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

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Abstract. We applied count-data travel cost methods to a truncated sample of visitors, to estimate the average CS per each day of visit of an individual, visiting the Peneda-Gerês National Park to enjoy their natural facilities for recreation purposes. As the recreation demand was measured in number of days of stay in the park the behaviour of the dependent variable is very specific. To overcome this situation, we propose the use of altered truncated count data models or truncated count data models on grouped data because we found they were better adjusted to our data set. The average individual CS per day is estimated to be €194 varying between €116 and €448, with Simulated Limits. This information is useful in the formulation of government policy relating directly to national parks and conservation and the determination of future natural park management. To our knowledge this is the first attempt to measure the average recreation net benefits per each day of stay supported by a national park, by using truncated altered and truncated grouped count data Travel Cost Model based on the observation of individual (not household) number of days of stay.

Key Words: Social Recreation Benefits; Wildlife Amenities; Count Data Models; Travel Cost.

Abbreviations: Consumer Surplus (CS).

JEL classifications: C3; D1; D4; Q2.

I Introduction

The Peneda-Gerês National Park (PGNP) was established in 1971 and is located in north-western Portugal. It covers 72,000 hectares and is the only National Park in mainland Portugal. It is a Specially Site Birds and included in the National List of Sites (Net Nature 2000). The park is rich in rare botanical species and fauna. Park historical heritage ranges from prehistoric and Roman remains, medieval monuments, curious mountain agglomerates, and unique humanised landscapes like *lameiros* and *prados de lima*. PGNP experiences uneven recreation demand with a peak period during summer (July, August, and September), and August is by far the busiest month. PGNP is around 37 km away from the third national urban centre (Braga), 102 km from the second (Porto) and 402 km away from the largest (Lisboa). There are no available statistics to account and characterise recreation visitors. As many others, PGNP is threatened by various factors such as forest fires, human settlement inside the park and encroachment by local villagers, pollution and other threats to conservation created by the visitors, particularly in summer. The overall negative impact of the above mentioned factors, along with insufficient funding, may have contributed to the mismanagement of the park. The government budget allocated for the management of PGNP and conservation in general is limited as competes with other public programmes, such as education, wealth, infrastructures, or defence spending, etc. The other alternative source of funds for park management, the entry fees, does not exist at present. Being able to show that PGNP enables high non-market recreation benefits gives decision-makers and park managers a stronger economic justification to support the park and to divert scarce financial funds from other social investment alternatives. Results from recreation benefits can further be used in pricing and in incentive policies to develop sustainable profit activities like eco-tourism. Values of recreation days per visitor can be used to decide the level of recreation use a campground or a national park should accommodate or how much land should be allocated to recreation use or even what price should be charged to obtain the efficient, optimal recreation use. In addition, an efficient allocation of financial resources would further contribute as a solution for some main problems presently faced by the region: unemployment, abandonment of land, and excessive pressure of tourism during summer. Technically, all these decisions require marginal valuation functions for incremental wildlife recreation use.

In this paper we estimate the average monetary value individual places on one recreation day in the PGNP by season to enjoy its unique and rare natural amenities and landscapes, by self-producing several recreation activities like camping, sight seeing, hiking, canoeing, and others. The Marshallian economic measure of recreation value, the Consumer Surplus (CS) per-day, defined as one person's CS on-site for any part of a calendar day (this is the US Forest Service's basic recreation economic measure as mentioned in Walsh 1990), is measured trough the difference between individual willingness to pay and actual recreation expenditure he/she supports to use park's wild amenities for leisure and recreation purposes, and estimated by integrating the area under a Marshallian demand recreation curve, between the actual travel costs and the choke travel cost (the highest recreation cost that turns to zero the park's recreation demand). The advantage of using this measure is that once it is estimated, it will be 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 days individual spent in recreation at that site (Morey 1994).

Travel Cost Method (TCM) has proven to be the most popular revealed preference based approach used over the past 30 years (Ward and Beal 2000) for placing values on recreational use of nature based simply on actual visitor behaviour measured in number of trips (visits) taken, and related individual expenditure on marketed commodities and time travelling (the trip price) as an indirect means of revealing individual preferences (Bockstael and McConnel 1999; Freeman III 2003; Haab and McConnell 2003). It is commonly applied in benefit-cost analysis, in natural resource damage assessments where non-marketed recreation benefits are important and in defining access and pricing policies for ecosystems (Parsons 2004). The wide variety of TCM models appearing in the academic and empirical literature (see, for example, 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 2005, Loomis 2006, Shrestha et al 2007, Meisner and others 2008, Martínez-Espiñeira and Amoako-Tuffour 2008, or Heberling and Templeton 2009) are variants on the general structure of the model in how the dependent variable and recreation demand are defined and measured, and the estimation strategy used (Fletcher and others 1990; Ward and Beal 2000; Freeman III 2003; Haab and McConnell 2003). Since Hotelling's TCM original proposal written in a letter to the Director of the USA National Park Service in 1947, the theoretical and empirical issues of the method have being revised with the aim of developing and refining it. But controversy still persists over some of the issues, like the effect of the visit length and the relationship between it, the measure used to quantify recreation demand, and the marginal value of recreation benefits. By using the number of trips (or visits) as the measure of quantity and travel cost per trip as the price, traditional TCM empirical approaches generally assume that the length of time spent on site is held constant all along the travel cost demand function. However, as others have pointed out (Kealy and Bishop 1986, Wilman 1987, Bell and Leeworthy 1990, Rockel and Kealy 1991, Larson 1993 a)b), Hof and King 1992, McConnell 1992 or Font 2002) many of the estimated demand functions for trips do not hold visit length constant and thus cannot be interpreted as a marginal valuation function. We have then to conclude that traditional TCM, by using number of trips as the endogenous variable that do not hold for the ability to allow time at the site to vary across individuals, is not appropriated to estimate the monetary value the individual places on one marginal homogeneous recreation demand quantity. We also conclude that while many researchers recognise this specification issue as a limitation of the TCM it still continues to be ignored by many actual empirical applications and though still defying resolution.

