ESTIMATING THE RECREATION VALUE OF ECOSYSTEMS BY USING A TRAVEL COST METHOD APPROACH[1]

Working Paper to be presented to the Permanent Seminar of the Department of Economics

24th May 2005

Isabel Mendes

Department of Economics

Instituto Superior de Economia e Gestão-ISEG/Centro de Investigações Regionais e Urbanas-CIRIUS/Technical University of Lisbon[2]

Isabel Proença

Department of Mathematics

Instituto Superior de Economia e Gestão-ISEG/Centro de Matemática Aplicada à Previsão e Decisão Económica-CEMAPRE/Technical University of Lisbon[3]

[1] This is a first draft. Please do not quote without the author's authorisation.

[2] Rua Miguel Lupi, 20, 1249-078 Lisbon, Portugal; http//www.iseg.utl.pt; Tel: 351 21 392 59 67; Fax: 351 21 396 64 07; Email: midm@iseg.utl.pt. Financial support received from the Fundação para a Ciência e Tecnologia under FCT/POCTI, partially funded by FEDER, is gratefully appreciated.

[3] Rua do Quelhas, 2, 1200-781 Lisbon, Portugal; http//www.iseg.utl.pt; Tel: 351 21 392 58 66; Fax: 351 21 392 27 81; Email: isabelp@iseg.utl.pt. Financial support received from the Fundação para a Ciência e Tecnologia under FCT/POCTI, partially funded by FEDER, is gratefully appreciated.

ABSTRACT

Recreation is one of the ecosystem's secondary values of a well conserved natural ecosystem, associated with the direct use individuals make of these natural assets. In this paper we define and estimate the total economic recreation value to visitors of a particular natural area, a national park. An on-site individual observation Travel Cost Model, Count Data distributions, and a version of hyperbolic discounting framework distribution were used to estimate a measure for the present recreation use of the site and the total discounted recreation value for a 50 years period. The empirical estimates of the average representative visitor's present equivalent surplus willingness to pay, based on the impact assumption of closure or loss of access to the park were 123 € per day per visit, and 593 € per each average five days length visit, per visitor. These values suggest that recreation use of nature has a higher value than certain economic activities in the area.

JEL: C3; D1; D4; Q2.

Key Words: Recreation Use Value; Ecosystem; Estimation; Travel Cost Method; Welfare Measures; Count Data Models.

1. Introduction

Increasingly, society is placing greater demands on wilderness areas for a variety of products including biodiversity, wildlife habitats, and recreation opportunities. Moreover, multiple-use sustainable management is been increasingly recognised as an important environmental policy tool, while non-consumptive nature's outputs like preservation, wildlife, and outdoor recreation are required to be considered in resource allocation decision-making on ecosystems. Hence, resource managers are facing decisions that balance society's different needs and values, while trying to ensure ecosystem sustainable integrity. This commonly leads to conflict and litigation, as individual's and stakeholder's opinions of ecosystem's management are commonly markedly different. Therefore managers need information that provides quantifiable measures of individual preferences and values associated with different management outcomes, to make effective, efficient, and equity planning and policy decisions. Money metrics of ecosystem's goods is though an important and desired tool in resource management. This is particularly important in a world of limited financial resources and environmental valuation, in combination with strong demand pressures for the overexploitation and destruction of natural assets. Although environmental valuation has been recognised and strongly applied by policy-makers in the EUA as an important decision-making instrument in the early sixties (Loomis 1999), it was only in the early nineties that EU environmental policies finally refer explicitly to economic valuation as a tool of decision[4]. Theoretically the utilitarian approach allows value to arise in a number of ways depending on how individuals use ecosystems[5]. Henceforth the recreation economic value of an ecosystem is economically defined as the sum of the net discounted values of the streams of the recreation services it offers. Depending on the type of use society makes of ecosystems, economics have settled for a total ecosystem value taxonomy interpreted as Total Economic Value (TEV) that distinguishes between Direct Use Values and Passive (Non-Use) Values (OECD 1999;

[4] Economic valuation is clearly mentioned as an important tool of the EU environmental policy in the following documents: Treaty on European Union signed in Maastricht in 1992, article 130R(3); the Fifth EC Environmental Action Program 1992 (Towards Sustainability: COM(92) 23); Treaty of Amsterdam 1997; the European Spatial Development Perspective (ESDP) document; the Agenda 2000 document; the use of Strategic Environmental Assessment (SEA), regulation 2001/41; the White Paper on Environmental Liability (COM (2000) 66); the Decision about the Sixth Environmental Action Programme 2001-2010 (Environment 2010: Our Future Our Choice: COM (2001) 31), January 2001; the European Strategy for Sustainable World (COM (2001) 264).

[5] Here interpreted as natural capital, i. e. a stock of environmental provided assets (e. g. soil, atmosphere, forests, water, wetlands, minerals) that result in flows of natural goods and services that are appropriated directly and indirectly by the economic sector and society in general when they used them at free cost (Serageldin 1996).

Turner 1999; Daily 1997). Total Recreation Value (TRV)[6] is one of the components of the TEV. Following the Hicks (1939) and Kaldor (1939) generic economic definition of value, the marginal recreation value an ecosystem has to the i^{th} individual that visits it, becomes the amount his or her would pay or be paid to be as well off with the ecosystem to produce recreation and leisure activities[7] as without it. Thus, recreation value is an answer, mostly, but not necessarily, expressed in monetary units to a carefully defined question in which two alternatives – the availability of the ecosystem to be visited and used or some amount of money – are being compared. Mäler (1971; 1974) defined four fundamental monetary measures of value of individual welfare change associated to choices involving the quantity and the quality of non-market goods and services[8] that can be easily applied to the existence and availability of ecosystems to produce outdoor recreation activities after the ecological characteristics of their amenities. If the object of choice generates an improvement in individual (visitor) wellbeing (a rising utility), like the availability of ecosystems for recreation purposes or an improvement of the quality of the natural amenities two situations are possible. Either the visitor is willing to pay (WTP) an amount to secure the change, termed Compensated Willingness to Pay (WTP^C) or he/she is willing to accept (WTA) a minimum of compensation to forgo it, the Equivalent Willingness to Accept measure (WTA^E). If the object of choice generates wellbeing deterioration (a decreasing utility) like the non-availability of some previous available ecosystem to be visit for recreation purposes, or its simple destruction, two situations are again possible. Either the individual is WTP to avoid this situation, termed the Equivalent Willingness to Pay measure (WTP^E) or he/she is WTA compensation to tolerate damage suffered, the Compensated Willingness to Accept (WTA^C). Formally, the measures can be defined in terms of the visitor expenditures function as follows[9]:

$$\boldsymbol{WTP^C / WTA^C = CS = e\left(p, r^1, U^0\right) - e\left(p, r^0, U^0\right) = \int_{r^0}^{r^1} \frac{\partial e\left(p, r, U^0\right)}{\partial r} dr} \qquad \textit{(1)}$$

And

$$\boldsymbol{WTP^E / WTA^E = ES = e\left(p, r^1, U^1\right) - e\left(p, r^0, U^1\right) = \int_{r^0}^{r^1} \frac{\partial e\left(p, r, U^1\right)}{\partial r} dr} \qquad \textit{(2)}$$

6 The formal definition of TRV and its components is based on Mendes 2004.
7 E. g. camping, hiking, sight-seeing, canoeing, birds- watching, horse-riding, climbing, and so on.
8 These four welfare measures were first proposed by Mäler as an extension of the standard theory of welfare measurement related to market price changes formulated by Hicks (1943). The analysis of this type of problem involving changes to either the quantity or quality of non-marketed environmental goods and services rather then changes to price or income, is often referred to as the theory of choice and welfare under quantity (Johansson 1987; Lankford 1988).
9 See Mendes 2004.

CS and ES are Consumer Surplus and Equivalent Surplus hicksian welfare money measures respectively, where $\boldsymbol{r}$ is a non-marketed environmental amenities vector representing an ecosystem and is assumed as a public good i.e. $\boldsymbol{r}$ is given; $\boldsymbol{p} = \boldsymbol{p}\left(\boldsymbol{p}^1,...,\boldsymbol{p}^i,...\boldsymbol{p}^n\right)$ is a vector of prices of the n marketed commodities that maintains constant; $\boldsymbol{r}^0$ is the initial state of $\boldsymbol{r}$, characterised by the preservation of a healthy ecosystem that produces amenities and $\boldsymbol{r}^1$ is the final state characterised by the ecosystem destruction or the non-availability of a previous existent ecosystem for recreation; U^0 is the visitor's level of welfare if he/she wishes to choose $\boldsymbol{r}^0$ and $\boldsymbol{U}^1$ is the visitor's level of welfare if he/she chooses r^1 so that $U^1 < U^0$; $\dfrac{\partial e\left(p,r,U^t\right)}{\partial r}$ is the derivative of the expenditure function with respect to $\boldsymbol{r}$, where $t = 0$ refers to the initial level of utility and $t = 1$ to the final's, after the change in $\boldsymbol{r}$; such a derivative represents the marginal value of a small change in $\boldsymbol{r}$ and is equal to the income variation that is just sufficient to maintain utility at its initial level (in the case of the CS money measure, $t = 0$) or final level (in the case of ES money measure, $t = 1$)[10]. Generally WTP differs from WTA which stems from both the respective differing welfare measure definitions and the choice contexts (Hanemann 1999): i) WTP is constrained by visitor wealth and the existence of substitutes as well, but WTA isn't; ii) if ***(p,r)*** changes and the visitor available income *m* remains unchanged, the measures are different; iii) WTA is particularly vulnerable to some pattern of individual behaviour in judgement and choice, involving phenomena commonly known as loss aversion (Kahnemann and Tversky 1979), endowment effect or status quo bias (Horowitz and McConnel 2002). This are the reasons why WTP is more often applied then WTA in empirical studies of non-market valuation because it overcomes the visitor's *risk aversion* related problems and is limited by the visitor available income. In short, when an economist is talking about the value the representative visitor gives to the right of using an ecosystem to produce outdoor recreation flows at time *t*, he or she means to WTP^{C_t}/WTA^{C_t} or WTP^{E_t}/WTA^{E_t}.

