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Measuring the Social Recreation Per-Day Net Benefit of the Wildlife Amenities of a National Park: A Count-Data Travel-Cost Approach

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Abstract In this article, we apply count-data travel-cost methods to a truncated sample of visitors to estimate the Peneda-Gerês National Park (PGNP) average consumer surplus (CS) for each day of visit. The measurement of recreation demand is highly specific because it is calculated by number of days of stay per visit. We therefore propose the application of altered truncated count-data models or truncated count-data models on grouped data to estimate a single, on-site individual recreation demand function, with the price (cost) of each recreation day per trip equal to out-of-pocket and time travel plus out-of-pocket and on-site time costs. We further check the sensitivity of coefficient estimations to alternative models and analyse the welfare measure precision by using the delta and simulation methods by Creel and Loomis. With simulated limits, CS is estimated to be €194 (range €116 to €448). This information is of use in the quest to improve government policy and PNPG management and conservation as well as promote nature-based tourism. To our knowledge, this is the first attempt to measure the average recreation net benefits of each day of stay generated by a national park by using truncated altered and truncated grouped count-data travel-cost models based on observing the individual number of days of stay.

Keywords Count-data models · Social recreation benefits · Travel cost · Wildlife amenities

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Introduction

Located in northwestern Portugal, the Peneda-Gerês National Park (PGNP) covers 72,000 hectares, is the only such park (i.e., International Union for Conservation of Nature category) in mainland Portugal, and was established in 1971. It is a Specially Protected Site for Birds included in the National List of Sites and a Special Conservation Site (Mata da Albergaria). The park has unusual mountainous features and is rich in endemic, rare, and unique botanical and animal species. The valleys abound with exuberant forests, some of which, such as those composed of *Albergaria* and *Cabril* sp., are particularly well conserved. The park's historical heritage ranges from prehistoric and Roman remains to medieval monuments. Currently the park is relatively scarcely populated, with a demography characterised by a majority of ageing, undereducated women. Massive emigration from this northern region of Portugal to coastal cities and abroad has long been a crippling impediment to sustainable development. Although the main economic activities were formerly subsistence agriculture and cattle breeding, these have been partially substituted by apiculture and forestry activities as well as some incipient industries, especially related to raising indigenous cattle breeds, building, and nature tourism–related activities. In addition to the annual summer forest-fire threat, the PGNP is subject to uneven recreation demand, which increases sharply in the summer months and peaks in August. The park is managed by a mostly state-funded public institution. Budgets have always been considered inadequate for financing the high management costs of fire-risk control and prevention, counteracting the effects of excess recreation and tourism demand during the summer, and carrying out the necessary maintenance and improvement work. The park's management is currently engaged in reinforcing and improving the biodiversity-conservation process and promoting local sustainable development to stem the rate of emigration and create synergies able to foster cooperation with the local population. However, concerns regarding long-term government financing are leading managers and visitors to consider the idea that users should pay to enjoy the park. The ability to demonstrate that the park generates high nonmarket recreation benefits would give park managers a stronger socioeconomic justification to augment the park's budget through this additional source of income. Furthermore, the valuation of recreation day benefits serves several political and fiscal criteria: (1) increasing funding for the national park, enabling national development strategies, and implementing nature-conservation methods in support of nature-based tourism; (2) deciding on the level of recreational use that a campsite or a national park should accommodate and how much land should be allocated to such recreational use; and (3) defining the appropriate user-fee strategy to cover some of the costs of providing nature based–tourism opportunities. Technically, these decisions require marginal functions to place a value on incremental wildlife recreation use. Therefore, we sought to estimate these marginal valuation functions as well as the average monetary value that an individual places on one recreation day in the PGNP by season. Therefore, we did not aim to predict multisite, multiactivity, or PGNP recreation demand. The economic measure for the marginal recreation value was defined as one person's on-site consumer surplus (CS) for any part of a calendar day (Walsh and others 1988) and represents the difference between an individual's willingness to pay and the actual recreation expenditure that he or she incurs in using the park's amenities for leisure and recreation purposes. Geometrically, CS is the integral of the area under a Marshallian demand recreation curve between the actual travel costs and the choke travel cost (i.e., the highest recreation cost that decreases the park's recreation demand to zero). The advantage of using such a measure is that once estimated, it becomes possible to obtain the recreation value of the site, or any similar site, by simply multiplying the representative visitor's CS per day by the total number of recreation days (Morey 1994).

The travel-cost method (TCM) has proven to be the most commonly adopted preference-based approach (Ward and Beal 2000) for placing values on recreational use of nature during the past 30 years. It is based on actual visitor behaviour and measured by number of trips (visits), individual expenditure on marketed commodities per trip, and travel time (trip price) as an indirect means of showing individual preferences (Bockstael and McConnell 1999; Freeman 2003; Haab and McConnell 2002). Among other applications, TCM is often employed to evaluate and promote nature-based tourism (Parsons 2004). The wide variety of TCM models appearing in the academic and empirical literature (e.g., Bell and Leeworthy 1990; Hof and King 1992; Beal 1995; Liston-Heyes and Heyes 1999; Font 2000; Bhat 2003; Hesseln and others 2003; Earnhart 2004; Hellström 2006; Loomis 2006; Shrestha and others 2007; Meisner and others 2008; Martínez-Espiñeira and Amoako-Tuffour 2008; Heberling and Templeton 2009) are variants on (1) the general model structure in terms of how the dependent variable is defined and measured and (2) the estimation strategy used (Fletcher and others 1990; Ward and Beal 2000; Freeman 2003; Haab and McConnell 2002). Since Hotelling's original proposal, TCM has been theoretically and empirically revised with the aim of developing and refining it. Nevertheless, controversy still persists over certain issues, including the relationship between the visit length, the measurement used to quantify recreation demand and the marginal value of recreation benefits. Traditional TCM empirical approaches generally assume that the length of time spent on-site is held constant throughout the travel-cost demand function (McConnel 1992). However, as others have pointed out (Kealy and Bishop 1986; Wilman 1987; Bell and Leeworthy 1990; Rockel and Kealy 1991; Larson 1993a, b; Hof and King 1992; McConnel 1992; Font 2000), many of the estimated recreation demand functions do not hold visit length constant and thus cannot be interpreted as marginal valuation functions. Therefore, we are led to conclude that traditional TCM does not allow for time at the site to vary across individuals and is correspondingly inappropriate for estimating the monetary value the individual places on one marginal homogeneous recreation demand quantity. Although many researchers recognise this specification issue as a limitation, it not only remains ignored by many current empirical applications but also continues to defy resolution.