To surround such specification problems we decided to use a single, on-site individual recreation demand function to estimate the average marginal (daily) CS of a visitor, where the dependent variable is number of days spent per visit (*i.e.* per trip) as a function of the price (cost) of each recreation day per trip and of other visitor and site characteristics as well. The price per day trip (equal to out-of-pocket and time travel costs plus out-of-pocket and on-site time costs) is assumed to be exogenous. We choose the on-site sampling to guarantee for gathering reliable responses in a short period of time and at a low cost, and we measured the dependent variable as the numbers of days of stay in the park per point visit in the season. There are, however, several features with the nature of on-site sample and the nature of the dependent variable worth to mention: *i)* the dependent variable is a count data process which is observed truncated at zero; *ii)* inexistence of endogenous stratification[1] because people was observed at the park entrance; *iii)* individuals revealed special preferences on specific number of stay days (like 8 or 15) inducing a particular behaviour of the dependent variable that cannot be well explained by common count data models like the Poisson (Shaw 1988) and Negative Binomial (Long 1997; Grogger and Carson 1991); therefore, we propose to use altered truncated count models or truncated count data models on grouped data to estimate recreation demand[2], instead. We also seek to investigate how sensitive the estimate coefficients and CS are to these alternative count-data models. Furthermore, we analyse the precision of the estimated welfare measure with the calculation of approximated confidence intervals for CS by using the Delta Method, and the simulation method of Creel and Loomis 1991.

We found that, by using the methodology based on alternative count data models, we gained in robustness of results but lost in precision of the CS estimates, leading to wider confidence intervals. The average individual CS per day is estimated to be € 193.74 varying (with 90% of confidence) between € 41 and € 347 with Delta Method and € 116 and € 448 with Simulated Limits.

Single site count data travel cost models became increasingly common as economists have recognised that travel cost studies permit demand to vary according to the traits of individual participants or participant groups (Shonkwiler 1999). A number of recent studies applied count data models to recreation demand and welfare measures estimates but none used count data TCM models to estimate the per visitor day recreation net benefits supported by national parks by using altered truncated or truncated models, applied to grouped data to a single site per individual and days as the dependent recreational demand variable. The results are aimed at providing robust information about the extent of the net recreation benefits supported by PGNP by using costless sample methods like on-site's. The main contributions of this study are: *i)* the estimation of the marginal recreation use value of PGNP; *ii)* the use of truncated altered and truncated grouped count data TCM, based on individual number of days of stay observations; *iii)* testing different count data models was improved to study their impact on estimated CS and on the relationship between the dependent variable (number of days), the recrteation price, and the visitor's characteristics.

The paper is composed of six sections. Following this Introduction, in Section II the empirical approach used to estimate the recreational demand function and the CS welfare measure is presented. Section III presents the data and empirical issues while in Section IV the econometric specification and estimation of the recreation demand function are obtained and discussed. In Section V, CS and the respective confidence intervals are estimated, and finally Section VI discusses results and their application to conservation policy setting out the main conclusions.

II. The single-site empirical regression

We seek to estimate the average monetary value the individual places on one recreation day in PGNP for the enjoyment of its unique and rare natural amenities and landscapes, by self-producing several recreation activities like camping, sight seeing, hiking, canoeing, and others. We state that traditional TCM empirical approaches are not appropriated to achieve that goal because they use trips as visits to measure the recreation quantity, and travel cost per trip as the price (Fletcher et al 1990, Ward and Beal 2000, Haab and McConnell 2002, Freeman III 2003), ignoring the length of time spent on-site per each trip for recreation purposes though assuming on-site time is held constant all along the travel cost demand function (McConnell 1985). This is the main reason why we state that traditional TCM demand curves cannot be interpreted as marginal valuation functions and the money measure CS estimated after them is not a marginal money measure of the recreation use value. As Burt and Brewer 1971 have pointed out, both travel time and on-site recreation experience itself are a package of commodities, and the consumer has no other alternative to the particular package presented to him by his spatial location - therefore, the appropriate unit of measurement for quantities of outdoor recreation services must be units of visitor-days instead of number of trips.

Several researchers pointed out the limitations derived from the non-homogeneity of the recreation trips, and the need to study more carefully the decisions made by recreationists regarding the conjoint decision over the number and the 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, McConnell 1992, Larson 1993 a)b), Font 2000). But dealing with visits of different duration has proved difficult because on-site recreation time plays a dual role in recreation demand estimation – it is a determinant of the quality of the recreation experience and a cost of the trip and of the on-site recreation experience as well (McConnell 1992). And in spite the researcher efforts, the non-homogeneity basic hypothesis of recreation trips continues to be ignored (see for instance Bhat 2003, Hesseln and others 2003, Earnhart 2004, Hellström 2006, Loomis 2006, Shrestha et al 2007, Martínez-Espiñeira and Amoako-Tuffour 2008 or Heberling and Templeton 2009) and though still defying resolution, with the more recent exception founded (to our knowledge) in the work of Font 2000.