In the absence of markets, methods like Contingent Valuation, Hedonic Approach, or Travel Cost are used to generate welfare outdoor recreation measures ***(1)*** and ***(2)*** for a sampled representative visitor based on a sample of n visitors selected from the N

[10] The signs of the measures ***(1)*** and ***(2)*** depend on the change of *r* being an improvement or a loss. When $\Delta\boldsymbol{r}$ is a hypothetical or effective loss as it is in our case, then $\Delta\boldsymbol{U} = \boldsymbol{U}^1 - \boldsymbol{U}^0 < 0$, and (- ES) measures the visitor's WTP^E to avoid the loss, while (- CS) measures his or her WTA^C to tolerate it. However, by convention, CS and ES are always defined so as to be non-negative (Hanemann 1999).

relevant population. Aggregating this set of individual welfare measures across all the individuals assuming that all behave like the representative one, then

$$TRV^{t=0} = WTA_S^{C_{t=0}} \times \mathrm{N} \ \ or \ \ WTP_S^{E_{t=0}} \times \mathrm{N} \qquad \textbf{(3)}$$

and one gets the aggregated welfare money measure of the value the relevant population puts on the availability of the ecosystem for recreation at the moment $t = 0$, the present moment, to which one is trying to estimate the value. But, as already stated, being natural reproducible assets, the ecosystems yield flows of recreation services over several time horizons whose order of magnitude goes far beyond the typical economic ones (30, 50, 100 or even 300 years and more) and the measure ***(3)*** only reflects the average present recreation value at a single moment $t = 0$. Applying the inter-temporal utilitarian approach (Freeman III 2003; Perman et al 2003), we may obtain a money measure of the ecosystem's TRV that generates a flow of recreation benefits over a period T by simply summing up the present value of the single-period welfare measure (equation ***(3)***) using a discount rate ρ[11] so that

$$TRV = \sum_{t=0}^{T} \frac{TRV^{t=0}}{(1+\rho)^t} \qquad \textbf{(4)}$$

The objective of this paper is to estimate the TRV as defined by ***(4)*** of a particular set of ecosystems, the Peneda-Gerês Natural Park (PGNP). To fulfilled this objective, the following steps have to be taken: i) to estimate $WTP_s^{E_{t=0}} / WTA_s^{C_{t=0}}$ for the NPPG by assessing the average value that the sampled representative visitor gives to the existence of the Park at $t=0$, and per each day of use; and ii) to estimate TRV using ***(4)***. To calculate $WTP_S^{E_{t=0}} / WTA_S^{C_{t=0}}$ we shall use one of the TCM's individual based observation versions and the demand recreation function will be estimated with count data models. To our knowledge and at the moment we are writing the paper, there are no studies in the professional literature dealing directly with the TRV, the recreation demand, or the use of count data models to estimate the recreation use values afforded by the PGNP. Within EU, many studies have been implemented since the last decade of the 20th century, to estimate the use and the non-use values of ecosystems, but only eight used travel cost method (Navrud and Vägues 2000; Mendes 1997). Of these, only two concern the PGNP (Mendes 1997; Santos J.M.L. 1997) and only one uses the travel cost

[11] Nevertheless we cannot say that welfare measures at moment t = 0 are equal to discounted welfare measures for some ρ. This economic and very common procedure overstates the true lifetime loss of welfare associated to the ecosystem destruction or the limitation of the right of using it for recreation purposes. However, the difference is significant only if high values for the elasticity of inter-temporal substitution combine with large values of compensatory welfare measures over time (Freeman III, 2003).

method (Mendes 1997). The paper is composed of four sections. Following this introduction, in section 2 we estimate the PGNP's TRV for the sampled representative visitor per each day of visit and per each average on-stay length visit. Count data models will be used within a TCM framework to estimate a recreation demand function of the park and the visitor surplus per day and per visit. The visitor surplus will be used afterwards to estimate the theoretical individual welfare measures as defined by ***(3)***. In section 3 the TRV as defined in ***(4)*** is calculated, and in section 4 come conclusions and results discussion.

2. The Estimation of the PGNP's Present Recreation Value for the Representative Visitor

Method

TCM provides a mean to estimate the monetary values of non-marketed commodities based on actual behaviour, by using the individual's expenses with marketed commodities that are weakly-complementary with the non-marketed ones[12] as an indirect way to reveal individual' preferences (Freeman III 2003).The method establishes a relationship between the costs (price) incurred by travellers to a site and the number of trips taken. This relationship is further exploited to derive Marshallian CS for access to the site, for a recreation experience, by simply integrating the area under the demand recreation curve, between two levels of price (costs): the actual and the choke price (cost). TCM is one of the more popular revealed preference based method used in non-marketed valuation, over the past 30 years (Ward and Beal 2000). The general theoretical basis derives from the basic economic notion of an individual utility function subject to budget and time constraints. The representative visitor or household preferences are represented by the utility function

$$U = U(x, r, q) \qquad \textbf{(5)}$$

where x is a vector of market goods and services quantities, including those related with recreational outdoor activities; r is a vector of recreational services including recreation

[12] Let $x_1 = x_1(p, q, m)$ be a Marshallian demand function for commodities x_1 where x_1 is the amount of consumer goods; q is a measure of some environmental attribute and is complementary with x_1; p is the vector of prices. x_1 and q are weakly-complementary when the marginal utility of q is zero when the quantity demanded x_1 is zero. This holds only if x_1 is non-essential (Freeman III 2003).

in the PGNP; and q is a vector denoting the quality characteristics of the ecosystems, including the PGNP. The representative visitor is subject to two constraints: the budget and the time constraint. The income constraint is represented by the equation

$$m = wT_W = p_X^{'}x + p_r^{'}r \quad \textbf{\textit{(6)}}$$

where m is the available income of the visitor; w is the market wage rate; T_W is time spent on work; p_X is the price vector of the quantities x; and p_r is the price(cost) vector corresponding to the quantities r. The time constraint is represented by the equation

$$T = T_W + T_r \qquad \textbf{\textit{(7)}}$$

where T is the total available time and T_r is the time spent with recreational activities r. The representative recreationist maximizes ***(5)*** subject to ***(6)*** and ***(7)***, yielding a set of ordinary demand functions for the marketed commodities and the recreational activities. Thus, the ith recreationist's demand function for the PGNP is

$$r_i = g_r\left(p_X, p_r, m, q\right) \quad \textbf{\textit{(8)}}$$

The estimated coefficients of ***(8)*** are further used to calculate the recreation value of the site. By simply integrating the recreationist's demand curve between two prices (costs) yields the CS marshallian welfare measure:

$$CS = \int_{p_r}^{p_r^0} g_r\left(p_X, p_r, m, q\right)\, dp_r \qquad \textbf{\textit{(9)}}$$

where p_r is the present recreation price which is equal to the recreationist's total expenditures necessary to produce r, and they may include trip, on-site expenditures, and the opportunity cost of time; p_r^0 is the choke recreation price. The measure ***(9)*** is the money measure of the ith individual's benefit related with the use of the site to produce recreation activities. TCM allows to measure p_r in the absence of recreation markets. The wide variety of TCM models appearing in the academic and empirical literature are variants on the general structure of the model above, the way the dependent variable r is defined and measured, and the estimation strategy used (Ward and Beal 2000; Fletcher et al 1990). Building on the belief that the basis for evaluation is the benefit measured by CS derived by people when they use the ecosystem, TCM is predicated on a number of assumptions, foremost of which is that individual's recreation visits to a site respond to changes in the travel-related component of the cost of the recreation visit in the same way as they would respond to a change in an admission fee (Freeman III 2003). TCM has generally been preferred to estimate economic use values over other non-market methods because of its behavioural base, although is not free of limitations. In spite of its direct link to actual visitor behaviour, a number of assumptions[13] and research judgements are required to get from reported visits to the relevant economic measures, like elasticity of demand and CS (Ward and Beal 2000; Mendes 1997; Fletcher and al 1990). The most frequently used TCM empirical versions are the zonal and the individual versions. The zonal version of the model was the first one to be developed (English and Bowker 1996; Hellerstein 1991). It establishes a relationship between per capita participation rates (the recreation demand *r*) at an ecosystem from various geographic origin zones, and the costs incurred in travel (the price per each unit of recreation demand) from the origin zone to the given natural site. The individual TCM version is conceptually similar to the zonal one, however, the recreation demand/price recreation cost relationship is based solely on individual observations. The individual version is highly preferred to the zonal for reasons such as (Mendes 1997): i) statistical efficiency; ii) theoretical consistency in modelling individual behaviour; iii) avoiding arbitrary zone definitions, and iv) increasing heterogeneity among populations within zones. There are however several problems with the nature of the dependent variable and the way it is measured and defined. Demand for visits to a specific site is frequently measured in number of trips or days per period of time. So they are non-negative integers which results in a truncated (at zero) data set. A second feature of recreation demand data is when the dependent variable is the count of the number of visits taken over some period of time (a season, or a year), many observations near 1 or 2 are common. Therefore the observed dependent variable is the outcome of a data-generating process based on unknown probability distribution function defined on the non-negative integers, termed count data process. A third feature of recreation demand is that with on site surveys of recreationists the probability of some visitor being surveyed depends on the frequency of visits to the site. This is called endogenous stratification. Count data models explicitly recognise the non-negative discrete nature of the recreation dependent variable, and they are particularly suitable for modelling recreation demand through the individual TCM version. A number of recent studies applied this type of models to recreation demand. Shaw (1988)

[13] Several separability assumptions are made concerning the arguments of the utility function like: i) the recreation activities used to produce the recreation services of the vector *r* are separable; ii) all the out of pocket expenses with the trip and the stay are separable between them; iii) in the presence of multi-destiny trips again separability is assumed; iv) and finally , there is total separability between trip choices which means each trip is decided one by one at the time, instead of all being chosen within a single period of time.

