not include the opportunity cost of time either in the travel cost or as a separate variable in the model (a downward bias of consumer surplus). Although Ovaskainen and others state that there is no valid measure of time cost, limitations of our data set prevent estimation of the opportunity cost of time. We do not include travel time as a separate variable because of multicollinearity and the difficulty of determining the mode of transportation used to get to the park. The only way to estimate travel time is to use round-trip distance, which is the variable used for travel cost. Englin and Shonkwiler (1995) described a similar issue with collinear results.

The second issue relates to including the travel costs to substitute sites. Not including substitute sites will bias consumer surplus (Liston-Heyes and Heyes 1999; Ovaskainen and others 2001), but including substitute price is sometimes not practical due to the lack of data (Liston-Heyes and Heyes 1999). Given our data source, it is difficult to estimate this variable. However, a number of studies do not include the price of substitute sites (e.g., see Liston-Heyes and Heyes 1999; Ovaskainen and others 2001). As related to these two final issues, Ovaskainen and others (2001, p. 132) point out, "Empirically, the results can be considered fairly realistic, because the two effects [opportunity cost of time and substitutes] work in the opposite direction."

Results

The data set for the travel cost model includes a total of 314 of the 364 returned questionnaires. We have a 66%

Table 2 Regression results using count data models corrected for truncation and endogenous stratification

Variable	TSP	TSNB	GTSNB
Constant	1.520** (11.296)	0.905** (3.442)	1.332** (3.688)
Travel Cost	−0.009** (−7.588)	−0.007** (−4.920)	−0.007** (−5.355)
Income	0.086** (9.669)	0.065** (3.245)	0.029 (0.677)
Age	0.017** (7.729)	0.011** (2.734)	0.007 (1.747)
Family	−0.643** (−11.340)	−0.426** (−3.822)	−0.309** (−2.647)
MultDays	0.079 (1.226)	−0.013 (−0.090)	−0.077 (−0.669)
OtherNP	−0.152* (−2.189)	0.082 (0.050)	0.094 (0.724)
UNP	−0.957** (−6.074)	−0.806* (−2.465)	−0.605* (−2.559)
SDT	−0.556** (−6.200)	−0.449** (−2.933)	−0.328* (−2.512)
UNP_TC	0.007** (4.540)	0.003 (1.577)	0.004* (2.317)
SDT_TC	0.006** (4.565)	0.003* (2.135)	0.004** (2.705)
ln(α)			
Constant		0.082 (0.311)	−1.400* (−2.469)
Income			0.017 (0.207)
Hike			0.752** (2.909)
Aware			0.973** (3.927)
N	314	314	314
Log-likelihood	−1093.381	−720.285	−709.722
χ^2	835.516	1581.707	1602.834
Pseudo-R^2	0.276	0.523	0.530

Note. The three models are (1) the Poisson model (TSP), (2) a standard negative binomial model where α does not vary with the visitors' characteristics (TSNB), and (3) a generalized negative binomial approach where α is a function of demographic variables (GTSNB). For variable definitions, see Table 1. The *t*-statistics are in parentheses.
* Significant at 5% level.
** Significant at 1% level.

usable response rate of on-site visitors. Fifty observations were dropped due to missing data and overseas visitors. The data only included country of origin for overseas visitors.

The estimation results of the count data models are presented in Table 2. All three models (TSP, TSNB, and GTSNB) have fairly similar results. Using the optimal regression-based test developed by Cameron and Trivedi (1990), we test the null hypothesis that the mean and variance are equal. We run two regressions suggested by Greene (1998):

$$z_i = \alpha_1[\hat{\mu}_i/(\sqrt{2}*\hat{\mu}_i)] + \epsilon_i \quad (5)$$

$$z_i = \alpha_2[(\hat{\mu}_i)^2/(\sqrt{2}*\hat{\mu}_i)] + \epsilon_i \quad (6)$$

where the dependent variable is calculated as $z_i = ((Persontrips_i - \hat{\mu}_i)^2 - Persontrips_i)/(\sqrt{2}*\hat{\mu}_i)$, α is an unknown parameter, ϵ_i is the error, and $\hat{\mu}_i$ is the prediction of the means from the Poisson model. The difference between the two regression equations, (5) and (6), is the form of overdispersion being tested. We find that α_1 is significant at the 5% level (*t*-statistic = 2.11) and α_2 is significant at the 1% level (*t*-statistic = 5.04), suggesting that there is overdispersion in the TSP. The scalar factor in the TSNB is not statistically significant (see Table 2; *t*-statistic = 0.311), but we still feel the TSP is not appropriate for the data because of the large *t*-values (McKean and others 2003, 2005). A likelihood ratio test comparing TSP and TSNB has a value of $\chi^2(1) = 746.19$, which is significant at the 1% level. Therefore, we only look at the results in the TSNB and GTSNB, which, as expected, have lower *t*-values and lower coefficients in absolute value for *Travel Cost* than the TSP.