To overcome this specification problem, we decided to use a single on-site individual recreation demand function to estimate the average marginal (daily) individual CS, in which the dependent variable is the number of days spent per visit (i.e., per trip) as a function of the price (cost) of each recreation day per trip and additional visitor and site characteristics. The price per day trip (equal to out-of-pocket and time travel costs plus out-of-pocket and on-site time costs) was assumed to be exogenous. We deployed a questionnaire to gather an on-site data sample, thereby ensuring reliable responses in a short period of time at low cost. Furthermore, we measured the dependent variable as the numbers of days of stay in the park per point of visit and by season. Several features regarding both the nature of our on-site sample and the dependent variable are worth mentioning: (1) the dependent variable is a count-data process, which is observed truncated at zero; (2) the non-existence of endogenous stratification is assumed given random subject selection at the park entrance; and (3) individuals showed particular preferences as to a specific number of stay days (8 or 15), thus inducing particular dependent-variable behaviour that cannot be well explained by common count-data models such as the Poisson (Shaw 1988) and Negative Binomial (NB; Long 1997; Grogger and Carson 1991) models. Hence, we adopted altered truncated generalised count models, or truncated generalised count-data models on grouped data, incorporating flexible forms of overdispersion as the most appropriate way to estimate recreation demand. Furthermore, we sought to investigate the sensitivity of the estimate coefficients and CS in these alternative count-data models as well as the precision of the estimated welfare measure by calculating the approximate confidence intervals for CS through the delta and Creel and Loomis simulation methods (1991).

Although a number of recent studies have applied count-data models to recreation demand, none have used count-data TCM models to estimate the net recreation benefits per visitor-day provided by national parks by using altered truncated or truncated models applied to data grouped to a single site per individual with days per trip as the dependent variable. The results are intended to provide robust information on the extent of the net recreation benefits generated by the PGNP by using costless sample methods, such as the on-site method. The main contributions of this study are (1) estimation of the PGNP visitor recreation real marginal value; (2) use of the truncated altered and truncated grouped count-data TCM to model a complex data-generating process of observed individual number of days of stay; and (3) further testing of different count-data models to study their impact on CS estimates as well as the relation between the dependent variable (number of days), price, and visitor characteristics.

This article comprises five sections. First, we describe the single-site empirical regression and the welfare measure used to estimate the social recreation per-day benefit. We then present the data and empirical issues. Next, the econometric specification and estimation of the recreation demand function are presented and discussed, which is followed by CS estimations and the respective confidence intervals. In the fifth and final section, conclusions are drawn.

Methods

Single-Site Empirical Regression

Here we seek to estimate the average monetary value that the individual places on one PGNP day of recreation. We acknowledge that traditional TCM empirical approaches are not appropriate to achieving our aim. Consequently, according to the argument of Burt and Brewer (1971), we defend that both travel time and on-site time form a package of commodities with consumers having no alternatives to the particular package stipulated by their respective spatial locations. Therefore, the appropriate unit of measurement for quantities of outdoor recreation services must be units of visitor days rather than trip numbers. Several researchers have highlighted the limitations derived from the nonhomogeneity of recreation trips and the need to more carefully study the decisions made by recreationists regarding the joint decision about the number and length of recreation trips (Smith and others 1983; Kealy and Bishop 1986; Wilman 1987; Bell and Leeworthy 1990; Rockel and Kealy 1991; Hof and King 1992; McConnel 1992; Larson 1993a, b; Font 2000). Nevertheless, dealing with visits of differing durations has proven difficult because on-site recreation time plays a dual role in recreation demand estimation: It is a determinant of both the recreation experience quality and the trip cost (McConnel 1992). Contemporary empirical TCM studies continue to use number of trips as the main recreation demand measure (see, for instance, Bhat 2003; Hesseln and others 2003; Earnhart 2004; Hellström 2006; Loomis 2006; Shrestha and others 2007; Martínez-Espiñeira and Amoako-Tuffour 2008; Heberling and Templeton 2009), with the most recent exception (to our knowledge) found in the work of Font (2000).

By taking into account this specification problem, and to achieve our objective of estimating a real marginal monetary measure, we decided to use a single, on-site individual demand recreation function of the following type (Eq. 1):

$$d = f(p, y, \tilde{x}), \tag{1}$$

where the dependent variable d, number of days spent per visit (i.e., per trip), is a function of the price (cost) of each recreation day per trip p, individual income y, and a vector of individual characteristics $\tilde{x}$. As in Kealy and Bishop (1986), we considered that individuals choose the total number of days they wish to spend at the recreation site at the beginning of each year and that the visitor combines time and money to reach the site and stay there, choosing the number of days that minimise total travel and in-stay costs (Wilman 1987). For the following reasons, we believe this particular recreation demand specification may have wide potential use for estimating real marginal recreation values for national parks because (1) it provides a homogeneous recreation demand relation where the dependent variable, the visit, is a single day and not trips of different lengths; (2) the recreation visitation pattern of protected natural sites is of the one-long-visit-per-year type (the representative trip) made during the summer holiday period; and (3) as we demonstrate here, it is possible to estimate a demand relation between number of days of stay per trip and the price of each recreation day per trip to then calculating a homogeneous marginal recreation value.