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 standard basic Poisson model (POIS) that corrected for the sampling problems. The basic POIS captures the discrete and nonnegative nature of the dependent recreation demand variable and allows inference on the probability of visits occurrence. However POIS estimators are biased downward and Marshallian's CS as calculated by ***(9)*** will be overstated in the presence of over dispersion[14], a very frequent statistical phenomenon in real data. The standard negative binomial model (NB) corrects for over dispersion, by allowing the conditional variance to be different from the mean (Long 1997; Grogger and Carson 1991). Subsequent work has extended Shaw's application to include truncated POIS (TPOIS) and NB distributions (TNB), as standard POIS and NB estimators are biased and inconsistent in the presence of truncation because the mean function of the count data model is misspecified (Creel and Loomis 1990; Grogger and Carson 1991; Gurmu 1991). 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 TNB model that corrected for both endogenous stratification and truncation. To recent developments in count data models applied to recreation see Sarker and Surry (2004) and Santos Silva (2003; 1997). Those further applying count data models to recreation demand functions and related welfare estimations based on individual TCM version include Hellerstein (1989; 1991), Creel and Loomis (1990; 1991), Hellerstein and Mendelsohn (1993), Yen and Adamowics (1993), Bowker and Leeworthy (1998), Sarker and Surry (1998; 2004), Crooker (2004); Englin and Moeltner (2004). Finally, the second problem with the nature of the dependent variable is related with its definition. If demand is defined as the number of trips to a site during a period of time, we will be dealing with a non-homogeneous

[14] There is over dispersion when the conditional variance of the dependent variable is greater than the conditional mean. This contradicts clearly the basic assumption of the POIS model, which states that the conditional variance must equal the conditional mean. Over dispersion is caused by unobserved heterogeneity in the population parameter. The POIS model with over dispersion: under predicts the true frequency of zeros; over predicts the true frequency of other small values; and under predicts the true frequency of large counts (Sarker and Surry 2004)

dependent variable, because there are one-day trips, two-day trips, three-day trips, and so forth. Non-homogeneity of the dependent variable becomes particularly problematic if the objective is to quantify monetarily welfare measures by using the CS measure, because we are not considering an homogeneous marginal CS. This problem is not generally recognised in most of the empirical TCM studies, even in those interested in the calculation of welfare measures and not only in the study of the recreation demand behaviour of a given site. One alternative to go beyond this obstacle is to define visits as the number of days per trip instead of the number of trips or visits and thereby we can calculate an average marginal CS associated with the recreation benefit of one day of stay in the site[15].

In this paper we want to monetarily estimate the recreation use value of the representative visitor of the PGNP by using the WTP^E welfare measure of one-day-of-stay in the park per visitor, by using the on-site individual TCM version to specify the recreation demand function. We are not interested in recreation demand prediction. A recreation demand function of the type of ***(8)*** will be estimated using count data models, in order to calculate the Marshallian welfare measure ***(9)*** for the sampled representative visitor. The measure **(9)** is equal or at least is a proxy of the true welfare Hicksian measure WTP^E only if the income effect related with p_r is inexistent or very small[16]. If the PGNP's recreation demand is a normal good, the hierarchical relation between the three welfare measures will be $WTP^E < CS < WTA^C$ in the case of a decreasing utility, related with the PGNP visitor interdiction.

The Model

Although the recreation demand for a site may be modelled as aggregate or market demand, the most common practice is to estimate the recreation demand of the representative individual and then to calculate aggregate value measures as the sum of the individual's recreation values (Freeman III 2003). To estimate the marginal CS of the i^{th} PGNP visitor who seeks this natural site to enjoy its unique and rare natural

[15] CS per day of use (CSPDU) is a common way to measure the recreation benefits the representative visitor derives from a visit and is commonly used, for instance, by the US Forest Service as a basic recreation site value. Morey (1994) defined CSPDU and how compensate valuation can be derived from it. He proofed that CSPDU for a price change of a recreational site is that price change, so it is a constant, independent from the number of days the site is visited. And if it is a constant, it can be used, along with information on the number of days at the site in the initial and the proposed states to approximate for compensated CS for that change.

[16] If, by no means, Marshallian CS ≠ WTP^E, the Marshallian measure is still a good WTP^E proxy if it is bounded by the intervals defined by Willig (1975), Randall and Stoll (1980) and Hanemann (1991).

amenities and landscapes, by self-producing several recreational activities like camping, sight seeing, hiking, canoeing, and others, we used an on-site individual TCM version (Bell and Leeworthy 1990; Hof and King 1992; Font 2000), where the dependent variable is number of days on-site, not number of trips, and because it uses on-site and travel out-of-pocket costs, as well as travel and on-site time opportunity costs, and not only travel costs. We used Mendes (1997) on-site TCM empirical approach, where the representative visitor combines time and money to reach the site and to stay there, and chooses the number of days per visit that minimize total travel and on-stay costs (Wilman 1987).

The general specification of the TCM was

$$DRP_i = f\left(price_i; available\ recreation\ income_i; individual\ characteristics_i, \beta, \varepsilon_i\right) \quad \textbf{(10)}$$

where price/recreation costs, available recreation income, and individual characteristics are independent variables, β is the vector of parameters, and ε_i is a random disturbance that is independent from the disturbances of other individuals. The recreation demand was modelled as the number of days one visitor stays in the park, per trip (DRP_i) at the time of the questionnaire. Count data models stipulates observed individual days of recreation per trip as realisations of unobserved actual on-site demand per trip, which follows standard or truncated POIS or NB distributions with mean λ_i [17]. By choosing the semi-log form[18], the expected on-day site demand equation ***(10)*** is specified as follows:

$$E(DRP_i) = \lambda_i = \exp\left(\beta_0 + \beta_1 CDRP_i + \beta_2 YR_i + \beta_3 TR_i + \beta_4 ID_i + \beta_5 ED_i + \beta_6 P_i\right) \quad \textbf{(11)}$$

and may be written as:

$$\ln \lambda_i = \beta_0 + \beta_1 CDRP_i + \beta_2 YR_i + \beta_3 TR_i + \beta_4 ID_i + \beta_5 ED_i + \beta_6 P_i \quad \textbf{(12)}$$ [19]

where $CDRP_i$, YR_i, TR_i, ID_i, ED_i, and P_i are explanatory variables, and *β's* are the unknown coefficient to be estimated. Explanatory variables include the i[th] minimum recreation cost of each day of stay in the PGNP, including travel cost ($CDRP_i$), per capita available recreation income (YR_i), number of available days to spend with recreation (TR_i), age (ID_i), level of education (ED_i), and the perception degree the visitor has of the natural characteristics of the park (P_i). As shown in Hellerstein and

[17] See Appendix.

[18] The semi-log form is commonly used to specify count data recreation demand models (Shaw 1988, Grogger and Carson 1991; Long 1997).

[19] Like many researchers in the past, Mendes (1997) used OLS to estimate several linear and non-linear recreation demand specification forms, which results however, as claimed by Shaw 1988), into biased and inconsistent estimated coefficients and welfare measures, if sample estimations are to be applied to the population.

Mendelsohn (1993), the representative visitor's CS per each average day of stay visit can be derived by integrating the recreation demand function ***(11)*** over the relevant price/ on-stay cost change i.e.

$$CS_{per\ visit} = \int_{CDRP_S}^{CDRP^0} \lambda_S \ dCDRP = -\frac{\lambda_S}{\beta_1} \qquad \textbf{\textit{(13)}}$$

where $CDRP_S$ is the actual sample mean of each day on-stay cost and $CDRP^0$ is the choke recreation day cost. The CS per visitor per each day of visit is simply measured by $-1/\beta_1$ (Bokstael 1987). Equation ***(11)*** gives λ_i, the expected latent quantity demand, where *β's* are the parameters of the population recreation demand for days of stay in the park per visit. Therefore the respective estimates can be used to calculate the CS for the general population (Grogger and Carson 1991[20]; Englin and Shonkwiller 1995[21]).