By taking into account this specification problems and to fulfilled our objective of estimating a real marginal money measure, we decided to use a single, on-site individual demand recreation function of the type

$$d = f\left(p, y, \tilde{x}\right) \quad (1),$$

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, the individual income y and a vector of individual characteristics $\tilde{x}$. Like as in Kealy and Bishop 1986 we considered that individuals choose the total number of days that 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 to stay there, choosing the number of days that minimize total travel and on-stay costs (Wilman 1987). The price per day per visit is composite as includes out-of-pocket and time travel cost, and out-of-pocket and on-site time costs as well, and is assumed to be exogenous. This particular recreation demand specification may have wide potential use to estimate marginal recreation value real measures of protected natural sites. Firstly because it provides a homogeneous recreation demand's relationship where the dependent variable, the visit, is a single day and not trips of different lengths. Secondly, because the recreation visitation pattern of protected natural sites is of the one-long-visit-per-year type (the representative trip), made during the summer holidays period. Thirdly, as we demonstrate here, it is possible to estimate a demand relationship between number of days of stay per trip and the composite price of each recreation day per trip and thus 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 what the individual must pay for it, we simply integrate *(1)* between two prices (recreation costs):

$$CS = \int_{p^0}^{p^1} f\left(p, y, \tilde{x}\right) dp \qquad (2)$$

where p^0 is the present recreation price (cost) which is equal to the recreationist's total expenditures necessary to produce d at the present; p^1 is the choke recreation price (cost), that is, the highest recreation price that turns to zero the site's recreation demand. The measure *(2)* is the money measure of the representative recreationist's benefit related with the use of the site.

Moreover, since we only observe the individuals that actually visited the park for one day on more only during a season, the recreation demand in the sample is truncated. Therefore, demand in the population, d, is a non-observable latent variable (see for instance Englin and Shonkwiler 1995) which relates to the demand in the sample, say *ND*, by the following,

$$ND = d \quad if \quad d>0$$

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 or Negative Binomial distributions with mean λ. By choosing the semi-log form the i^{th} individual expected on-day site demand can be specified as follows:

$$E(d_i \,|x_i) = \lambda_i = exp(\beta_0 + \beta_1 p_i + \beta_2 y_i + \tilde{\beta}\tilde{x}_i) \qquad (3)$$

where p_i is the Price/Recreation Cost of one day visit per trip of visitor i, y_i the available recreation income of visitor i, $\tilde{x}_i$ a vector of individual characteristics and other variables that influence recreation demand faced by the i^{th} visitor, β_j, with j = 0,1,2 , and $\tilde{\beta}$ are unknown parameters, and x_i is the vector with all the explanatory variables p_i, y_i, and $\tilde{x}_i$. Observe that the unknown vector of parameters $\beta = (\beta_0, \beta_1, \beta_2, \tilde{\beta})$ refer to the population and it can be consistently estimated in the sample by using adequate truncated count data models (Grogger and Carson 1991, Englin and Shonkiller 1995), satisfying,

$$E(ND_i \,|\, x_i) = E(d_i \,|\, d_i > 0, x_i) = g(\beta x_i)$$

The CS of a given number of days of visit per trip for the representative visitor can be obtained with *(2)* using the recreation demand in *(3)* leading to the CS per each average visit lengh (Hellerstein and Mendelsohn 1993),

$$CS = \int_{P_0}^{P_1} \lambda_i \; dP = -\frac{\lambda_i}{\beta_1} \qquad (4)$$

Finally, following Yen and Adamowicz (1993), the CS per visitor per day per trip (CS_D) is measured by,

$$CS_D = -\frac{1}{\beta_1} \qquad (5)$$

III. The Data and Empirical Issues

Sample

Data were partially obtained from an on-site questionnaire inquiry of a population composed of Portuguese citizens aged over 18. 1,000 questionnaires were distributed to adult Portuguese citizens visiting the park throughout the summer peak-period months (July-September) staying at least one night and longer. 41% of the sample individuals came from the two metropolitan areas- Lisboa and Porto – and 86% declared to be on holidays.

Almost 90% of the total PNPG person-trips and person days are concentrated in summer season. Only campiest were interview, to avoid the lodging utility generation effect upon the recreation value of PGNP. Endogenous stratification was circumvented by interrogating visitors at the time they registered at the camping reception centres. Several individuals were dropped from the sample due to incorrectly filled questionnaires, resulting on 243 appropriated observations. Information collected focused on number of days of stay, visitor per-capita income bracket, place of origin, mean of transportation, whether the visitor travelled independently or in a group, various demographic characteristics (gender, age, years of education, whether on vacation and total of vacation days), further questions delineating visitor perceptions on PGNP's natural and humanised ecosystems and landscapes. This last variable had to be excluded because a great majority of visitors did not adequately answer this category. Nevertheless, another questionnaire implemented by Santos J. M. L (1997) conclusively demonstrated that visitors broadly recognise specific PGNP characteristics with demand unambiguously related to them. We assumed this visitor's recognition to be sufficiently strong not to considerate a substitute for the PGNP[3]. All monetary terms are calculated in 2005 euros.

Variables

We consider as explanatory variables visitor's minimum recreation cost of each day of stay per trip in the PGNP (including out-of-pocket travel and on-stay costs, and travel and on-stay opportunity time), $[TCOS_i]$; individual per capita available recreation income, $[RY_i]$; number of available days to spend with recreation, $[ADR_i]$; age, $[AGE_i]$; and years of Education, $[ED_i]$.