To yield the CS Marshallian money measure, or the amount by which an individual's willingness to pay for the site exceeds that which the individual must pay for it, we simply integrate Eq. 1 between two prices (Eq. 2):

$$\mathrm{CS} = \int_{p^0}^{p^1} f(p, y, \tilde{x})\mathrm{d}p, \tag{2}$$

where p^0 is the present recreation price, which is equal to the total visitor's expenditure necessary to produce d in the present, and p^1 is the choke recreation price, *i.e.*, the highest recreation price that decreases the site's recreation demand to zero. Equation 2 is the monetary measure of the representative visitor's benefit derived from site utilisation.

Moreover, because we only observe individuals actually visiting the park for ≥1 day during a particular season, the sample's recreation demand is truncated. Therefore, demand in population, d, is a nonobservable latent variable (Englin and Shonkwiler 1995), which relates to demand in the sample, e.g., ND, as follows (Eq. 3):

$$\mathrm{ND} = d \quad \text{if} \quad d > 0, \tag{3}$$

where ND is a count variable truncated at zero. The usual count-data approach (e.g., Shaw 1988; Grogger and Carson 1991; Englin and Shonkwiler 1995; Sarker and Surry 2004) considers this process to follow truncated Poisson (TPOIS) or NB distributions with mean λ. By choosing the semilog form, the ith individual expected in-day site demand can be specified as follows (Eq. 4):

$$E(d_i|x_i) = \lambda_i = \exp\left(\beta_0 + \beta_1 p_i + \beta_2 y_i + \tilde{\beta}\tilde{x}_i\right), \tag{4}$$

where p_i is the price or recreation cost of each one day visit per trip of visitor i; y_i is the available visitor recreation income i; $\tilde{x}_i$ is a vector of individual characteristics and other variables that influence ith visitor recreation demand; β_j, j = 0,1,2, and $\tilde{\beta}$ are unknown parameters associated with the explanatory variables; and x_i is the vector with all of the explanatory variables p_i, y_i, and $\tilde{x}_i$. Observe that the unknown vector of parameters $\beta = (\beta_0, \beta_1, \beta_2, \tilde{\beta})$ refers to the population and can be consistently estimated in the sample by using adequately truncated count-data models (Grogger and Carson 1991; Englin and Shonkwiler 1995), thereby satisfying the following formula (Eq. 5)

$$E(\mathrm{ND}_i|x_i) = E(d_i|d_i > 0, x_i) = g(\beta x_i). \tag{5}$$

The average CS of a given number of visit days per trip for the representative visitor can be obtained with Eq. 2 using the recreation demand in Eq. 4, leading to (in accordance with Hellerstein and Mendelsohn 1993) Eq. 6:

$$\mathrm{CS} = \int_{P_0}^{P_1} \lambda_i \,\mathrm{d}P = -\frac{\lambda_i}{\beta_1}. \tag{6}$$

According to Yen and Adamowicz (1993), CS per visitor per day per trip ($\mathrm{CS_D}$) is measured by the following formula (Eq. 7):

$$\mathrm{CS_D} = -\frac{1}{\beta_1}. \tag{7}$$

The Sample

Data were partially derived from an on-site questionnaire inquiry of a population composed of Portuguese citizens older than 18 years. To avoid on-site sample selection bias, visitors were randomly chosen at the moment of their initial arrival at the park for that visit. One thousand questionnaires were distributed to visitors throughout the peak-period summer months (July through September). Only visitors staying for at least one night were considered, and 86% of interviewees declared that they were on holiday. A number of individuals were dropped from the sample due to incorrectly completed questionnaires, resulting in a total of 243 appropriate observations. Information collected focused on the number of stay days, visitor per-capita income bracket, place of origin, means of transportation, whether the visitor travelled independently or in a group, various demographic characteristics (sex, age, years of education, whether on vacation, and total vacation days), and further questions delineating visitor perceptions of the PGNP's natural and humanised landscapes. This latter variable was excluded because a majority of visitors did not adequately answer this category. As already stated in the Introduction, as Portugal's only national park, the PGNP offers unique landscapes and a mix of numerous and rare fauna and flora nonexistent elsewhere. As the work of Santos (1997) conclusively demonstrated, Portuguese visitors recognise that the PGNP offers specific amenities that cannot be found elsewhere. This explains our previous assumption that visitor recognition of the specific and unique PGNP characteristics was strong enough to ensure that no substitute for the PGNP was considered. All monetary terms are calculated in 2005 Euros.

Variables

As explanatory variables, we considered the visitor's minimum recreation cost of each day of stay per trip [$TCOS_i$]; visitor per-capita available recreation income [RY_i]; number of available recreational days [ADR_i]; visitor age [AGE_i]; and visitor years of education [ED_i]. The dependent variable [ND_i] was measured according to the information reported directly by the visitor. To determine the exogenous variable [$TCOS_i$], we assumed that at the beginning of each year, an individual attributes time and money both to reaching and staying at the site and chooses the number of days per visit that minimises total travel time and on-site costs (Wilman 1987), which we assumed to be exogenous. To overcome the difficulty deriving from the nonlinearity of the budgetary constraint, which is caused by the fact that time spent in the park was taken to be a variable affecting the dependent variable (see McConnel 1992), we assumed fixed costs for each day of recreation in general and fixed on-site and travel time costs in particular (Wilman 1980, 1987; Smith and others 1983). This means that the marginal in-stay cost was assumed to be invariant with stay length, which seems reasonable because out-of-pocket stay and on-site time opportunity costs also do not vary with visit length in our approach. Therefore, the minimum cost of one day of stay per trip in the park (in 2005 Euros) for individual i was calculated by the following formula (Eq. 8):