As shown in Bockstael et al (1987) and Englin and Shonkwiller (1995), the visitor's Hicksian welfare measures of one average length day-of-stay visit with a semi-logaritmic form demand function, are given by the formulas:

$$WTA_S^{\ C} = \frac{1}{\beta_2} \ln\left(1 + \frac{\lambda_S \beta_2}{\beta_1}\right)$$

and ***(14)***

$$WTP_S^{\ E} = -\frac{1}{\beta_2} \ln\left(1 - \frac{\lambda_S \beta_2}{\beta_1}\right)$$

where β_1 is the estimated parameter of price/recreation cost of the recreation demand function, and β_2 is the estimated available recreation income parameter of the same function. These expressions are based on the impact assumption of a recreation cost change for infinity of a day-of-stay in the PGNP, which in turn can be interpreted as PGNP closure or loss of access for the time period of interest. The expressions can be converted into per-day of stay measure by dividing them by λ_S.

Aggregating ***(13)*** and ***(14)*** by ***(3)*** for the *n* individuals of the sample, yields $TRV^{t=0}$**,** the present recreation value for the sample[22].

[20] "From equation *(19)* … we see that the effect of a change in one of the X_{ith} on the latent dependent variable in the full underlying population can be inferred from information obtained from a choice-based sample [that is the group in the population of interest from which the choice-based sample is drawn]", pp 6.

[21] "The average person's total use value is the product of the value per trip to the average individual in the population times the number of trips the average person will take (the latent variable)", pp 1.

[22] Farber et al (2002) pointed out that this traditional aggregating visitor values procedure is an appropriate way to represent the socially-relevant unit value if the negative effects of recreation externalities – congestion -, if existing, may be considered as having

The Data, Estimation, and Analysis of Results

PGNP was created in 1971 and is located to Northwest of Portugal. It includes a surface of 72000ha and it is the only National Park Category within the Continental part of the country. It is an Area of Special Birds Protection and a site included in the National List of Sites (Net Nature 2000). The park is rich in rare botanical species (as the lily of Gerês, an Iberian endemism, or the fetus of Gerês) and it presents important stains of well conserved oak-groves, riparial vegetation and peat-bogs. The fauna is also very rich and includes the wolf, the stag, and savage ponies, several species of bats, and Iberian Peninsula typical mountain birds. The area is fertile in prehistoric and Roman trucks, medieval monuments, curious mountain agglomerates, and curious and unique humanised landscapes like *lameiros* and *prados de lima*. Like many other European national parks, PGNP experiences uneven recreation demand, with a peak period during summer (July, August, and September), but it is during August that recreation demand rises exponentially. The rest of the year is non-peak period. There aren't available statistics accounting for and characterising the visitors. The only existing data are those of park's camping sites, but they are not sufficient enough to characterise recreation demand.

Some of the data used to quantify the dependent and independent variables of ***(11)*** were obtained part from an on-site inquiry by questionnaire to a population composed of Portuguese citizen's over-18th. 1000 questionnaires were distributed to Portuguese citizen's over-18th that were visiting the park at the time of the questionnaire during the 1994 summer peak-period months, for visits equal or greater then 24h. 243 had been correctly filled out. All the monetary data are measured in 2005 euros. The information gathered included the number of days of stay in the park during that visit, the income step the inquired belongs to, his/her geographical origin, the transportation mode, if he/she travelled in company, various demographic characteristics (gender, age, number of years of education, if they were in the vacancy period and the number of vacancy days), and some questions to capture the visitor's perception concerning the specificities

---

an irrelevant impact upon the visitor recreation utility. And we further add that this may be accurate as far as the marginal income is constant with respect to recreation demand and income and if we accept the assumption of the equality between the N individual utility functions (Johansson 1987).

of the PGNP natural and humanised ecosystems and landscapes. Unfortunately we had to drop this last variable because a great majority of visitors did not answer adequately. Nevertheless, the questionnaire implemented by Santos J.M.L. (1997) permits to conclude that visitors generally recognise the PGNP's specificities, and their demand is unambiguously related with them. Yet the absence of a perception variable in this empirical on-site cost TCM approach is by no means an obligation, because the aim is to estimate a welfare measure and not to predict multi-site or PGNP recreation demand, nor to measure the welfare impact of quantity modifications in the ecosystems. Substitutable variables are not considered because: i) we do not want to predict PGNP recreation demand; and ii) one assumed visitors recognise PGNP as being a unique ecosystem, with non-substitutable amenities. To overcome the multi-destiny trip problems, trips to additional sites were counted as separate observations and thereupon we considered visitor's geographical origin to be the place the visitor was when he/she definitely decided to travel to the park. To quantify the PGNP's welfare measure, only the relevant expenses strictly related with the trip and the on-site stay were considered. For these reasons, the distance in Km's since the origin to the site was calculated assuming the faster and more accessible itinerary, to avoid the trip's utility generation. The Km's were counted on a common road map. In the case of multiple destination trips where the PGNP was not the primary purpose, only the round-trip km's from the temporary origin to the park was included[23]. To avoid lodging's utility generation, camping was considered the relevant mode of lodging. Due to severe time and budget constraints to implement the questionnaire, the camping on-site sample was the method chosen to gather a sample with non-zero answers, and guarantee an adequate number of observations related with one-day and more day visits. To avoid endogenous stratification, visitors were interrogated at the time they addressed themselves to the camping reception centre, for camping inscription. The cost of one day of stay[24] in the park (in euros) was calculated according to the formula

$$CDRP_i = \frac{CV_i}{MDE_i} + CMDE_i + CT_{vi} + CT_{ei} + PUD$$

[23] Although this method used to surround the multiple destination trip problems remains a debatable researcher judgement, as all the others do too, we feel, like Bowker and Leeworthy (1998), it is appropriated.

[24] The marginal cost of one day of stay was assumed to be constant, which seems to be reasonable because: i) the travel cost is fixed with the geographical origin; ii) the on-stay costs are minimum and there isn't any entrance fee; iii) the marginal cost only depends of the opportunity time cost, which is assumed to be constant.

where CV_i is round travel cost in euros[25]; MDE_i is the mean number of days that the visitors with origin from the same geographical district as visitor *i*, stayed in the park[26]; $CMDE_i$ is the cost in euros of each day of stay[27]; CT_{vi} and CT_{ei} are the opportunity costs in euros of travel and on-site stay time per visitor per day, respectively; *PUD* is the park entrance fee in euros which is zero. To quantify CT_{vi} and CT_{ei}[28] we partially based on the opportunity travel and on-site time cost's valuation method more commonly used in TCM literature, where travel and on-site time cost is one-third of the individual's wage rate (Bockstael 1987; Chakraborty and Keith 2000)[29]. Instead of individual's wage rate we used the visitor's per capita per hour available recreation income measured in euros instead. Travel and on-site recreation time were both previously estimated, and it was assumed that a recreation day is equal to 16h following the definition of one typical recreation day of Walsh (1986) (see Mendes (1997) for details). *YR*, was estimated since the net income declared by individuals in the questionnaire and it was assumed to be equal to a 14th monthly remuneration (see Mendes (1997) for details). The other explanatory variables like *TR*, *ID* and *ED* were quantified directly from the questionnaires. The sample has nonnegative integer characteristics, is truncated at zero because observations with zero days in the park are not observed, and is not endogenously stratified.

Descriptive statistics from the data set are presented in Table 1 and Table 2. During the on-peak summer season, the visitors of the PGNP stayed in the park for 5.284 days on average. The data do not exhibit a quick decay process; more than one half of the sample visitors took visits of one day to six days. About 10% took one-day visits, 16% two days visits, 10% three days visits and so on. About 5% made ten days visits and 3% fifteen days visits. The variance of the dependent variable is high, 12.766, which means the equidispersion property of the POIS model may not hold. Table 3 presents the

---

[25] The transport mode was considered. If the visitor used a car then $CV_{car,per\ capita} = [\cos t / km \times n^{o}\ km's + taxes] \times 2$; per-km cost was dependent of the technical characteristics of the vehicle and included oil, gas, and tolls. If the visitor used a moto, then $CV_{moto} = [\cos t / km \times n^{o}\ km's] \times 0.5 \times 2$. If the visitor used a public transport, then $CV_{public} = [travel\ fee] \times 2$. For individuals travelling together, shared costs were apportioned to the respondent. See details in Mendes (1997).

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

[27] *CMDE = camping visitor fee + car fee + alveolus fee*. Food expenses are not included, because they are not relevant costs.

[28] $CT_{vcar} = 1/3 \times median\ YR\ percapita\ perhour \times \left(\frac{number\ of\ hours\ traveled\ to\ the\ PGNP\ and\ back}{number\ of\ days\ of\ stay} \right)$; $CT_e = 1/3 \times medianYRpercapitaperhour \times 16h$.