Comparing the TSNB and the GTSNB, all the variables have the same sign. *Travel Cost* is significantly different from zero at the 0.01 level and negative in both models as expected. *Income* is not significantly different from zero at the 0.05 level in the GTSNB, but it is significant at the 0.01 level in the TSNB. The coefficient on *Family* is negative and significantly different from zero at the 1% level in both models, suggesting that families that travel together take fewer trips to the GSD. *UNP* and *SDT* are significant at the 5% level and negative in both the TSNB and GTSNB, suggesting that multiple-trip and unplanned visitors take fewer trips than travelers for whom GSD is their primary destination. The interactive variable *UNP_TC* is significant at the 5% level only in the GTSNB. In the TSNB, the slope for the unplanned trips demand is not statistically different from zero at the 5% level (*t*-statistic = 1.58). The interactive variables *UNP_TC* and *SDT_TC* have similar coefficients in both models. The log-likelihoods and the pseudo-R^2 both suggest that the GTSNB is preferred. A likelihood ratio test comparing the TSNB and GTSNB has a value of $\chi^2(3) = 21.13$, which is significant at the 1% level. Similar to the results of Martínez-Espiñeira and Amoako-Tuffour (2007), the GTSNB does a better job of estimating the model.

Benefit Estimates for GSD

Estimating the benefits of a trip to a national park follows from the results of these count data models. The value individuals place on a trip is based on their consumer surplus. It is used as an approximation of the more exact welfare measures (Willig 1976; Freeman 1993). Consumer surplus can be thought of as the net benefit of a trip; it is the difference between the value of a trip and the costs required to take that trip.

To estimate the consumer surplus per visitor per year, we use

$$CS/visitor/year = \frac{[(-1/\beta_{Travelcost}) * \mathrm{E}[Persontrips_i|\mathbf{s}_i]]}{\mathrm{E}(GroupSize)} \quad (7)$$

Rather than just calculating $(-1/\beta_{Travel\ Cost})$, we multiply the reciprocal of the *Travel Cost* coefficient by predicted *Persontrips* (Englin and Shonkwiler 1995). This provides an estimate of the CS per group per year, which needs to be divided by average group size (Martínez-Espiñeira and Amoako-Tuffour 2007). This, however, only represents the consumer surplus for primary destination visitors. To calculate the consumer surplus for visitors who are traveling to several destinations (UNP would be a similar calculation using the coefficients related to *UNP*), we use

$$CS/visitor_{SDT}/year = \frac{[(-1/(\beta_{Travelcost} + \beta_{SDT\_TC})) * \mathrm{E}[Persontrips_{i,SDT}|\mathbf{s}_i]]}{\mathrm{E}(GroupSize_{SDT})} \quad (8)$$

Because of the data and model specification, we estimate expected *Persontrips* for SDT and UNP visitors. Estimated 95% confidence intervals of consumer surplus are calculated using the WALD procedure in the software package LIMDEP (Greene 1998). This procedure uses the delta method to calculate the standard errors.

Table 3 presents the consumer surplus estimates and 95% confidence intervals. The GTSNB has a lower consumer surplus per persontrip than the more restrictive model (TSNB). But the consumer surplus calculations for UNP and SDT visitors are higher in the GTSNB compared to the TSNB. Since the consumer surplus/UNP 95% confidence interval for the GTSNB model is contained within the consumer surplus/UNP 95% confidence interval for the TSNB model, one can conclude that there is no statistical difference between the slopes. This is also true for the consumer surplus/SDT slopes. Comparing the TSNB results, we see that measures of consumer surplus for UNP and SDT visitors are both higher than for primary destination visitors. Similar results can be seen for the GTSNB model. Loomis and others (2000) and Loomis (2006) both found consumer surplus estimates for joint and incidental trips to be higher than for primary destination trips. For the joint and incidental trips, the consumer surplus includes the additional sites visited and is, therefore, larger (Parsons and Wilson 1997; Loomis and others 2000). Table 3 also presents consumer surplus per group per year and consumer surplus per individual per year using estimates of expected *Persontrips* and average group sizes.

