# Recreation demand analysis of natural areas: a revealed-preference approach

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# Recreation Demand Analysis of Natural Areas: a Revealed-Preference Approach

## *Preliminary version*[*]

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**Abstract**

Natural areas are multifunctional, contributing through multiple ways to human well-being. Ecosystem goods and services are provided through ecosystem functions (regulation, habitat, production and information). Among the multiple services provided by natural areas, recreational services are increasingly valuable.

The main objective of our paper is to estimate the recreation value (use value) of natural areas whilst using the Travel Cost Method (TCM). The recreation use value is measured in terms of visitors' Willingness To Pay (WTP) or Consumer Surplus (CS). For natural resource managers, the value assigned provides essential information about the economic value of the natural resources of the sites that is not revealed by

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market exchanges. To estimate the recreation value, we apply the TCM to evaluate the recreation demand within the Département de l'Hérault (Hérault Department, France) / Conseil Général du Département de l'Hérault (CG34) "Espaces Naturels Sensibles" (ENS) public policy.

Our first contribution is a methodological one and consists in the way we consider the ENS public policy. We apply the TCM to seven areas, assuming they constitute the same and single site characterizing the ENS diversity.We suppose that these seven chosen areas are well representing the whole ENS of the Department, in terms of recreational use, landscapes and environmental goods provided. It may be discussed to allow a single value ; however this is the most efficient way to capture the ENS heterogeneity. Our second contribution is to highlight one dimension of the potential benefits regarding recreation through the ENS conservation policy in a Cost-Benefit Analysis (CBA) whilst measuring the direct use value by visitors. We apply the individual approach of the TCM, based on an on-site survey, and we get the CS mean value estimated at €58.82 from €34.60 to €83.04 per visitor and per trip. Our third contribution is finally to complete the set of empirical environmental non market valuation analyses carried out in France.

*JEL classification:* Q26 - Q51 - R14.

*Keywords:* Natural Area, Recreation Value, On-Site Survey, Travel Cost Method (TCM), Truncation, Over-Dispersion, Endogenous Stratification, Consumer Surplus, Weighted Travel Cost.

# 1 Introduction

## 1.1 Current issues

Natural areas are multifunctional, contributing through multiple ways to human well-being. Ecosystem goods and services are provided through ecosystem functions (regulation, habitat, production and information) (de Groot *et al.* (2002), Chevassus-au-Louis *et al.* (2009)). Among the multiple services provided by natural areas, recreational services are increasingly valuable (Clawson and Knetsch (1966), Costa and Climaco (1999), Phaneuf and Smith (2005)).

To implement public environmental policies, policymakers and managers need well-suited ecological, socio-cultural and economic information to assess the corresponding values, as this takes place in a comprehensive Cost-Benefit Analysis (CBA). With regards to recreational services, the economic value allowed to this type of services is not known, as the quantifying process is not straightforward. In some countries, entry fees may play the role of a proxy to provide price information (as in National Parks). However, when the access is free of charge this kind of proxy is not available, and suitable economic methods have to be carried out.

## 1.2 Motivations and achievements

The main objective of our paper is to estimate the recreation value (use value) of natural areas whilst using the Travel Cost Method (TCM) (Hotelling (1947), Clawson (1959)). The recreation use value is measured in terms of visitors' Willingness To Pay (WTP) or Consumer Surplus (CS). For natural resource managers, the value assigned provides essential information about the economic value of the natural resources of the sites that is not revealed by market exchanges. As a consequence, the true value must be estimated using non-market valuation methods. There is a need to justify the allocation of scarce public funds in situation when costs are known but benefits are hardly known. The benefits and positive impacts of these areas must be demonstrated.

To estimate the recreation value, we apply the TCM to evaluate the recreation demand within the Département de l'Hérault (Hérault Department, France) / Conseil Général du Département de l'Hérault (CG34) "Espaces Naturels Sensibles" (ENS) public policy[1][2]. These natural areas are acquired as land ownership by the Hérault Department to ensure their protection from urban pressure and making them free to access. Our objective is then to

[1] French administrative hierarchical organisation (top down) and requirements through decentralization: Government / Ministries and local bodies of the Ministries, Regions, Departments, Community of Municipalities, and Municipalities. The Departments have the competencies of the following public policies: social, disabilities, secondary school / junior high school, environment (coastal erosion, natural areas so-called "Espaces Naturels Sensibles").