[29] The opportunity cost of travel and on-site time has been one of the more discussed issues by those economists interested in the use of recreation or wilderness sites and is still on going. To have a more complete picture about this subject see for instance Fletcher et al (1990); Ward and Beal (2000); Mendes (2002). For details about the methodology used in this paper see Mendes 1997.

parameters estimates from six specifications of count data model: standard and truncated POIS, NBI, and NBII. The technical description of these statistical analyses is found in the Appendix. We tested for several alternative specifications of the demand equation ***(12)***[30] but the one that fits the best to the data is the semi-log form, which is presented. We also test for other two alternative methods of quantifying the travel and on-site cost of time[31], but the estimated price/recreation cost coefficients were all very similar, which allow us to conclude that our estimated demand recreation function is not significantly sensitive to the way time cost is measured. The maximum likelihood procedure is used to estimate all count data models[32]. It was hypothesized that demand for recreation days in the PGNP would 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. α, the nuisance parameter, that reflects the existence of over dispersion, is significant in the NB models, which suggests that the POIS estimation is not a suitable estimator for our data[33] given that it is truncated. This confirms our early conclusions drawn from the analysis of the descriptive statistics presented in Table 1. Furthermore, based on the smaller value of the log-likelihood function of TNBI relatively to TNBII we may consider the first a better fit. The standard errors of the coefficients were computed using the Eicker-White procedure[34]. The price/recreation cost, the available recreation income, and the available recreation day variables have 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 recreation days. Therefore PGNP's per trip recreation days demand is an ordinary (price-elasticity is negative), and normal good (income elasticity is positive and inferior to one). Also, the number of recreation days is more responsive to price changes than to income changes (the absolute value of the price-elasticity is higher than the absolute value of income-elasticity). Truncation did not reduce, rather augmented, the absolute values of price and income elasticity. However, the demand for recreation days seems to be not very

[30] Logarithms of continuous right-hand side variables and quadratic forms for some variables like ID and ED did not visibly improved the results.
[31] We test the results without time cost and with time cost equal to 50% of the median YR per capita per hour. And the results for the parameter β_1 associated to the variable of price/recreation cost CDRP varied between 0.00470 without any time cost, 0.00567 with time cost equal to 1/3, and 0.00550 with time cost equal to 1/2, for the NBII model. The same type of conclusion was drawn from the POIS and NBI models.
[32] The estimation programs were written in TSP.
[33] Over dispersion tests for the POIS regression confirm the evidence of over dispersion.
[34] This procedure generates a heteroskedasticity-consistent covariance that is asymptotically valid when there is heteroskedasticity of unknown forms. Heteroskedasticity is very common in cross-section estimations (Green 1991).

sensitive (inelastic) both to recreation cost and income variation; per each unitary growth of recreation cost the demand for recreation days in the PGNP goes down only from 0.53% minimum in the NBII distribution, to 0.72% maximum in the TNBI distribution while per each unitary growth of the available recreation income, the demand for recreation days goes up from 0.030% minimum in the NBII and TNBII distributions to 0.04% maximum in the TNBI. Using TNBI estimates of price elasticity (Table 3), a price/recreation cost increase of 1% per person per day effect approximately a 0.364 drop in recreation's day demand per person. The variable Age (ID) has the expected signs, but the variable Education (ED) doesn't. These two demographic variables are the only ones that are not significantly different from zero. This is explained perhaps by the fact the sample's dimension is not sufficiently high to incorporate the ID and ED variations as being significant for the DRP explanation. All the other variables are significantly different from zero at 1% level and less. The parameter estimates of the six models are similar in magnitude and sign, except for the demographic variables ID and ED which allows us to conclude that the coefficient estimators are not significantly sensitive to the estimation process. However the truncated models seem in general to provide a better fit four our data accordingly to the value of the log-likelihood function.

Both Marshallian and Hicksian welfare measures were estimated in this study. Table 4 reports CS, WTP^E, and WTA^C per person per visit, and per person per day. CS, WTP^E, and WTA^C per person per visit were calculated by the formulas ***(13)*** and ***(14)***, respectively. CS, WTP^E, and WTA^C per day were estimated by dividing the former measures by λ_S. Consumer Surplus per day of the representative visitor who took a trip to the PGNP during the summer of 1994 for recreation purposes varies from 138 € minimum in the TNBI distribution to 190 € maximum in the NBII distribution (37%). The Consumer Surplus per each 5 days-length visit to the PGNP varies from 664 € in the TNBI distribution to 971 € in the NBII distribution (46%). However, the differences are not so sensitive within each group of distribution. The difference between the CS per day calculated after the three generalised models is only 8% and within the truncated models is 21%. The three welfare measures are hierarchically related as theoretically expected for all the models, when we are dealing with welfare changes associated with declining utilities. As expected, WTP^E of the representative visitor per day is inferior to Marshallian CS and obviously inferior to both CS and WTA^C, and varies from 124 € in the TNBI to 167 € in the NBII. Again the differences with the WTP^E are similar to those in CS. The welfare measures reveal some sensitiveness to the estimation procedures, particularly in the group of the truncated distributions, but not as high as what we would expect, from the analysis of the empirical results of other TCM's studies. However, the differences are sufficiently important to estimate the intervals of confidence for the welfare measures[35]. The same moderated sensitiveness is revealed between the welfare estimates and the time cost procedure (e.g. WTP^E varies only 8% from the POIS lower level to the higher NBII level, while CS estimated from NBII varies only 17% between the lower level (zero time cost) to the higher level (time cost equal to 50% of the available recreation income). Aggregating the WTP^E of the representative visitor per day calculated by the TNBI model across the sample following equation ***(3)*** generates the sample's WTP^E, for one day of recreation in the PGNP, which is 30016 € (123.521×243). These values mean that the PGNP's representative visitor gets a use benefit of 124 € per each day in the park, and 593 € per each visit of 5 days. The recreation use value of 1215 days in the park is 150660 € (1215×124 *euros*).

3. The TRV of the PGNP

The values estimated in section 2 are related with the recreation use benefits of a sample of visitors, during the summer season. Nevertheless they may be interpreted as being representative of annual instead of seasonal values, because of the seasonal characteristics of outdoor recreation. Besides, the values reflect the recreation value at a single present moment, but do not account for the temporal dimension of natural recreation use values. But as the PGNP's is a reproducible asset yielding annual recreation benefit flows over several time horizons, in practice this means that if we assume: i) the visitor preferences are fix; ii) the PGNP maintains there natural characteristics and availability for recreation, then the 243 visitors of the sample will annually beneficiate of a 150660 € benefit flow equivalent to 1215 days of use. Therefore, to obtain the sample's TRV of the PGNP over a period T (say 30, 50, 100 or 300 years and more) we will summing up the present recreation value of the single-period welfare measure calculated in section 2, by using a discount rate, following the

[35] Confidence intervals around these measures will be measured latter on, by using a re-sampling technique known as bootstrapping. This is an important task because point estimates of average benefits derived from a single sample of visitors may not be sufficient information for making optimal decisions.

equation (4)[36]. Due to several reasons already explained in the paper, WTP^E estimated by the TNBI model will be used to calculate TRV of the PGNP. Discounted utilitarianism has proven particularly controversial when applied to environmental valuations[37]. The origins of such controversy are: the practice of discounting itself; the number used to measure the discount rate ρ; and the irreversibility, risk, and uncertainty surrounding futures outcomes (Freeman III 2003; Heal 1998). Albeit all the still persisting controversy about discounting, Heal (1998, 1985) demonstrated that discounting future utilities is in some sense logically necessary. A growing body of empirical evidence suggests that the discount rate that people apply to future projects is positive, not zero, and depends on the futurity of the projects and the magnitude of income involved (Cropper et al 1994; Lowenstein and Elster 1992; Lowenstein and Prelec 1992; Lowenstein and Thaler 1989; Thaler 1981). Because utilitarian geometrical discounting based on a positive constant rate is discriminating against future generations by attributing less weight to their utility levels while empirical evidence seems to deny the constancy of the discount rate, some economists began to think over alternatives to the classical utilitarian approach. Logarithmic discounting or hyperbolic discounting is one such alternative[38] (Lowenstein and Prelec 1992). Another problem with utilitarian discounting is about the number that shall be assigned to the rate of discount. Arrow et al 1996 advocate that there are basically two approaches to choose the discount rate, the prescriptive approach and the descriptive approach. Under the former, lower future discount rates must be used (tending to zero) in contrast with the last approach that relies fully on historical market rates of return to measure the discount rate. In practice, policy makers have, in certain cases, applied lower discount rates to long-term intergenerational projects (Bazerlon and Smetters 1999). More recently Weitzman 2001 demonstrated that the very wide spread of professional opinion on the discount framework mean that declining discount rates should be used, around 4% annum for the immediate future down to around zero for the far-distant future (300 years and more). Another major issue in ecosystem evaluation has been how to account for the fact that preserving an ecosystem is likely to represent an impediment to alternative economic investment that might generate a higher rate of return than the effective interest rate governing individual intertemporal substitutions. In doubt, and where the environment

[36] The default criteria used by economists to include time is provided by the discounted utilitarianism framework which has thus far dominated more for lack of convincing alternatives than because of the conviction it inspires.
[37] For discussions see Nordhaus 1994, and Portney and Weyant 1999.
[38] It is grounded in empirical individual behaviour suggesting that a given change in futurity leads to decreasing weighting of future utilities the further the event extends into the future.

is involved, most non-economists and economists take the view that a lower rate is more adequate when geometric discount is applied, as it attaches greater weight to the interests of future generations than a higher one. Beyond the controversy surrounding discounting framework and its arithmetic, some other questions arise when ecosystem valuation is under discussion, such as irreversibility and uncertainty over visitor's preferences[39]. The former inflationates the ecosystem's scarcity value (Krutilla and Fisher 1985). The later has large consequences for optimal choice and welfare measures related with preference aggregations (Pizer 1998; Arrow et al 1996). Regardless, some authors prefer to choose fix overtime preferences because of the difficulties with preference aggregations (Nordhaus and Popp (1997) for instance). To compute (4) to estimate total recreation use value of PGNP, we are going to follow the Weitzman (2001) hyperbolic discounting framework for a period of time T equal to 50 years. These mean that the Immediate Future (1-5 years) is discounted at 4% marginal rate; the Near Future (6-25 years) at a 3% marginal rate; the Medium Future (26-50 years) at a 2% marginal rate; and finally the Distant Future (76-300 years) at a 1% marginal rate.