The dependent variable, $[ND_i]$, was measured by using the direct information reported by the visitant during the questionnaire. To determine the exogenous variable $[TCOS_i]$ we assumed that at the beginning of each year, individual combines time and money to reach the site and to stay there and chooses the number of days per visit that minimises total travel and on-site costs (Wilman 1987) that we assumed to be exogenous. To surround the difficulty related with the non-linearity of the budget constraint, caused by the fact of the time spent in the Park being taken as a variable affecting the dependent variable (see McConnell 1992), we assumed fixed costs for each day of recreation in general, and fixed on-site and travel time cost in particular (Wilman 1987, 1980, Smith and others 1983). This means marginal on-stay costs is assumed to be constant, which seems reasonable because: *i)* the on-stay costs are minimum and there isn't a fee; *ii*) the marginal cost only depends on the on-site time opportunity cost, which is assumed to be constant, 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 formula,

$$TCOS_i = \frac{RTC_i}{MDS_i} + OCDS_i + TC_{ti} + TC_{si} + PEF$$

$[RTC_i]$ is the roundtrip travel cost in euros[4]. For private vehicle it is equal to per-km cost[5] multiplied by the number of kilometres[6] travelled. For public transport is equal to the transport fee paid by the respondent. $\left[MDS_i\right]$ is the mean number of days the visitors travelling from the same geographical district as visitor *i* stayed in the park[7]. $\left[OCDS_i\right]$ is the on-site cost in euros per each day of stay[8]. $\left[TC_{ti}\right]$ and $\left[TC_{si}\right]$ are the opportunity costs in euros of travel and on-site stay time per visitor per day[9] respectively, quantified in costs in euros per each hour expended during the trip and the stay. The cost in euros was assumed the same whether expended on travelling or on stay[10] and equal to one-third of the visitor's per capita per hour available recreation income measured in euros. We partially based on the opportunity travel and on-site time cost valuation *ad hoc* method more commonly used in TCM literature where travel time cost is equal to a specific percent 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) [11]. We considered travel and on-site time cost to be one-third of the visitor's per capita per hour available recreation income, instead one-third of the wage rate[12]. Travel time was exogenously estimated by dividing the km travelled by the visitor from the origin to the park, and back, by the maximum speed legally allowed in Portugal, because Portuguese drivers speed a lot and often surmounted it (120Km/h on motorways and 90km/h on other roads for private vehicles). For public transport, we considered as time travelled the time between the departure and the arrival of the respective means, multiplied by two. In the case of the time spent on site, we used the reported number of days of stay in the park, but only the number of waking hours in a typical day of recreation in a protected area was considered, in other words, 16 hours (Walsh 1986). We still considered other two alternative methods of quantifying the travel and on-site cost of time [13] but the results for the parameter associated to the variable of price/recreation cost did not changed much. $\left[PEF\right]$ is the park entrance fee which is zero at the present. $[RY]$ was estimated after the reported net income and was assumed to be equal to the holidays subsidy received by Portuguese employees which is equal to a month of regular payment. The other explanatory variables like $[ADR]$, $[AGE]$, and $[ED]$ were quantified directly from questionnaires. Descriptive statistics from the data set are presented in *Table I*.

Table I Descriptive Statistics

Variable	Mean	Stand Deviation	Max	Min
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

Note: observations = 243

During the on-peak summer season, PGNP visitors stayed in the park for 5.284 days on average. The variance of the dependent variable is high, 12.766 (much higher than the empirical mean), meaning the equidispersion property of the standard Poisson model may not hold (see *Table I*).

There can be seen that the data do not exhibit any quick decay process, with more than

Table II contains the frequencies of *Table II* Frequencies of the Number of Recreation Days in the PGNP during the Visit

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

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one half of the sample visitors making visits of between one and six days. About 10%

made one-day visits, 16% two-day visits, 10% three-day visits and so on. About 11% made eight-day visits, around 5% made ten-day visits and 3% fifteen-day visits. As stated before, common Poisson and Non-Negative Binomial models are not the more useful to regress $\left[ND\right]$, because the behaviour of this variable is very specific: figures show that 2, 4, 8, 10 and 15 day visits are more frequent than the neighbouring values, inducing that standard count data models may have problems to adjust well to this specific behaviour of our dependent variable. The choice of such figures may represent, in part, preference of the individuals but may also be due to measurement errors, in the sense that people are unable to report exactly the number of days of their stay but they report a close round number either. For example in Portugal it is frequent that people refer to a week as 8 days and two weeks as 15 days.

IV. Econometric Model Specification and Estimation Results

a. Literature Survey

A number of recent studies applied count data models to recreation demand and welfare measures estimates. Shaw (1988) was the first to recognise the non-negative 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 truncated Poisson model (TPOIS) that corrected for the sampling problems and captured the discrete and nonnegative nature of the dependent recreation demand variable allowing inference on the probability of visits occurrence (see also Creel and Loomis 1990; Gurmu 1991). Grogger and Carson (1991) found that the standard negative binomial model (NB) corrects for over dispersion, a very frequent statistical phenomenon not captured by the standard POIS. Further more, Gurmu and Trivedi (1994) noted that empirics demonstrated that a vast majority of the visitors make at least one or two trips and the number of recreational trips higher then two falls rapidly when the dependent variable is measured in number of trips to the site. This is called a fast decay process, a common characteristic in recreation-demand setting, and results in over dispersion. Sarker and Surry (2004) proved that the NBII model is capable of fitting a fast decay process. Englin and Shonkwiller (1995) developed a truncated negative binomial (TNB) model that corrected for both endogenous stratification and truncation. Those further applying count data models to recreation demand functions and related welfare estimations based on individual TCM version include for instance Hellerstein (1991), Creel and Loomis (1991), Hellerstein and Mendelsohn (1993), Yen and Adamowicz (1993), Bowker and Leeworthy (1998), Sarker and Surry (1998;2004), Santos Silva J.M.C. (1997), Zawacki and others (2000), Bhat (2003), Crooker (2004), Englin and Moeltner (2004), Hellström (2006), Egan and Herriges (2006), Shrestha and (2007), Martinez-Espiñeira and Amoako-Tuffour (2008), Meisner and others (2008), Heberling and Templeton (2009); and within EU, Ovaskainen and others (2001) and Bartczak and others (2008).