$$TCOS_i = \frac{RTC_i}{MDS_i} + OCDS_i + TTC_i + STC_i + PEF. \qquad (8)$$

[RTC_i] is the round-trip travel cost. For private vehicles, this is equal to the per-kilometer cost (including petrol, oil, and tolls), which varies by the technical characteristics of the vehicle multiplied by the number of kilometres travelled. For public transport, the round-trip travel cost is equal to the ticket price paid by the respondent. To avoid multiple-destination trip problems, we took the origin of the trip to be the place where the PGNP visitor was at the moment when deciding to visit the park. To avoid any individual preference for a particular itinerary, kilometres were exogenously calculated by using road maps and assuming the fastest and most accessible itinerary from origin to destination. For individuals travelling together, shared costs were apportioned to the respondent in accordance with the transport mode.

[MDS_i] is the average number of days spent by visitors travelling from the same geographical district as park visitor i. The correlation coefficient between the distance travelled and the in-stay number of days is significantly inferior to the unit ($r = 0.04$), which enables us to assume the exogeneity of this variable regarding the distance travelled (Rockel and Kealy 1991).

[$OCDS_i$] is the on-site cost per day of stay. Only relevant costs, such as campsite, parking, and tent charges were considered. Food was deemed irrelevant because visitors are obliged to eat regardless of their activity. To avoid individual accommodation preferences, camping cost was considered as the minimum park in-stay cost.

[TTC_i] and [STC_i] are the travel and on-site stay time opportunity costs per visitor per day, respectively, quantified in Euros for each hour spent on the trip and the stay as well as per day of stay. Both were introduced into the demand function in composite form to resolve a multicolinearity problem between length of travel time to the site and length of time spent at the site (Cesario and Knetsch 1970). We assumed that the opportunity cost of one hour is the same, whether it is spent travelling to or at the park (Cesario 1976), even although it may vary individually. It was evaluated as one third of each visitor's per-capita, per-hour available recreation income. The aforementioned method was partially based on the ad hoc methods more commonly applied in the literature on TCM, where time cost is equal to a specific percentage (generally one third) of the wage rate (e.g., Wilman 1980; Smith and others 1983; Sarker and Surry 1998; Liston-Heyes and Heyes 1999; Chakraborty and Keith 2000; Hagerty and Moeltner 2005). The ad hoc methods seemed the best choice in our case because almost the entire sample reported either being on vacation or visiting the park on a long bank-holiday weekend. Hence, it seemed implausible to apply the classic trade-off between leisure and work hours under these circumstances. Instead, we assumed that in the absence of further individual information on visitor perceptions regarding this time issue, the PGNP's opportunity recreation time is equal to the individual's foregone utility in the nonspending of his or her income and his or her time on alternative recreation activities. There is also evidence of alternative theoretical approaches to introducing time costs into recreation demand specifications (Bockstael and others 1987; Shaw 1992; Larson 1993b; Shaw and Feather 1999; McKean and others 2003; Larson and Shaikh 2004). However, these could not be followed due to a lack of information. Total travel time was measured in hours and was exogenously estimated by dividing visitor kilometres travelled to and from the park by the maximum road speeds in Portugal, i.e., 120 km/h on motorways and 90 km/h on other roads. For public transport, we considered time travelled as the time between departure and arrival of the respective means multiplied by two. In the case of time spent on-site, we used the reported number of park stay days while only taking into consideration the number of waking hours in a typical day of protected-area recreation, i.e., 16 h (Walsh 1986).

[PEF] is the park entrance fee, which is currently zero. [RY_i] was estimated by reported net visitor income and was assumed to be equal to the holiday subsidy received by Portuguese employees, which is equal to a regular month's payment. The other explanatory variables [ADR_i], [AGE_i], and [ED_i] were quantified directly from the questionnaires. Descriptive statistics from the data set are listed in Table 1.

During the peak summer season, PGNP visitors stayed in the park for an average of 5,284 days. Variance in the dependent variable is high at 12,766 (much greater than the

Table 1 Descriptive statistics

Variable	Mean	SD	Maximum	Minimum
ND	5.284	3.573	18.000	1.000
€*TCOS*	50.479	30.604	215.266	12.098
ADR	22.329	15.138	90.000	1.000
AGE	30.926	10.871	66.000	18.000
ED	6.984	2.225	10.000	2.000
€*RY*	799.080	482.880	3452.265	143.844

Observations = 243

Table 2 Frequencies of recreation visit-day numbers in the PGNP

ND_i	Count	%	ND_i	Count	%
1	24	9.88	10	13	5.35
2	39	16.05	11	3	1.23
3	25	10.29	12	3	1.23
4	36	14.81	13	1	0.41
5	27	11.11	14	2	0.82
6	15	6.17	15	8	3.29
7	17	7.00	16	1	0.41
8	27	11.11	17	0	0.00
9	1	0.41	18	1	0.41

empirical mean), meaning that the equidispersion property of the Standard Poisson model may not hold in the population (see Table 1). Table 2 lists the [ND_i] frequencies. Clearly, the data do not display any quick process of decay, with more than half of the sample visitors staying between 1 and 6 days. As stated before, common Poisson and non-NB models are not the most appropriate for explaining [*ND*] because the variable's behaviour is specific: Figures show that 2-, 4-, 8-, 10-, and 15-day visits are more frequent than their adjoining numbers, implying that standard count-data models may have problems in appropriately adjusting to this specific dependent variable behaviour. The choice of such values may in part represent individual preferences, but it may also be due to measurement errors in the sense that people are unable to report exactly the number of days of their stay and rather state the closest round number. For example, in Portugal, people frequently refer to a week as 8 days and two weeks as 15 days.