Therefore, by using ***(4)*** and the Weitzman (2001) hyperbolic discounting framework, if the PGNP will maintain their ecosystems holding the same natural characteristics and amenities for 50 years, and if it will be available for recreation use, than one day of recreation will generate a total recreation use value of 3874 €. The total recreation use value for the representative visitor during 50 years, per visit, will be worth 17896 €, and 1215 recreation use days in the park worth 4369434 €. Due to difficulties with inter-temporal preference aggregations, it is assumed that individual preferences are fixed and equal to those at the present time. In practice this means that it will be assumed that the present total recreation value as estimated in section 2 will be fix for the relevant period of time T = 50.

4. Discussion and Conclusions

In this paper we calculate the willingness to pay by an average visitor of the PGNP when he/she uses the park's ecosystems as a natural capital to produce flows of outdoor recreation services. Following the theoretical definitions of the recreation welfare

[39] Visitors might be uncertain as to whether a specific ecosystem amenity flow will be available for their use in the future or whether individuals themselves will want to consumptively use certain ecosystems in the future or provide future generations instead with the opportunity to decide between conservation and development.

measures came the empirical application where a TCM's individual version based on count data models was used to estimate the PGNP's recreation demand function and the subsequent visitor's Mashallian CS welfare measure, and the Hicksian CS and ES welfare measures. These measures were estimated based on the hypothetical impact assumption of a recreation price (cost) change for infinity of a day of stay in the PGNP which in turn can be interpreted as PGNP closure or loss of access. To pass over some problems related with the nature of the dependent variable and the way it is measured and defined the following options were made. The dependent variable was defined as the number of recreation days each visitor stayed in the park, during that visit, at the moment of the questionnaire. By doing so it was possible to estimate the Marshallian consumer surplus per each day, and per each visit, on average, for the representative visitor of the sample, and the subsequent Hicksian welfare measure WTP^E per day and per visit. Count data models were used to estimate the recreation demand function, because the number of recreation days per trip are non-negative integers, and the sample is truncated at zero. Therefore, the use of common regression linear methods with this type of data sample would generate inefficient, biased, and inconsistent estimations. We obtained the following results. One recreation day in the PGNP at the present moment of the questionnaire values 124 € (2005 prices) for the average representative visitor of the sample, and 593 € per each average five days length visit. Thereupon, we considered that if the average representative visitor would keep on visiting the park for 50 more years, the total recreation value of each day visit would be 3 874 € and each average five days length visit would be worth 17 896 €. These are relatively large use values for the users of the PGNP. To have a more precise idea about the values involved in the year of the questionnaire, approximately 12 000 visitors camped in PGNP generating a present recreation value per day of visit of 1 488 000 € $(12\ 000 \times 124\ euros)$), and of 7 116 000 € $(12\ 000 \times 593\ euros)$ per each average five days length visit. To infer about the population use value of PGNP some caution has to be taken. Though the parameter estimators of the demand curve are consistent for the population, it does not guarantee that the representative visitor based in the sample is representative for the population. This is due to the fact that the explanatory variables observed, the visitors' characteristics, come from the truncated distribution and following Santos Silva (2003) the truncated distribution of the independent variables is different from the un-truncated population distribution. On other words, the average person of the sample can be thought as representative of those that actually visited de park and not of the entirely population. Therefore, only those measures that depend exclusively on the parameters of the demand curve, as the Marshallian CS per day, can be used to make predictions for the population. Consequently, if for example 1% of the 18th and more year old Portuguese population went to visit the PGNP, a $10 \times 10^6 euros$[40] (70262×138 *euros*) total present use benefit per day would be generated, while 25% of the same population would generate a total present use benefit of 242×10^6 euros[41] per day. Applying the same ratiocination to half of the population, one recreation day in the PGNP would have a present benefit value almost equivalent to half's that of the Vasco da Gama's bridge[42]. The results indicate that PGNP's visitors receive a considerable amount of benefit from the recreation use of PGNP's ecosystems which allow us to conclude that the park has a high hidden economic value and is a valuable asset for society. This suggests that management resource should be allocated to recreation use, specifically to eco-tourism activities, as a mean to develop the local area in a sustainable way, and 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 existing natural facilities that would probably be economically and socially justifiable. For instance, one of the problems with the PGNP is a certain degree of congestion during the peak-load summer season, where many people share the PGNP while revealing behaviours that are not compatible with nature conservation goals. The price/recreation cost elasticity suggests that if the management entities of the park would want to implement entry or access fees, that would not have any dramatic effect upon recreation days demand per trip. Besides, during the questionnaire phase of this study, visitors were asked if they were prepared to pay an access fee and 23% answered Yes. At a first glance, this percentage does not seem particularly enthusiastic, but it is nevertheless important for the Portuguese case and similar countries, where people are not used to the idea of paying an access fee for the right of using nature. The major limitations of our study are the small sample size and perhaps the lack of some socio-demographic variables. Also we only estimate the point welfare measures but not the confidence intervals which will be done later on. Another limitation is the lack of statistical information about the annual number of visitors. If the PGNP's managers would allocate resources to obtain this

---

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

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

[42] 485×10^6 euros and 897×10^6 euros, respectively.

statistical information, the conclusions of this study could be used to quantify the stock recreation value of the PGNP.

Acknowledgements

We wish to thank João Caravana Santos Silva for their helpful comments and suggestions. Any remaining errors are of course our own.

Appendix: the Estimators

The standard POIS model assumes that the non-negative integer nature of recreation demand data can be described as the result of many discrete choices, satisfying a Poisson discreet probability distribution, $\mathbf{Prob}(Y_i = k) = f(k) = \frac{\exp(-\lambda)\lambda^k}{k!}, \forall \lambda > 0,$ where *i = 1, 2, ..., N* visitors, Y_i is the i[th] observation on the number of days in the park per trip, and *k = 0, 1, 2, ...* is the set of the possible nonnegative integer values that Y_i can take. λ is the Poisson parameter. The model can be extended to a regression by setting $\lambda_i = \exp(X_i\beta)$ where X_i is the matrix of explanatory variables and β the Poisson parameters to be estimated. The exponential specification is used to restrict λ_i to be positive as is required for a proper distribution. The log-likelihood of the model is:

$$\ln L = \sum_{i=1}^{n} -\exp(X_i\beta) + Y_i X_i\beta - \ln Y_i!$$

The conditional mean of Y_i is given by:

$$E(Y_i|X_i) = \lambda_i = \exp(X_i\beta)$$

Conditional variance equals the conditional means. However if there is over dispersion, the first is consistently estimated using standard POIS model but the standard errors of the estimators β are biased downward (Grogger and Carson 1991). Cameron and Trivedi (1990) developed tests for over dispersion in the POIS model.

In the presence of over dispersion the negative binomial estimator, a generalisation of the POIS model, is a possible solution to this problem. The NB probability

$$\mathbf{Prob}(Y_i = k) = f_{NB}(k) = \frac{\Gamma\left(k + \frac{1}{\alpha}\right)}{\Gamma(k+1)\Gamma\left(\frac{1}{\alpha}\right)}(\alpha\lambda_i)^k\left[1+\alpha\lambda_i\right]^{-\left(k+\frac{1}{\alpha}\right)}$$

where $\alpha > 0$, and λ_i are distributed as gamma random variables $\left[\Gamma(.)\right]$. α is a nuisance parameter to be estimated along with β.

The conditional mean is:

$$E(Y_i|X_i) = \lambda_i = \exp(X_i\beta)$$

and the conditional variance is:

$$Var(Y_i|X_i) = \lambda_i(1+\alpha\lambda_i)$$

so that $Var(Y_i|X_i) > E(Y_i|X_i)$. The ratio variance-mean $1+\alpha\lambda_i$ is the degree of over dispersion. This specification is known as Type II Binomial Model (NBII). The log-likelihood of the model is:

$$\ln L = \sum_{i=1}^{n}\left\{\ln\left(\Gamma\left(k+\frac{1}{\alpha}\right)\right) - \ln\left(\Gamma(k+1)\right) - \ln\left(\Gamma\left(\frac{1}{\alpha}\right)\right) + k\ln(\alpha\lambda_i) - \left(k+\frac{1}{\alpha}\right)\log(1+\alpha\lambda_i)\right\}$$

If there is truncation at zero, which occurs when zero visits demand is not observed by the visitor sampling, the truncated POIS (TPOIS) and NBII (TNBII) can be used.