b. General Econometric Approach

As pointed out in the last section we measured the dependent variable as the number of days of stay in the park per visit to surmount the problem of working with a non-homogeneous dependent variable, as it would happen if we used instead the number of trips, because there are one-day trips, two-day trips, and so forth: a marginal CS valuation based on a demand that ignores the non-homogeneity of trips in terms of overnight stays is not economically correct. As a consequence, our dependent variable has specificities like, for instance, certain figures are more preferred than the neighbouring ones, which may be due to the holiday season or weekend effect, reinforcing the inadequacy of standard count data models to our study. Therefore, we choose two other more flexible and general count data specifications to start with: the Truncated Generalised Poisson (TGP) and the Truncated Generalised Negative-Binomial (TGNB). The other specifications considered are obtained from these ones.

The Generalised Poisson (GP) given in Santos Silva (1997) verifies,

$$Var\left(d \mid x\right) = E\left(d \mid x\right)\left[1 + \alpha E\left(d \mid x\right)\right]^2$$

with $E\left(d \mid x\right)$ as in *(3)* and α equal to,

$$\alpha = exp\left(\gamma_0 + \gamma_1 TCOS + \gamma_2 RY + \gamma_3 ADR + \gamma_4 AGE + \gamma_5 ED\right) \qquad (6)$$

with γ_j, j = 0, …,5 unknown parameters to be estimated together with β. The Standard Poisson model is nested in the GP and its adequacy can be tested as shown in Santos Silva (1997). The second model considered is the Generalised Negative Binomial (GNB) with,

$$Var\left(d \mid x\right) = E\left(d \mid x\right) + \alpha E\left(d \mid x\right)^2$$

We have considered some altered versions of these models by changing probabilities of certain figures. Finally, we have also defined the appropriate specification of these models for grouped data.

The truncated specifications of all the models considered were estimated by Maximum Likelihood (ML) using TSP 4.5. Robust standard errors were computed using the Eicker-White procedure. The RESET test was calculated to test for omission of variables and nonlinearities of $\beta' x$ in *(4)* and $\gamma' x$ in *(6)*. Therefore to perform this test the variable $\left(\hat{\beta}' x\right)^2$ was added to *(3),* $\left(\hat{\gamma}' x\right)^2$ was included in *(6)* and the extended model was estimated by ML. Then, the null that both coefficients of the new added variables are jointly zero is tested and its rejection shows evidence of misspecification. The adequacy of Poisson specifications were compared with the corresponding alternative Negative Binomial using the non-nested hypothesis tests of Vuong (1989) and Santos Silva (2001). Following the former, a non rejection in the test he proposes induces that both models are equivalent but most probably ill-specified. Rejection of the test gives information about which model is appropriated depending whether the test statistics is negative or positive. The approach of Santos Silva (2001) is rather different because it tests explicitly under the null one of the model against the other in the alternative. Therefore, the test has to be applied in both directions and the final conclusion combines the result obtained in each application.

We expected demand for PGNP recreation days per trip to be negatively correlated with the on-site daily recreation cost and with age, and positively correlated with the available recreation income, the available time for recreation activities and the level of education. For all estimations the price/recreation cost, the available income, and the available recreation day variables register the expected signs. The expected number of recreation days spent in the PGNP per trip goes down with higher recreation costs and up with higher available recreation income and time. The estimate of the coefficient of [AGE] has the expected sign, but the estimated effect of the variable $\left[ED\right]$ does not: however both are not significantly different from zero.

c. Model selection

Since some of the parameters in the function α given by *(6)*(that reflects the existence of overdispersion) were significant in the TGP and TGNB it leads to conclude that the truncated Standard Poisson and truncated NB regressions are not suitable. Moreover, we have applied the test in Santos Silva (1997) to evaluate the adequacy of the Truncated Standard Poisson obtaining a test statistic of 4.72 indicating its rejection. These results confirm our early conclusions drawn from analysis of the descriptive statistics presented in *Table II*. The results of the non-tested specification tests of Vuong and Santos Silva included in the *Appendice* show the inadequacy of both TGP and TGNB. Most for sure such inadequacy is related with the weird behaviour of the frequencies of the dependent variable.

Since there are some peaks in visit days like 2, 4, 8, 10, and 15 it suggests modifying the probabilities of the TGP and TGNB in order to increase probabilities of these days making the necessary transformation for the other probabilities just to guarantee that the usual properties of probability functions are verified. Winkelman (2003) applies this procedure to a standard Poisson. To deduce it for the TGP and TGNB was straightforward. It is not wise to alter the probabilities of all the figures mentioned because it will result in too many parameters to be estimated given the number of observations. We have chosen to alter only at 8 and 10 because those were the figures where the frequency peaks were relatively more important. However, the last one was not statistically significant. Results in the *Appendix* concerning the application of the non-nested hypothesis tests show inadequacy of the altered models at 5%. This inadequacy may suggest that the behaviour of the probability function of the recreation day's demand may be too complex to be approximated by these known models. Given that the number of observations in the sample is not too big is not wise to insert more structural parameters in the models because the respective estimates would be hardly statistically significant. A better solution is to group data in order that the probability function of the grouped data becomes more regular, and consequently, easier to adjust by a simple model.