Econometric Model Specifications and Estimation Results

Literature Survey

A number of studies apply count-data models to recreation demand and welfare measure estimates. Shaw (1988) was the first to recognise the nonnegative integers, truncation, and endogenous-stratification nature of on-site sampling recreation data characteristics and to assume that the use of common regression linear methods with this type of data sample generate inefficient, biased, and inconsistent estimations. He developed a TPOIS model that corrected for the sampling problems and captured the discrete and nonnegative nature of the dependent recreation demand variable, thus allowing for the inference of visit occurrence probability (see also Creel and Loomis 1990; Gurmu 1991). Grogger and Carson (1991) found that the standard NB model corrects for overdispersion, a frequent statistical phenomenon not captured by the Standard Poisson. Furthermore, Gurmu and Trivedi (1994) noted that empirical research demonstrated that a majority of visitors make at least one or two trips and that the number of recreational trips greater than two decreases rapidly when the dependent variable is measured by number of trips to the site. This is called a "fast-decay process" and is a common characteristic in recreation-demand settings, resulting in overdispersion. Sarker and Surry (2004) proved that the NBII model is capable of capturing a fast-decay process. Englin and Shonkwiler (1995) developed a truncated NB (TNB) model that corrects for both endogenous stratification and truncation. Others also applying count-data models to recreation demand functions and related welfare estimations include, e.g., Hellerstein (1991), Creel and Loomis (1990, 1991), Hellerstein and Mendelsohn (1993), Yen and Adamowicz (1993), Gurmu and Trivedi (1996), Santos Silva (1997), Bowker and Leeworthy (1998), Sarker and Surry (1998; 2004), Shonkwiler (1999), Zawacki and others (2000), Ovaskainen and others (2001), Bhat (2003), Crooker (2004), Englin and Moeltner (2004), Hellström (2006), Egan and Herriges (2006), Shrestha and others (2007), Bartczak and others (2008), Martínez-Espiñeira and Amoako-Tuffour (2008), Meisner and others (2008), and Heberling and Templeton (2009).

The General Econometric Approach

Because there are 1-day trips, 2-day trips, and so forth, we measured the dependent variable as the number of park stay days per visit rather than the number of trips to resolve the problem of working with a nonhomogeneous dependent variable. Consequently, our dependent variable is a count-data process that is observed to be truncated at zero. Moreover, by analysing the empirical frequencies included in Table 2, we find that individuals showed special preferences on a specific number of stay days (e.g., 2, 8, or 15), which may be due to holiday season or weekend effects.

Standard Poisson and NB models are not appropriate to depict this specific behaviour and were therefore ruled out. Instead, we started by accounting for overdispersion with the truncated generalised Poisson (TGP) and the truncated generalised negative-binomial (TGNB) models, which accommodate flexible specifications of the variance. In contrast, we also considered some altered versions of these models by allowing the probabilities of the specific number of stay days that were clearly more preferred than their neighbouring ones to be freely estimated. As an alternative, we thus estimated the TGP and the TGNB for grouped data. For the sake of brevity, we only include here the estimation results for the latter.

The Generalised Poisson (GP) model given in Santos Silva (1997) verifies the following formula (Eq. 9):

$$\mathrm{Var}(d|x) = E(d|x)[1 + \alpha E(d|x)]^2 \tag{9}$$

with $E(d|x)$as in Eq. 4 and α equal to:

$$\alpha = \exp(\gamma_0 + \gamma_1 TCOS + \gamma_2 RY + \gamma_3 ADR + \gamma_4 AGE + \gamma_5 ED), \tag{10}$$

with γ_j ($j = 0,....,5$) being unknown parameters to be estimated together with β. The Standard Poisson model is nested in the GP model, and its suitability can be tested as shown in Santos Silva (1997). The second model considered is the generalised NB model (Eq. 10):

$$\mathrm{Var}(d|x) = E(d|x) + \alpha E(d|x)^2, \tag{11}$$

with α given in Eq. 9. We also considered some altered versions of these models by changing the probabilities of certain values. Finally, we defined the appropriate model specifications for grouped data.

The truncated specifications of all of the models considered were estimated by maximum likelihood (ML) method using TSP 4.5 (TSP International/licence code GSET-4ACE-000E-47EA-TSP-50). Robust SEs were computed using the Eicker-White procedure. The RESET test was calculated to test for omission of variables and nonlinearities of $\beta' x$ in Eq. 4 and $\gamma' x$ in Eq. 9: The variable $\left(\hat{\beta}' x\right)^2$ was added to Eq. 4; $(\hat{\gamma}' x)^2$ was included in Eq. 9; and the extended model was estimated by ML method. Then the null that both coefficients of the newly added variables be jointly zero was tested, and its rejection shows evidence of misspecification. Moreover, the adequacy of the TGP specification was tested against the alternative, TGNB, with the nonnested hypothesis tests of Santos Silva (2001) and Vuong (1989); the results are shown in the Appendix. Note that a possible conclusion delivered by these procedures may be the inadequacy or adequacy specification of both models.

We expected demand for PGNP recreation days per trip to be negatively correlated with both on-site daily recreation cost and visitor age and positively correlated with available recreation income, available time for recreation activities, and visitor level of education. The preliminary estimates obtained with TGP and TGNB for price and recreation cost, available income, and available recreation day variables returned expected results. The expected number of recreation days spent in the PGNP per trip decreased with greater recreation costs and increased with greater available recreation income and time. The estimate of the coefficient of [*AGE*] was within the expected range, but the estimated effect of the variable [*ED*] was not; however, neither differed significantly from zero. Results are available on request.