[2] "Espaces Naturels Sensibles" means literally "Sensitive Natural Area".

economically ground this ENS conservation policy.

Our first contribution is a methodological one and consists in the way we consider the ENS public policy. We apply the TCM to seven areas, assuming they constitute the same and single site characterizing the ENS diversity.We suppose that these seven chosen areas are well representing the whole ENS of the Department, in terms of recreational use, landscapes and environmental goods provided. It may be discussed to allow a single value; however this is the most efficient way to capture the ENS heterogeneity[3]. Our second contribution is to highlight one dimension of the potential benefits regarding recreation through the ENS conservation policy in a Cost-Benefit Analysis (CBA) whilst measuring the direct use value by visitors. We apply the individual approach of the TCM, based on an on-site survey, and we get the CS mean value estimated at €58.82 from €34.60 to €83.04 per visitor and per trip. Our third contribution is finally to complete the set of empirical environmental non market valuation analyses carried out in France.

## 1.3 Literature review and methodology used

The TCM methodology is now widely recognized by the scientific community as a robust methodology (Freeman (1993), Bateman and Willis (1999)). Based on revealed preferences, the TCM measures the recreational value allowed to natural areas in terms of individuals CS to visit the sites. CS is estimated from a recreation demand function, determined by a price (travel cost) and other socio-economic characteristics of the visitors (McConnell (1985), Parsons (2003)). The demand function is supposed to be standard, *i.e.*, declining with price increase. The estimated CS is then considered as a good welfare approximation (Willig (1976)).

Considering the inherent data for the dependent variable in the TCM, *i.e.*, the number of annual trips to the sites which takes a few values, linear models may be unsuitable to estimate the recreation demand function. Shaw (1988) showed that count data models are more appropriate to estimate accurately the recreational value in single sites models and

[3] Garcia and Jacob (2010) did slightly the same process at a broader scale whilst analysing the recreation value of french forests in segmenting them in 9 inter-regions.

this is mainly used in the literature (Cameron and Trivedi (1986), Creel and Loomis (1990), Grogger and Carson (1991), Englin and Shonkwiler (1995), Shresta *et al.* (2002), Martinez-Espiñeira and Amoako-Tuffour (2008), Anderson (2010)).

In the literature, we can highlight a few relevant contributions. Englin and Shonkwiler (1995) developed a Negative Binomial model of recreation demand, and show the joint nature of the population's latent demand for trips and the consumer surplus associated with those trips. They completed the set of count data models following Shaw (1998), and applied this methodology to hikers in the Cascade Mountains of Washington State (USA). Shresta *et al.* (2002) estimated the recreational fishing value of the Brazilian Pantanal from an angler population, and compare non linear, Poisson and Negative Binomial models. They got a CS from \$540.54 to \$869.57 per trip, that is a relatively high value compared to other parts of the world. On their side, Martinez-Espiñeira and Amoako-Tuffour (2008, 2009) in a set of paper analysed the recreation demand of the Gros Morne National Park (Canada) and get a \$535 value. They showed that there are biases implying the need to reset for zero-truncation, overdispersion and endogenous stratification, and also to assess multi-destination and multi-purpose trip issues. Finally, Garcia and Jacob (2010) made a rigorous econometric analysis of the forest recreation function in France and reach a bit greater than \$22 value, whereas Anderson (2010) assessed the demand for ice climbing in Hyalite Canyon (Montana, USA) and estimated per person per trip values in a range of \$76 to \$135.

To estimate the demand function, we use count data models, and particularly Truncated and Stratified Poisson model (TSP) (Shaw (1988)), Negative Binomial model (NB) correcting overdispersion, Truncated Stratified Negative Binomial (TSNB) (Englin and Shonkwiler (1995)). We estimate the demand function using these three models and discuss their relative performance. We finally use the TSNB model to approximate the CS and consider the multi-destination trip effect for tourist population, considering the different sample biases inherent to recreation data and the on-site survey mode.