Looking again to *Table I* we can classify the preferences on the number of visiting days roughly on three major groups. First group includes 151 individuals that visited the park from 1 to 5 days; a second group has 73 individuals with visits that range from 6 to 10 days and a third group with 19 observations includes the individuals that visit the PGNP more than 10 days. With this approach we loose information because we will not use the exact observed values to build the likelihood but only the information of the group that each one belongs. However, this information is more robust and reliable for estimate the coefficients of the demand function and consequently the CS.

The non-nested hypothesis tests in the *Appendice* do not reject the adequacy of the TGP for grouped data.

d. Estimation Results for Grouped Data

We include only the results concerning the estimation of the TGP and TGNB models for the grouped data (respectively GTGP and GTGNB) for sake of simplicity. Those can be seen in *Table III* which includes also estimates for their restricted versions.

Contrary to the other specifications also considered in this study, we now verify the existence of clear differences in the estimates returned by each grouped model, namely for the coefficients of the price proxy variable and the recreation income. In the GTGP the coefficient estimate for this variable is not statistically significant though its value is around the triple than the respective estimate of the non-grouped TGP. Given the economic importance of this variable we have opted to estimate a restricted version of the last model that includes it, the RGTGP I. However, it was still not statistically significant, which lead us to estimate the RGTGP II that excludes it from the regressors, inducing just a small variation of the price proxy coefficient estimate. There are also differences in the specification of the α function given that it includes the recreational income in the GTGP and the price proxy in the GTGNB while in all models for the non-grouped data they were absent from the variance function. The fact that these variables are now influencing the variance may explain their distinct behaviour on the mean function of the grouped data relatively to the non-grouped.

Table III Estimates Results of Grouped TGP and TGNB

Variable	GTGP	RGTGPI	RGTGPII	GTGNB	RGTGNB
			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
RESET Test		5.34 (0.07)	2.76 (0.251)		6.66 (0.036)

Note: 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.

RESET test gives evidence of misspecification of the GTGNB whether for RGTGPI and RGTGPII does not reject the hypothesis of no misspecification at 5% level. We opted for RGTGPII instead of RGTPI for sake of efficiency. Indeed, RGTGPII can be considered an acceptable model to estimate the CS in the sense that has passed all tests of misspecification used and therefore is better adjusted to the data.

V. Point and Confidence Interval Estimates for CS

The Marshallian CS provides an approximation of the welfare associated with visiting the PGNP. Following Willig (1976), Randall and Stoll (1980), and Hanemann (1999), it would be possible to estimate Hicksian measures of recreation value like willingness to pay equivalent (Mäler 1971, 1974), by using Marshallian CS estimates, which is a common practice in academic literature. However, Englin and Shonkwiller (1995) showed that the visitor's Hicksian welfare measures of one average length day-of-stay visit depend upon individual socio-economic characteristics. The usual approach extrapolates these measures for the average individual in population after the estimated measures for the population sample. However, we could not follow this approach because we used an on-site truncated sample of individuals that actually visited the site and therefore their characteristics are not representative of those of the Portuguese population which includes as well individuals with zero visits. That is why we based our measure of recreation value on the Marshallian CS per day instead because this indicator depends only upon an unknown parameter of the population which can be consistently estimated with the truncated sample by using the adequate models.

The point estimates of the CS per day obtained according to *(5)* in Section II are given in *Table IV*. For sake of comparison, calculations are done for the restricted versions of all the models introduced before though our preferred is the RGTGPII (for grouped data).

Table IV Point and 90% Confidence Interval Estimates for CS per visitor per day (2005 euros)

		Delta Method		*Simulated*	
	CS	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

CS reveals some sensitiveness to estimation procedures, particularly in the RGTGNB. Confidence limits for CS are not so straightforward to obtain given that it is a nonlinear function of a parameter. The standard approach is to use the Delta Method. Creel and Loomis (1991) propose to construct approximated confidence limits based on simulating from the joint asymptotic Normal Distribution of the ML estimator for β with mean vector and covariance matrix given by the ML estimates. We have obtained the confidence limits using both methods. Their accuracy depends on the accuracy of the asymptotic normal distribution to approximate the true distribution of the estimator. Here, given the fact that the sample size of our data is not big, results should be taken with caution. Simulated confidence limits were obtained considering one million draws. Results follow the common characteristic of those obtained from truncated estimators (Yen and Adamowicz 1993): larger consumer surplus estimates with wider confidence intervals. Simulated confidence limits have a tendency to be higher than the respective limit obtained with the Delta methods, for all models. Considering more flexibility in estimation has the cost of a loss of precision leading to wider confidence intervals. However, there is a gain in robustness of the results. Narrow confidence intervals with wrong information are indeed useless. Particularly, our preferred model, the RGTGPII, produces the widest intervals compared to the other specifications: CS varies from €116 to €448 with simulated limits, €41 to €345 with delta method, and the point CS is €194 but we believe that these estimates are more robust than those estimated with the other models. This variance may not be seen as a surprise cause by grouping the data, which is equivalent of censoring, there is somehow a loss of information. In spite of it, the censored data gives more reliable information that can be better fitted by a count data model, where the dependent variable is number of days of stay during one point trip to a natural area. The major conclusion is though the confidence limits are some how apart they do not include the zero. Therefore, we can reject the hypothesis that CS is null for the PGNP.