Model Selection

Given that some parameters in function α in Eq. 9 were significant in both the TGP and TGNB models, we have the expected evidence of overdispersion, thus rendering the Standard Poisson and the Standard TNB regressions inappropriate to explain the dependent variable. However, the nonnested Vuong (1989) and Santos Silva (2001) specification test results, which are included in the Appendix, demonstrate the inadequacy of both the TGP and TGNBI. This fact led us to define the altered TGP, the altered TGNB, and the estimation of the TGP and TGNB for grouped data, as mentioned previously.

The causes of the above-mentioned inadequacy of both generalised models are most certainly related to the distinct behaviour of the dependent variable frequencies. The fact that there are peaks in visit days 2, 4, 8, 10, and 15 raises the suggestion that the probabilities returned by the TGP and TGNB are susceptible to modification to increase the probability of these days undergoing the transformations necessary, thus guaranteeing that the usual properties of the probability function are verified. Winkelmann (2003) applied this procedure to an Standard Poisson, and deducing it for the TGP and TGNB proved straightforward. It is necessary to avoid altering the probabilities of all day numbers mentioned with preference peaks because this would result in an excess of parameters being estimated given the number of observations. We opted to alter only day numbers 8 and 10 because those were the day numbers where the frequency peaks were relatively greater. However, these altered models were also rejected at 5% according to the results of the nonnested specification tests included in the Appendix. This inadequacy may suggest that the behaviour of the recreation-day demand probability function may be too complex to be approximated by these well-known models. Given a restricted number of sample observations, it would be inappropriate to insert more structural parameters into the models because the respective estimates would hardly be statistically significant. A better solution is to group data so that the grouped-data probability function becomes smoother and less complex and hence easier to estimate consistently by a simple model. Looking again at Table 2, we can approximately classify visit-day number preferences into three major groups. The first group consisted of 151 individuals who were visiting the park for 1 to 5 days. The second group had 73 individuals who were visiting the park for 6 to 10 days. The third group comprised 19 individuals who were visiting the PGNP for >10 days. Although with this approach we use different information making up the likelihood function (because we incorporate only knowledge on the group to which each observation belongs instead of the exact number of the days observed) we estimate the same parameters for the TGP and TGNB as before. This may result in a loss of estimation precision, but this is acceptable to ensure that consistency is achieved. Indeed, the nonnested specification hypothesis tests presented in the Appendix do not reject TGP grouped data adequacy.

Estimation Results for Grouped Data

Table 3 lists the results from the TGP and TGNB model estimations for the grouped data and their restricted versions, respectively, RTGPI, RTGPII, and truncated generalised NB (RTGNB). Clear differences in the estimates obtained by each model are worth detailing. For the mean function, the estimates return the expected sign although the effect of income is statistically significant only for TGNB and RTGNB. Furthermore, the effect of the proxy price variable is, in absolute values, almost four times greater in RTGNB than it is in RTGP. The variance function includes income (at 10%; positive effect) and education (negative effect) as statistically significant RTGP variables. For RTGNB, the variables are proxy price (positive impact) and number of available recreational days (at 10%; negative effect).

The RESET test reports evidence that only the RTGPI and RTGPII are correctly specified at the 5% level, whereas the other specification tests contained in the Appendix reject the TGNB. We opted for RGTGPII instead of RGTPI for the sake of efficiency and also due to the stronger evidence favouring the correct specification hypothesis obtained by the RESET test statistic. Indeed, RGTGPII may be proposed as an acceptable model for estimating CS in the sense that it is not only a simple and flexible model that incorporates overdispersion, but it was also not rejected by any of the misspecification tests applied.

CS Point and Confidence Interval Estimates

According to Willig (1976), Randall and Stoll (1980), and Hanemann (1999), we may estimate Hicksian measures of recreation value (Mäler 1971, 1974) through Marshallian CS estimates. Furthermore, Englin and Shonkwiler (1995) showed that visitor Hicksian measurements of one average-length day-of-stay visit depend on individual socioeconomic characteristics. The usual empirical approach is to

Table 3 Grouped TGP and TGNB estimate results

Variable	TGP	RTGPI	RTGPII	TGNB	RTGNB
Estimates for β					
Intercept	1.330 (6.65)	1.481 (12.51)	1.547 (13.70)	1.582 (3.55)	1.651 (9.37)
TCOS (10^2€)	−0.602 (−1.87)	−0.607 (−1.91)	−0.516 (−2.08)	−1.483 (−2.27)	−1.902 (−2.75)
RY (10^3€/per capita)	0.120 (0.78)	0.151 (1.06)		0.455 (1.75)	0.539 (3.09)
ADR (days)	0.010 (3.28)	0.010 (3.72)	0.010 (3.73)	0.014 (4.46)	0.013 (4.55)
AGE (years)	0.003 (0.74)			0.003 (0.57)	
ED (years)	0.012 (0.60)			−0.018 (−0.78)	
Estimates for γ					
Intercept	−1.633 (−1.54)	−2.777 (−5.36)	−2.903 (−5.45)	0.029 (0.01)	−2.032 (−2.29)
TCOS (10^2€)	0.084 (0.06)			3.626 (3.72)	3.815 (3.09)
RY (10^3€/per capita)	0.709 (1.38)	0.616 (1.82)	0.659 (1.82)	0.536 (0.28)	
ADR (days)	0.000 (0.06)			−0.053 (−1.45)	−0.045 (−1.88)
AGE (years)	−0.036 (−1.41)			−0.052 (−0.67)	
ED (years)	−0.211 (−2.40)	−0.174 (−2.17)	−0.158 (−2.05)	−0.122 (−0.87)	
Log-likelihood	−160.692	−161.830	−162.340	−186.703	−188.411
Likelihood ratio test		2.28 (0.810)	3.30 (0.771)		3.42 (0.636)
RESET test		5.34 (0.07)	2.76 (0.251)		6.66 (0.036)

t-statistics are in parentheses. Likelihood ratio tests the restricted model against the respective unrestricted model. The RESET test of no joint misspecification of $\beta' x$ and $\gamma' x$ has a $\chi^2(2)$ under the null. For both tests, *p*-values are in parentheses extrapolate the results for the average individual after adjusting the population sample. However, we could not follow this procedure here because we are not in possession of the characteristics and data of all PNPG users. Therefore, we based our recreation value measure on the Marshallian CS per day, as defined by Eq. 7, because this indicator depends only on an unknown population parameter. It was consistently estimated with the restricted truncated generalised Poisson for grouped data (RTGPII), and the results are given in Table 4. For comparison, we have included the estimates produced by the other models that were rejected by the specification tests. As expected, grouped data results differ from those for the previous form, particularly regarding the RTGNB. Our selected model returned the greater point estimates.