The structure of the TPOIS is only slightly different from the standard POIS. As

$$\mathbf{Prob}\left(Y_i = 0\right) = f\left(Y = 0\right) = \exp(-\lambda)$$

and the probability of observing Y_i, given that it exceeds the truncation point *k* is

$$f_k(Y_i) = f(Y_i)/\left[1 - F(k)\right],$$

the Poisson probability for counts truncated at left (k = 0) can be written as:

$$\mathbf{Prob}\left(Y_i = k \middle| k > 0\right) = \frac{\exp(-\lambda)\lambda^k}{k!} \cdot \frac{1}{\left(1 - \exp(-\lambda)\right)}$$

The conditional mean is

$$E\left(Y_i = X_i, Y_i > 0\right) = \lambda_i\left[1 - F_p(0)\right]^{-1}$$

And the conditional variance is:

$$Var\left(Y_i \mid X_i, Y_i > 0\right) = E\left(Y_i \mid X_i, Y_i > 0\right) \times \left[1 - F_p(0) E(Y_i \mid X_i > 0\right]$$

The log-likelihood for the TPOIS model is:

$$\ln L = \sum_{i=1}^{n} Y_i X_i \beta - \ln\left[\exp(\lambda_i) - 1\right] - \ln(Y_i!)$$

The TNBII probability density function truncated at left is given by:

$$\mathbf{Prob}(Y_i = k \mid Y_i > 0) = F_{TNB}(k) = \frac{\Gamma(k + \frac{1}{\alpha})}{\Gamma(k+1)\Gamma(\frac{1}{\alpha})}(\alpha\lambda_i)\left[1 + \alpha\lambda_i\right]^{-(k+\frac{1}{\alpha})}\left[1 - F_{NB}(0)\right]^{-1}$$

The conditional mean and variance are:

$$E(Y_i \mid X_i, Y_i > 0) = \lambda_i\left[1 - F_{NB}(0)\right]^{-1}$$

and

$$Var(Y_i \mid X_i, Y_i > 0) = \frac{E(Y_i \mid X_i, Y_i > 0)}{F_{NB}(0)^{\alpha}}\left[1 - F_{NB}(0)\right]^{1+\alpha} E(Y_i \mid X_i, Y_i > 0)$$

The log-likelihood is:

$$\ln L = \sum_{i=1}^{n} \ln\left(\Gamma\left(k + \frac{1}{\alpha}\right)\right) - \ln\left(\Gamma\left(k+1\right)\right) - \ln\left(\Gamma\left(\frac{1}{\alpha}\right)\right) + k\ln\left(\alpha\right) + kX_i\beta - \left(k + \frac{1}{\alpha}\right)\ln\left[1 + \alpha\lambda_i\right]$$
$$- \ln\left[1 - \left(1 + \alpha\lambda_i\right)^{-1/\alpha}\right]$$

Newton's method can be used to find consistent maximum-likelihood estimates of β. All the models can be programmed with TSP.

References

- Arrow R. J., Cline W.-R., Mäller K.-G., Munasinghe M., Squitieri R., Stiglitz J. E.. 1996. Intertemporal Equity, Discounting and Economic Efficiency. In Bruce J. P., Lee H., and Haites E. F. (eds). *Climate Change 1995-Economic and Social Dimensions of Climate Change*. Cambridge University Press: Cambridge.
- Bazerlon C. and Smetters K.. 1999. Discounting Inside the Belway. *Journal of Economic Perspectives* **13**: pp 213-228.
- Bell F. and Leeworthy V. R..1990. Recreational Demand by Tourists for Saltwater Beach Days. *Journal of Environmental Economics and Management* **18**: pp 189-205.
- Bockstael N., Hanemann W. M., and Strand I.. 1989. *Measuring the Benefit of Water Quality Improvements Using Recreation Models*. Vol II. EPA-230-10-89-069. USEPA: Washington D.C..
- Bowker J. M. and Leeworthy V. R..1998. Accounting for Ethnicity in Recreation Demand: A Flexible Count Data Approach, *Journal of Leisure Research*, **30**(1): pp 64-78.
- Cameron A. C. and Trivedi P.. 1986. Econometric Models Based on Count Data: Comparisons and Applications of Some Estimators and Tests. *Journal of Applied Econometrics* **1**: pp 29-53.
- Chakraborty K. and Keith J. E.. 2000. Estimating the Recreation Demand and Economic Value of Mountain Biking in Moab, Utah: an Application of Count Data Models. *Journal of Environmental Planning and Management* **43**(4): pp 461-469.
- Creel M. and Loomis J.. 1990. Theoretical and Empirical Advantages of Truncated Count Data Estimators for Analysis of Deer Hunting in California. *American Journal of Agricultural Economics* **72**: pp 434-441.
- ……………………………. 1991. Confidence Intervals for Welfare Measures with Application to a Problem of Truncated Counts. *The Review of Economics and Statistics* **73**: pp 370-373.

- Crooker J. R.. 2004. *Valuing Resource Access with Seminonparametric Techniques: an Application to Clear Lake*. Working Paper 04-WP 352, Centre for Agricultural ND Rural Development, Iowa State University, www.card.iaste.edu.
- Cropper M. L., Aydede S. K., and Portney P. R.. 1994. Preferences for Life Saving Problems: How the Public Discounts Time and Age. *Journal of Risk and Uncertainty* **8**: pp 243-265.
- Daily G. C.. 1997. *Nature's Services. Societal Dependence on Natural Ecosystems*. Island Press: Washington D.C..
- Englin J. and Moeltner K.. 2004. The Value of Snowfall to Skiers and Boarders. *Environmental and Resource Economics* **29**: pp 123-136.
- Englin J. and Shonkwiler J. S.. 1995. Estimating Social Welfare Using Count Data Models: an Application to Long-Run Recreation Demand Under Conditions of Endogenous Stratification and Truncation. *The Review of Economics and Statistics* **77**: pp 104-112.
- Farber S. C., Constanza R., and Wilson M. A.. 2002. Economic and Ecological Perspectives. *Ecological Economics* **41**: pp 375-392.
- Fletcher J. J., Adamowicz W. L., and Graham-Tomasi T.. 1990. The Travel Cost Model of Recreation Demand. *Leisure Sciences* **12**(1): pp 119-149.
- Font A. R.. 2000. Mass Tourism and the Demand for Protected Natural Areas: a Travel Cost Approach, *Journal of Environmental Economics and Management* **39**: pp 97 – 116.
- Freeman A. M. III. 2003. *The Measurement of Environmental and Resource Values: Theory and Methods*. Resources for the Future: Washington D.C..
- Greene W. H.. 1991. *Econometric Analysis*. MacMillan Publishing Cpmpany: New York.
- Grogger J. and Carson R.. 1991. Models for Truncated Counts. *Journal of Applied Econometrics* **6**: pp 225-238.
- Gurmu S.. 1991. Tests for Detecting Overdispersion in the Positive Poisson Regression Model. *Journal of Business and Economic Statistics* **9**: pp 215-222.

- Gurmu S. and Trivedi P. K.. 1994. *Recent Development in Event Count Models: a Survey*. Discussion Paper nº 261, Thomas Jefferson Centre, Department of Economics, University of Virginia: Virginia.
- Hanemann W. M..1980. Measuring the Worth of Natural Resource Facilities: Comment. *Land Economics* **56**: pp 482-486.
- …………………. 1999. The Economic Theory of WTP and WTA, in Bateman I. J. and Willis K. G. (eds), *Valuing Environmental Preferences*. Oxford University Press: New York.
- Heal G.. 1998. *Valuing the Future. Economic Theory and Sustainability*. Columbia University Press: New York.
- Hellerstein D.. 1981. *The Use of Count Data Models in Travel Cost Analysis: an Application to the Boundary Waters Canoe Area*. Unpublished PhD dissertation, Yale University: New Haven.
- Hellerstein D. and Mendelsohn R.. 1993. A Theoretical Foundation for Count Data Models, with Application to a Travel Cost Model. *American Journal of Agricultural Economics* **75**: pp 604-611.
- …………….. 1991. Using Count Data Models in Travel Cost Analysis with Aggregated Data. *American Journal of Agricultural Economics* **73**: pp 860-867.
- Hicks J. R..1939. The Foundations of Welfare Economics. *Economic Journal* **49**(196): pp 696-712.
- …………… 1943. The Four Consumer Surpluses. *Review of Economic Studies* **11**: pp 31-41.
- Hof J. G. and King D. A.. 1992. Recreational Demand by Tourists for Saltwater Beach Days: Comment, *Journal of Environmental Economics and Management* **22**: pp 281-291.
- Horowitz J. K. and McConnell K. E.. 2002. A Review of WTA/WTP Studies. *Journal of Environmental Economics and Management* **44**(3): pp 426-447.
- Johansson P.-O.. 1987. *The Economic Theory and Measurement of Environmental Benefits*. Cambridge University Press: Cambridge.
- Kaldor N.. 1939. Welfare Propositions of Economics and Interpersonal Comparisons of Utility. *Economic Journal* **49**: pp 549-552.

- Kahnemann D. and Tversky A. 1979. Prospect Theory: an Analysis of Decisions Under Risk. *Econometrica* **47**: pp 263-291.
- Krutilla J. V. and Fisher A. C.. 1985. *The Economics of Natural Environments. Studies in the Valuation of Commodity and Amenity Resources*. Resources for the Future: Washington D.C..
- Lankford R. H.. 1988. Measuring Welfare Changes in Settings With Imposed Quantities. *Journal of Environmental Economics and Management* **15**(1): pp 45-63.
- Long J. S.. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Sage Publications: Thousand Oaks.
- Loomis J. B.. 1999. Contingent Valuation Methodology and the US Institutional Framework, in Bateman I. J. and Willis K. G. (eds), *Valuing Environmental Preferences*. Oxford University Press: New York.
- Lowenstein G. and Elster (eds). 1992. *Choice Over Time*. Russel Sage Foundation: New York.
- Lowenstein G. and Prelec D.. 1992. Anomalies in Intertemporal Choice: Evidence and an Interpretation. In Lowenstein G. and Elster (eds). *Choice Over Time*. Russel Sage Foundation: New York.
- Lowenstein G. and Thaler R.. 1989. Intertemporal Choice. *Journal of Economic Perspectives* **3**: pp 181-193.
- Mäler K. G.. 1971. A Method of Estimating Social Benefits from Pollution Control. *Swedish Journal of Economics* **73**: pp 121-133.
- ……………… 1974. *Environmental Economics: a Theoretical Inquiry*. Johns Hopkins Press: Baltimore.
- Mendes I.. 2002. Travel and on Site Recreation Time: an Empirical Approach to Value the Recreation Benefits of Peneda-Gerês National Park. In *IATUR's 2002 Conference Proceedings*, CISEP, ISEG, Technical University of Lisbon: Lisbon.
- …………. 2004. *Valuing Ecosystems. A Methodological Applying Approach*. Working Paper WP11/2004/DE/CIRIUS. ISEG, Technical University of Lisbon: Lisbon.
- ………….. 1997. The Recreation Value of Protected Areas: an Application to the Peneda-Gerês National Park. Thesis submitted in fulfilment of the degree of Doctor of Philosophy. ISEG, Technical University of Lisbon: Lisbon.