VI. Discussion and Conclusions

In this paper we seek to measure the average per-day recreation net benefit of wildlife amenities of a national park, defined as the amount of money by which an individual is willing to pay for recreation services produced in the park that exceeds what the individual must pay at the present to produce those recreation services in the park. To estimate the average marginal CS of a PGNP visitor, we used a single, on-site individual empirical demand function that predicts the number of days on PGNP per visit as a function of the price (recreation cost) of each recreation day, and of other characteristics of the visitor. The price variable includes travel and on-site out-of-pocket costs, and travel and on-site time opportunity costs, and not only travels costs. The data were used to estimate the coefficients of a demand function for recreation days where we proposed the use of altered truncated count models and truncated count data models on grouped data, instead of standard count data models. We found the truncated Poisson on grouped data – RGTGPII, more adequate to our data in the sense that has passed all tests of misspecification used while the others revealed evidence of misspecification. The inverse of the estimate price/recreation variable coefficient of the recreation demand function was further exploited to get the Marshallian Consumer Surplus (CS) per each day, per visit, for individual access to the park for recreation experiences. We obtain the following results. One recreation day in the PGNP at the time of the questionnaire worth €193.74 (2005 prices) per each visitor and varies (with 90% of confidence) between €40.68 and €346.80 with Delta Method, and € 116 and € 448 with Simulated Limits. By choosing the RGTGPII as the more adequate to estimate CS, we gained in robustness of the results but we somehow loose in precision, leading to wider intervals. However, narrow confidence intervals with wrong information are indeed useless. Estimates vary according to the model used which is not unusual in TCM approaches. The greatest variations are revealed with the grouped models, which is not surprising because when grouping data, which is equivalent to censoring, information somehow is lost, but what remains is more reliable.

Two main problems were faced by us: the problem of the on-site sample versus extrapolation of the sample estimates involving individual characteristics to the overall population and the problem of the dimension of the sample versus the need to use more complex truncated count data, given the specificities of the behaviour of the recreational demand in the sample. A compromise solution for this last issue was found grouping the data. On the other hand, the idea of using number of days of stay during one main season trip as the dependent recreation variable ran pretty well. Our strongest conclusion is that CS per-day, per-individual, is surely different from zero and significantly higher than €0, what each visitor actually pays to use the PGNP beyond the travel and on-stay expenses. Our CS estimates are not directly comparable with others because, to our knowledge, there are no other similar applications. However we can confirm they do not differ significantly from other wildlife- associated recreation activity's CS or wildlife- associated recreation CS for national parks or other ecosystems, while it is clear that more research is necessary and subject to the usual case-study caveats. For instance, Bowker and Leeworthy (1998) found that CS per trip associated with natural resource based recreation in the Florida Keys is $757 for white visitors and $121 for Hispanic visitors. Baht (2003) found that CS per person per day value for recreation activities in the Florida Keys Marine Reserve is $122. In Shrestha and others 2007, the CS estimate per day for the Apalachicola River region recreation visits is $74.18. Martínez-Espiñeira and Amoako-Tuffour 2008 found that CS per person trip for the Gros Morne National Park in Newfoundland varies from $668 to $1596 accordingly to the type of regression used. Heberling and Templeton 2009 estimate the Great Sand Dunes National Park CS person/trip as being between $152 and $141 varying with the regressions used. Point CS estimates of €193.74 per person per recreation day in the PGNP may be felt by some as being unrealistically high, in the sense that if the visitor would be hypothetically asked about his/her maximum amount of money he/she would be willing to pay to maintain his/her right to use the park for recreation, perhaps the answer would be closer to the lower bound of the CS confidence interval, rather than the point's. However, we must remember that welfare money measures estimated following Travel Cost methods are based on real, not hypothetical, market expenses effectively supported by visitors. As we know and is largely confirmed by practice and sustained theoretically, individuals hardly have a clear perception of the truly expenses they have to support to get some natural resource based commodity, while assuming very conservative behaviours when they are directly asked about their willingness to pay for them.

Our model estimates that if some person with the average characteristics observed in the sample visits the park, will have an average stay of 4.51 days, giving a CS per visit of €873.77 (4.51 × €193.74), varying between €183.47 and €1564.07 with Delta Method or between €522.93 and €2021.07 with Simulated Limits. To gain a more precise idea about the values involved, approximately 12,000 visitors were camping in the PGNP generating a recreational value per day of visit of €2,324,880 (12,000 × €193.74), and assuming an average 4.51 days visit a value of €10,461,960.

Making broader predictions for the entire population after these values is not straightforward. As we already said elsewhere in the paper though the parameter estimators of the recreation demand are consistent for the population, it does not guarantee that the representative visitor of our truncated on-site sample is representative for the population as a whole. In other words, the sample's average person may be considered as representative of those actually visiting the park but not of the entire Portuguese population. Therefore, we would need to estimate the probability of an individual from the population to visit the park, but there is no data available to do it. Meanwhile we can only speculate about this value creating different scenarios to estimate the monetary recreation value magnitude. For instance, if 1% of the aged 18 or over went to visit the PGNP, a €13×10^6 ($70,262\times193.74$)[14] total present use benefit per day would be generated, while 25% would generate total present use net benefit of €272×10^6 ($1,405,240\times193.74$)[15] per day. Applying the same rational to half of the aged 18 or over population, one day of PGNP recreation worth a value equivalent to almost half that of Lisbon's Vasco da Gama Bridge which is a valuable asset for Portuguese society.