CS confidence limits are not so straightforwardly obtained given that they are a nonlinear function of a parameter. The standard approach is to use the delta method. Creel and Loomis (1991) proposed constructing approximated confidence limits based on simulating the joint asymptotic normal distribution of the ML estimator for β, with the mean vector and covariance matrix derived from the ML estimates. We obtained confidence limits using both methods. Their accuracy depends on the accuracy of the asymptotic normal distribution to approximate the true estimator distribution. Here, given the limited sample size of our data, these results should be viewed with caution. Simulated confidence limits were obtained considering one million draws. Results are in line with the common characteristics of those obtained from truncated estimators (Yen and Adamowicz 1993), i.e., larger consumer surplus estimates with wider confidence intervals. Simulated confidence limits for all models have a tendency to be greater than the respective limit obtained by the delta method.

Our selected model, the RTGPII, produced the widest intervals compared with the other specifications: CS varied from €116 to €448 with simulated limits; it varied from €41 to €345 with the delta method; and the CS point was €194. These results are not surprising given that we were expecting to achieve consistency after having killed precision. Indeed, narrow confidence intervals generating wrong inferences are of no value. However, although the selected confidence limits are wide, they do point to the major conclusion that the hypothesis of null PGNP CS is rejected.

Our CS estimates are not comparable with others because, to our knowledge, there are no other similar applications whose results can be directly compared with our own. However, we can confirm they do not differ significantly from several obtained for other recreation sites (Bowker and Leeworthy 1998; Bhat 2003; Shrestha and others 2007; Martínez-Espiñeira and Amoako-Tuffour 2008; Heberling and Templeton 2009), although it remains clear that more research is still necessary and is subject to the usual case-study caveats.

Conclusion

In this article, we sought (1) to measure the average per-day net recreation benefit of the wildlife amenities of a national park, the PGNP, defined as the amount of money that an individual is willing to pay for recreation services produced in the park in excess of the amount that the individual currently pays for them and (2) to discuss the usefulness of count-data econometric approaches to this end. The data were applied to estimate the coefficients of a demand function for recreation days. To overcome the problem of nonhomogeneous demand, we observed the number of days people stayed in the park per trip rather than the number of trips they made. Therefore, we specified a count-data regression model that predicts the number of days per visit to the PGNP as a function of price (recreation cost) and other visitor characteristics. The price variable includes travel and on-site out-of-pocket costs as well as travel and on-site time opportunity costs. Our data displayed certain specificities that made the modelling process nontrivial, thus rendering the classic and most used count-data models inadequate. First, given that we have an on-site sample of individuals, no zeros were observed, leading to the use of truncated count-data regression models. Second,

Table 4 Point and 90% confidence interval estimates for CS per visitor per day (2005 Euros)

Models	CS	Delta method		Simulated limits	
		Lower	Upper	Lower	Upper
TGP	136.48	80.99	191.98	99.32	217.57
TGNB	145.42	81.06	209.78	104.19	239.77
Altered at 8 TGP	147.34	77.62	217.06	102.53	258.57
Altered at 8 TGNB	156.65	77.19	236.11	107.65	282.37
RGTGPII	193.74	40.68	346.80	115.95	448.13
RGTGNB	52.58	21.16	84.00	35.73	97.45

individuals showed a particular preference for a certain number of days compared with others, which, combined with the heterogeneity of observations, led us to expect overdispersion. This was accounted for by adopting Generalised Poisson and generalised NB specifications, which are much more flexible than the usual approach based on the classic NB. In contrast, the particular behaviour showed in the empirical frequencies of the chosen number of stay days induced a complex data-generating process that was not well adjusted, even by the generalised models under consideration. Therefore, we opted to smooth the data-grouping observations to build up the likelihood function. We lost some precision, but we achieved consistency with a regression model that was not rejected by any of the specification tests used.

The inverse of the estimate price and recreation variable coefficient of the recreation demand function was further exploited to obtain the Marshallian CS per day per visit. We correspondingly obtained the following results: CS per day per individual is statistically different from zero and equals €193.74 (2005 prices), varying, with 90% confidence, between €40.68 and €346.80 with the delta method and between €116 and €448 with simulated limits. In selecting the RGTGPII model as being the most appropriate for estimating CS, we gained robustness but lost a degree of precision, leading to wider intervals. However, this is undeniably preferable to narrow confidence intervals with erroneous information. Estimates vary according to the model used, which is not unusual in TCM approaches. The greatest variations are showed by the grouped models, which is not surprising because when grouping data equivalent to its censorship, some information is lost, but that remaining becomes more reliable.

We encountered a problem related to the dimension of the sample *versus* the need to use more complex truncated count-data given the specificities of the behaviour of recreation demand in the sample. A compromise solution for this issue was found in grouping the data. In contrast, the idea of using days-of-stay numbers during one main season trip as the dependent recreation variable proved fairly fruitful. Our CS estimates are not comparable with others because, to our knowledge, there are no other similar applications whose results can be directly compared with our own. However, we can confirm they do not differ significantly from several obtained for other recreation sites, although it is clear that more research is still necessary and is subject to the usual case-study caveats.