- Morey E.R. 1994. What is Consumer Surplus Per Day of Use, When Is It a Constant Independent of the Number of Days of the Number of Days of Use, and What Does It Tell Us About Consumer Surplus? *Journal of Environmental Economics and Management* **26**(3): pp 215-303.
- Navrud S. and Vågues M.. 2000. Assessment of Environmental Valuation Reference Inventory (EVRI) and the Expansion of its Coverage to the EU. Report to the European Commission, DGXI.
- Nordhaus W. D.. 1999. The Optimal Choice of Climate Change Policy in the Presence of Uncertainty. *Resource and Energy Economics* **21**(3-4): pp 255-287.
- Nordhaus W. D. and Popp D.. 1997. What is the Value of Scientific Knowledge? An Application to Global Warming Using the PRICE model. *Energy Journal* **18**: pp 1-45.
- OECD. 1999. *Handbook of Incentive Measures for Biodiversity*. OECD: Paris.
- Portney P. R. and Weyant J. P. (eds). 1999. *Discounting and Intergenerational Equity*. Resources for the Future: Washington D.C..
- Perman R. Ma Y, McGilvray J., Common M.. 2003. *Natural Resources and Environmental Economics*. Pearson: Essex.
- Randall A. and Stoll J. R.. 1980. Consumer's Surplus in Commodity Space. *American Economic Review* **70**: pp 71-83.
- Rockel M. and Kealy J.. 1991. The Value of Noncomsuptive Wildlife Recreation in the United States. *Land Economics* **67**(4): pp 422-434.
- Santos J. M. L.. 1997. *Valuation and Cost-Benefit Analysis of Multi-Attribute Environmental Changes*. Thesis submitted in fulfilment of the degree of Doctor in Philosophy. Department of Town and Country Planning, University of New Castle upon Tyne: New Castle.
- Santos Silva J.M.C. 2003. A Note on the Estimation of Mixture Models Under Endogenous Sampling. *Econometrics Journal* **6**: pp46-52.
- …………………… 1997. Generalized Poisson Regression for Positive Count Data. *Communications in Statistics-Simulation Methods* **26**: pp 423-430.
- Sarker R. and Surry I.. 1998. Economic Value of Big Game Hunting: the Case of Moose Hunting in Ontario. *Journal of Forest Economics* **4**(1): pp 29-60.

- ………………………. 2004. The Fast Decay Process in Outdoor Recreational Activities and the Use of Alternative Count Data Models. *American Journal of Agricultural Economics* **86**(3): pp 701-715.
- Serargeldin I.. 1996. *Sustainability and the Wealth of Nations. First Steps in on Going Journey*. ESD Studies and Monographs Series nº 5. World Bank: Washington D.C..
- Shaw D.. 1988. On-Site Sample's Regression: Problems of Non-Negative Integers, Truncation, and Endogenous Stratification. *Journal of Econometrics* **37**: pp 211-223.
- Thaler K.. 1981. Some Empirical Evidence on Dynamic Inconsistency. *Economic Letters* **8**: pp 201-207.
- Turner R. K.. 1999. The Place of Economic Values in Environmental Valuation, in Bateman I. J. and Willis K. G. (eds) *Valuing Environmental Preferences*. Oxford University Press: New York.
- Walsh R. G. (1986), *Recreation Economic Decisions: Comparing Benefits and Costs*, Pensylvania, Venture Publishing, Inc.
- Ward F. A. and Beal D.. 2000. *Valuing Nature With Travel Cost Models*. Edward Elgar: Cheltnham.
- Weitzman M. L.. 2001. Gamma Discounting. *American Economic Review* **91**(1): pp 260-271.
- Willig R. D.. 1976. Consumer's Surplus Without Apology. *American Economic Review* **66**(4): pp 589-597.
- Wilman E. A.. 1987. A Simple Repackaging Model of Recreational Choices, *American Journal of Agricultural Economics* **69**: pp 603-612.
- Yen S. T. and Adamowicz W. L.. 1993. Statistical Properties of Welfare Measures from Count Data Models of Recreation Demand. *Review of Agricultural Economics* **15**: pp 203-215.

Table 1 Descriptive Statistics

Variable	Mean	Standard deviation	Maximum	Minimum
DRP	5.284	3.573	18.000	1.000
CDRP (€)	50.479	30.604	215.266	12.098
TR (days)	22.329	15.138	90.000	1.000
ID (years)	30.926	10.871	66.000	18.000
ED (years)	6.984	2.225	10.000	2.000
YR (€/per capita)	799.080	482.880	3452.265	143.844

Note: observations = 243

Table 2 Frequence Distributions of the Number of Recreation Days in the PNPG

Recreation days (number)	Count of recreation days Per visitor	%
1	24	9.88
2	39	16.05
3	25	10.29
4	36	14.81
5	27	11.11
6	15	6.17
7	17	7.00
8	27	11.11
9	1	0.41
10	13	5.35
11	3	1.23
12	3	1.23
13	1	0.41
14	2	0.82
15	8	3.29
16	1	0.41
17	0	0.00
18	1	0.41
Total	243	100.00

Table 3 Parameter Estimates from the POIS, NBI, NBII, TPOIS, TNBI and TNBII models

Variable	POIS	NBI	NBII	TPOIS	TNBI	TNBII
Constant	1.475	1.369	1.460	1.46578	1.264	1.398
	(6.737)	(7.339)	(7.941)	(6.432)	(5.098)	(5.912)
CDRP (€)	-0.00567	-0.00542	-0.00526	-0.00610	-0.00722	0.00599
	(-3.530)	(-3.272)	(-3.258)	(-3.347)	(-3.244)	(-3.109)
TR (days)	0.01183	0.0124	0.0125	0.0121	0.0142	0.0137
	(5.205)	(5.466)	(4.743)	(5.188)	(6.235)	(4.757)
ID (years)	-0.00182	-0.00050	-0.00245	0.00182	0.0007	-0.00276
	(-0.457)	(-0.134)	(-0.671)	(-0.439)	(0.0156)	(-0.661)
ED (years)	0.00346	0.00396	-0.00094	-0.00329	0.00702	0.00050
	(-0.210)	(0.225)	(-0.050)	(-0.192)	(0.375)	(0.0260)
YR (€/per capita)	0.00032	0.00031	0.00030	0.00034	0.00038	0.00033
	(3.692)	(3.624)	(3.386)	(3.733)	(3.809)	(3.487)
Price/recreation cost Elasticity[(a)]	-0.286	-0.274	-0.266	-0.308	-0.364	-0.302
Income Elasticity[(b)]	0.256	0.248	0.240	0.256	0.301	0.264
Log likelihood	-631.888	-597.364	-598.725	-629.210	-586.420	-589.485
α		0.91685	0.17426		1.25540	0.240301
		(5.222)	(5.212)		(5.504)	(5.160)

NOTE: T-statistics are in parenthesis; *(a)* for the semi-log specification, price elasticity is generally calculated as $\varepsilon_{DRP,CDRP} = \beta_1 \times \boldsymbol{CDRP}$ (Bowker and Leeworthy 1998) where CDRP = sample variable mean and β_1 is the estimated coefficient of CDRP ; *(b)* for the semi-log specification, income elasticity is generally calculated as $\varepsilon_{DRP,YR} = \beta_2 \times \boldsymbol{YR}$ (Bowker and Leeworthy 1998) where YR = sample variable mean and β_2 is the estimated coefficient of YR.

Table 4 Estimated Trip Demand, CS, WTP^E, and WTA^C per person per day and per person per visit

2005 euros

	POIS	NBI	NBII	Mean	Stdv	TPOIS	TNBI	TNBII	Mean	Stdv
Expected Visitor's quantity demanded $\lambda_S = E(Y_S \mid X_S)$ *(a)*	5.108	5.106	5.108			5.051	4.798	4.871		
CS per person per day	176.367	184.501	190.114	184	5.8	163.985	138.425	166.863	156	15.9
WTP^E per person per day	154.765	161.970	166.882	161	4.9	144.510	123.521	147.846	139	13.1
WTA^C per person per day	208.528	217.616	224.737	217	6.5	192.535	159.356	194.222	182	19.9
CS per person per visit*(b)*	900.882	942.066	971.102	938	28.7	828.364	664.220	812.839	768	90.7
WTP^E per person per visit	790.540	827.018	852.432	823	25.0	729.985	592.704	720.201	681	76.4
WTA^C per person per visit	1065.161	1111.140	1147.956	1108	33.6	972.985	764.656	946.116	895	113.1

(a) X_S = means of the explanatory variables from the user sample; *(b)* CS per person per each median 5.284 day's of stay length visit in the PGNP.