The results of the present work provide the decision-makers with valuable information on the real value of the park. They indicate that PGNP visitors seemed to receive a considerable amount of benefit from recreational use of the park enabling us to conclude that the park has a hidden economic value. The values suggest that management resource shall continuously be allocated to PGNP preservation, and to develop recreation activities, specifically eco-tourism, as a mean to develop the local area in a sustainable way in full respect of the conservation goals, which are priority. Besides, the large estimated use value would suggest yet that undertaking major improvement work for the management of the existing natural facilities like the adoption of entry fees and per use-day fees would probably be economically and socially justifiable to guarantee more revenues for park management through user fees. This is particularly important at the present because the administration of the park struggles with accruing problems related with financing, human desertification, excessive raising demand for recreation activities, and deficit of education and environmental information from the population in general (OECD 2001). This means further exploration of the possibility of raising funds from private sources will be advisable, like user fees. Along with financial problems depopulation of rural areas in the interior can make even harder the task of managing the park because traditional agriculture and pasture helps strongly to preserve landscape and natural habitats. Although eco-tourism activity is expected to offer a supplementary source of income to the residents, eco-tourism demand must be carefully regulated to minimise the risk for accrue even more the physical or biological environmental damages. This kind of damage is one of the problems PGNP managers are facing actually.

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Notes

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[1] Endogenous stratification refers to the fact that usually in on site surveys the probability of some visitor being surveyed depends on the frequency of visits to the site.

[2] A hurdle model like the one applied by Santos Silva and Covas (2000) was also thought to be equally appropriated to our data although we didn't apply it because it involved too many parameters to be estimated with precision for such a small sample size as ours. Further applications of count data hurdle models to recreation demand are Mullahy (1986), Creel and Loomis (1990), Gurmu and Triverdi (1996), and Hellström (2006).

[3] The assumption seems to be reasonable, because PGNP is the only national park existing in the continental part of Portugal. Besides, national park category is only used when there exits unique and/or rare ecosystems that deserve to be protected.

[4] For individuals travelling together, shared costs were apportioned to the respondent. The transport mode was considered.

[5] Per-km cost was dependent of technical characteristics of the vehicle and included oil, gas, and tolls.

[6] To avoid multiple-destination trip problems we took the origin of the trip to be the place the PGNP visitor was at the moment he took the decision to go to the Park. To avoid the individual preference for some special itinerary, kilometres were exogenously calculated by using road maps, and assuming the fastest and most accessible itinerary since the origin to the destination.

[7] The correlation coefficient between distance travelled and the on-stay number of days is significantly inferior to the unity ($r = 0.04$), which allow us to assume the exogenity of this variable with reference to the distance travelled (Rockel and Kealy 1991).

[8] To avoid lodging individual preferences, camping was considered as the minimum on-stay cost in the park. Only relevant costs were considered, such as camp site, parking and tent charges. Food was deemed irrelevant, because visitors have to eat regardless of their activity.

[9] Both times spent on the trip and on stay were introduced in the demand function of recreation days in a composite way to surround some multicolinearity problems between the length of travel to the site and length of time spent on the site (Cesario et al 1970).

[10] We further assumed travel and on-site time costs to be the same across individuals, recreational activities, and on-stay length (Cesario 1976).

[11] The opportunity cost of travel and on-site time has been one of the better discussed issues and it is still ongoing. See for instance Fletcher and others 1990, Ward and Beal 2000 to gain a more complete picture. Besides these *ad hoc* specification solutions, there has been evidence of theoretical approaches to introduce the travel time into recreation demand specifications (Bockstael and others 1987, Shaw 1992, Larson 1993b, Shaw and Feather 1999, Larson and Shaikh 2001, McKean and others 2003). However, the design of our questionnaire did not contemplate all the information needed to apply more rigorous forms to specify the travel and on-site time cost.

[12] This option seems to be the best in this case because the interviewee declared their incomes to have other origins, besides work. On a second hand, almost all the individuals of the sample declared to be on vacations or they were visiting the park during a large weekend period. Hence it seemed not plausible to apply the classical trade-off between leisure and work hours under these circumstances. We assumed that, in the absence of further individual information about their perception over the time issue, PGNP's opportunity recreation time is equal to the individual foregone utility, for non-spending his income and his time in other alternative recreation activities, different from PGNP's.

[13] We test the results without time cost and with time cost equal to 50% of RY per capita per hour.

[14] This is approximately 0.007% of the Portuguese GDP at market prices, 0.03% of the North Region's GVA, and 1% of the agricultural GVA of the same region.

[15] This is approximately 0.2% of the Portuguese GDP at market prices. 0.89% of the North Region's GVA, and 26% of the agricultural GVA of the same region.

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Appendice

Non-nested specification tests

Test	Statistic	p-value	Evaluation
	Initial Models		
Santos Silva [1]	8.264	.004	Rejects the Generalized Poisson at 1%
Santos Silva[2]	8.918	.003	Rejects the Gen. Negative Binomial at 1%
Vuong	1.630	.103	Both Models are possibly inadequate at 10%
	Altered at 8 & 10		
Santos Silva [1]	6.132	.013	Rejects the Generalized Poisson at 2%
Santos Silva [2]	8.247	.004	Rejects the Gen. Negative Binomial at 1%
Vuong	1.948	.051	Both Models are possibly inadequate at 5 % Rejects the Gen. Negative Binomial at 10%
	Altered at 8		
Santos Silva [1]	4.331	.037	Rejects the Generalized Poisson at 4%
Santos Silva [2]	8.918	.003	Rejects the Gen. Negative Binomial at 1%
Vuong	1.737	.082	Both Models are possibly inadequate at 5 % Rejects the Gen. Negative Binomial at 10 %
	Grouped Data		
Santos Silva [1]	-0.239		Test not valid[3]
Santos Silva[2]	240.108	.000	Rejects the Gen. Negative Binomial at 1%
Vuong	3.643	.000	Rejects the Gen. Negative Binomial at 1%

[1] Restricted Generalized Poisson under the null; [2] Restricted Generalized Negative Binomial under the null; [3] Given that under the null the test statistic has a 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.