Point CS estimates of €193.74 per person per recreation day in the PGNP may be thought by some to be unrealistically high in the sense that if a visitor were asked about the hypothetical maximum amount of money that he or she would be willing to pay to maintain his or her right to use the park for recreation, perhaps the answer would be closer to the lower boundary of the CS confidence interval. Conversely, we must remember that TCM-estimated welfare money measures are based on real, not hypothetical, market expenses effectively supported by visitors. As we know, and as is largely confirmed by practice and sustained theoretically, individuals assume conservative behaviour when asked directly about their willingness to pay. Our model estimates that should a person with the average characteristics observed in the sample visit the park for an average stay of 4.51 days, it would yield a CS per visit of €873.77 (4.51 × €193.74 [range €183.47 to €1564.07 with the delta method and €522.93 to €2021.07 with simulated limits]). Making broader predictions for the entire population of visitors according to these values is not straightforward because there are no databases containing either the numbers or the characteristics of PGNP visitors. The only available data, albeit not accurate, consider the number of campers. For instance, in the year of the questionnaire, approximately 12,000 visitors camped in the PGNP and, according to our estimates, they benefited from a recreation value per day of visit of €2,324,880 (12,000 × €193.74) and a recreation value per average day length of visit of €10,485,208 (12,000 × 4.51 × €193.74). These figures indicate that visitors receive considerable benefits far exceeding the current null admission and user fees, which enables us to conclude that there is a hidden, unpaid economic recreation use value. For example, the recreation benefit per average day length of visit for the aforementioned 12,000 users alone represents 78% of the annual investment spent by public entities and other stakeholders during 2001 through 2006 to finance several rehabilitation programs in the park.

These findings provide full justification for the national parks authority to implement admission fees to maintain the quality of the environment, thereby avoiding degradation of the natural ecosystems, especially should the government decrease budgetary support. Hidden private benefits may be captured, for example, by introducing park entrance fees. However, management authorities must be aware that setting fees for nature-based recreation is a complex task because the public agency must ponder several issues, such as (1) management pricing-policy objectives; (2) recognition of visitor categories; and (3) actual choice of the appropriate type or types of fee(s) to be applied. Increasingly, the context of the decision-making process surrounding the charging of fees is surrounded by vigorous cultural, philosophical, and legislative debates. In the face of public resistance to fees, the park's public management agency must be aware of the best strategies with which to counteract such opposition. For example, visitors and local communities become more receptive to a fee-based policy when they know that the main objective of its introduction is the rationing of demand during peak periods and that revenues raised are to be invested in improving both the quality of the park and its nature based–tourism service. When questioned about such an eventuality by means of an open question, this was precisely the argument stated by 23% of interviewees in justifying the payment of a hypothetical park-entrance fee. Although this percentage may not inspire great optimism, it is nevertheless important information for the management of protected natural areas where people are not accustomed to the idea of paying an access fee for the right to enjoy nature. It is also highly important to set the appropriate type of fee and amount. If one of the fee-strategy's objectives is to control recreation demand during peak periods, then a going-rate charge type, together with a bundle of various types of fees and charges for access to and use of nature based–tourism sites, must be considered. To set the amount of these fees and charges, a market-demand framework must be adopted to evaluate the impact of the fees on recreation demand while also taking into account the type of visitors and visits. Contingent valuation, rather than the travel-cost approach, which is employed more often to evaluate and promote nature-based tourism rather than to serve as a guide for pricing park use, is the most appropriate technique for this purpose.

The values further provide useful information for natural resources management and a rationale to preserve unique ecosystems, such as the PNPG and others, by proposing that management resources are continuously allocated to nature preservation and to developing nature recreation activities, such as ecotourism, as a means of sustainably boosting local communities in full respect of priority conservation goals.

The current travel-cost approach and related results not only provide decision-makers with valuable information on the recreation use value of protected areas but also demonstrate to nature conservation stakeholders that when managers seek to plan the economic value of nature-based recreation in their regions (as this study shows) that more development is not necessarily required. However, although more ecotourism-development activities may be expected to generate an accrued supplementary source of income to residents, ecotourism demand must be carefully regulated to minimise the potential risk for risking the associated physical and biological environmental damages and consequently lowering the prevailing recreation-use value.

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Appendix

See Table 5

Table 5 Nonnested specification tests

Test	Statistic	*p*-value	Evaluation
Initial models			
Santos Silva[a]	8.264	.004	Rejects Generalised Poisson at 1%
Santos Silva[b]	8.918	.003	Rejects general NB at 1%
Vuong	1.630	.103	Both models are potentially inadequate at 10%
Altered at 8 and 10			
Santos Silva[a]	6.132	.013	Rejects Generalised Poisson at 2%
Santos Silva[b]	8.247	.004	Rejects general NB at 1%
Vuong	1.948	.051	Both models are possibly inadequate at 5%
			Rejects general NB at 10%
Altered at 8			
Santos Silva[a]	4.331	.037	Rejects Generalised Poisson at 4%
Santos Silva[b]	8.918	.003	Rejects general NB at 1%
Vuong	1.737	.082	Both models are possibly inadequate at 5%
			Rejects general NB at 10%
Grouped data			
Santos Silva[a]	−0.239		Test not valid[c]
Santos Silva[b]	240.108	.000	Rejects general NB at 1%
Vuong	3.643	.000	Rejects general NB at 1%

[a] Restricted Generalised Poisson under the null

[b] Restricted generalised NB under the null

[c] Given that under the null the test statistic has an approximated Chi-square distribution, the negative value could indicate a rejection. However, given that the figure is close to zero, it may also be due to sampling error

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