Table 3 Consumer surplus (CS) calculations (in 2002 U.S. $)

	TSNB	GTSNB
CS/persontrip	$152 ($92–$213)[a]	$141 ($89–$193)
Expected persontrips	3.70	3.06
CS/group/year[b]	$564	$432
CS/individual/year[c]	$117	$89
CS/UNP persontrip	$304 ($5–$603)	$324 ($70–$578)
Expected UNP persontrips	2.38	2.32
CS/UNP group/year	$724	$752
CS/UNP individual/year[d]	$229	$238
CS/SDT persontrip	$291 ($196–$386)	$306 ($212–$400)
Expected SDT persontrips	3.67	3.52
CS/SDT group/year	$1068	$1078
CS/SDT individual/year[e]	$253	$256

[a] Ninety-five percent confidence intervals are based on standard errors calculated as the square roots of the diagonal elements of the estimated asymptotic covariance matrix using the delta method (Greene 1998)

[b] CS/persontrip × expected *persontrips*

[c] Average group size for primary destination travelers is 4.84

[d] Average group size for UNP is 3.16

[e] Average group size for SDT is 4.22

Using the benefit transfer approach, Kaval and Loomis (2003) estimate U.S. $39/person per 24-h recreational day (2002 U.S. $) for national parks in the Intermountain Region and U.S. $50/person per 24-h recreational day for national parks in general. In order to compare our consumer surplus per person per year to their results, we calculate average trips per year and average recreational days per trip. The average respondent in our sample who traveled to GSD as the primary destination took 1.59 trips per year and, for each trip, spent 1.03 recreational days on-site. Consumer surplus per person per recreational day for GSD, based on the GTSNB, is U.S. $54. Our estimate is slightly higher than both estimates given by Kaval and Loomis (2003).

Discussion and Conclusion

This paper uses a travel cost model to estimate the value of a recreational trip to Great Sand Dunes National Park and

Preserve. Since very few travel cost studies have looked at U.S. national parks, this study is a unique contribution to the literature and a valuable resource for park managers and policymakers. Following Martínez-Espiñeira and Amoako-Tuffour (2007), who developed a more flexible truncated negative binomial model corrected for endogenous stratification, the estimate of annual consumer surplus per visitor for GSD as the primary destination is approximately U.S. $89. As expected, the consumer surplus per year related to multidestination trips and unplanned trips is much larger, U.S. $256 and U.S. $238, respectively.

We are aware of a number of limitations of this study. Variables not included in the survey, such as travel cost and income, were based on Zip Code. Other questions related to substitute sites, travel time, mode of transportation, and changes in quality or park services were not asked and, therefore, not included in the model. Although this would have been preferred, the results are expected, and not different from those of other models in the literature. However, before these values can be used in policy decisions, additional research should focus on how close the sample means are to the population means. There could be a seasonal effect on the sample means which would affect the calculation of expected *Persontrips*.

One of the few published economic studies focused on nonmarket valuation that mentions the data collected by the VSP is Turner (2002). He states (p. 8), "The questions fall far short, however, of estimating the value visitors place on park resources, different activities, congestion, and park management services." We agree with his analysis in terms of the problems with estimating the marginal benefits of these services and resources. His model creates a list of questions that would support different management decisions. However, as we show, the data collected by the VSP, given that they were not collected to estimate travel cost models, are still usable for certain research questions.

We understand that additional data are needed to improve our model. Some of those data could be collected in the VSP surveys, but some of those data do not fall within the scope of the VSP mission. Including certain questions in the VSP surveys would require a more lengthy review process and would prevent the VSP from meeting its management needs for visitor data (personal communication with Daniel Stynes, James Gramann, and Margaret Littlejohn). Given the data limitations, we provide an approach that follows the standard estimation of travel cost models. The approach presented in this paper could be duplicated for some of the 183 data sets available at the VSP Web site. Although we did not review all data sets, the survey methodology is consistent since 1988 (VSP 2007). In some cases, the questions differ slightly but still could be used in the travel cost model. In other cases, additional questions that could be used in a travel cost model, such as those listed as a limitation of our model, were asked (e.g., travel expenditures and education level were asked in the Cuyahoga Valley National Park questionnaire [Le and others 2006]). The results, generated from the existing VSP data sets, would be another inexpensive source of economic information for supporting NPS decisions.

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