### 1.4 Outline

The remainder of this paper is organised as follows. In Section 2, we describe the economic framework for estimating consumers preference in terms of recreation, our research strategy and the choices made to estimate the CS. In Section 3, we present our case study, the on-going ENS public policy and the services supplied by these areas, and then our empirical analysis and results. In Section 4, we provide a full discussion of our results. Last, concluding remarks are offered in Section 5.

## 2 Recreation value estimate

### 2.1 The Travel Cost Method (TCM)

The Travel Cost Method (TCM) is a revealed preference valuation method used for non-maket valuation, which measures the value granted to a natural area through users effective behaviour. This is an indirect valuation method because the valuation of the recreation service relies on the recreation demand function estimate regarding the site (Parsons (2003)). Within the TCM method, the recreation demand function is the number of trips undertaken to the site per year, determined by an implicit price (the travel cost), and a set of others variables (distance, time available, income, other available sites as substitutes, and visitors' socio-economic characteristics, etc.). The demand function is supposed to be standard, *i.e.*, decreasing with price increase.

This is the weak complementarity introduced by Mäler in 1974, between marketed goods and the enjoyment from the recreational site visit, that makes people getting utility from a public good only if they consume a weakly complementary private good (travel cost). It is thus supposed that visitors perceive and respond to a change of travel cost to reach the site as if they would perceive and respond to a change of entry fee. As a consequence, if the site could close during a season or a year, individuals would lose the access to the site and then the corresponding CS (Martinez-Espiñeira and Amoako-Tuffour (2008)). Implicitly, visitors are those for whom the value allowed to a visit exceeds its cost.

In this paper, we use the single-site model (Clawson (1959), Parsons (2003)) of the TCM estimating a unique demand equation. Our aim is to analyse the access value of the considered sites. Moreover, we use the individual approach (Brown and Nawas (1973)) rather than the zonal approach of the TCM (Clawson and Knetsch (1966)); the individual approach is sharper as this is based on individuals, *i.e.*, on users data.

## 2.2 Travel Cost Calculation

The TCM includes all the expenses related to the recreation site journey and the aim is to assess the full Travel Cost ($TC$). The $TC$ includes the effective individual travel cost ($tC$), the Opportunity Cost of Time ($OCT$) as well as other costs such as accommodation costs and equipment costs (regarding the outdoor activity undertaken on-sites). In this sub-section, we review the methodology we have retained to design the $TC$.

Firstly, we calculate the $tC$ for individuals reaching the site by car as:

$$tC = \frac{((D * KMC) + Toll) * 2)}{P}$$

Where $D$ is the distance between the individual's residence place and the site (whilst supposing that individuals choose the shortest route to reach the site), $KMC$ is the cost per kilometer published annually by the fiscal administration[4], $Toll$ is the potential toll road cost, and $P$ refers to the group size during the visit. The effective distance and related costs and the toll costs are multiplied by 2 to take into account the go and return travel.

Secondly, an individual who visits a recreation site has an opportunity to use its time differently and is subjected to an opportunity cost. The $OCT$ characterizes this opportunity cost whilst traveling to and from the site. According to Bocksteal *et al.* (1987) and Phaneuf and Smith (2005), the $OCT$ can be high and set the demand function. Considering and measuring this $OCT$ is one of the main issue discussed in the TCM literature. The underlying difficulty is to agree on the value allowed to time, and then to the lost opportunities. According to Cesario (1976), the value of the time lost whilst traveling is set between a quarter

[4]This $KMC$ takes into account the vehicle depreciation, maintenance, fuel and insurance costs.

and a half of a hourly wage rate as individuals may have flexible jobs and can substitute work time for leisure time at the margin (Parsons (2003)). Within the literature, rates go from 0 to 1 (from 0 for Garcia and Jacob (2010) to 0.43 for Cesario (1976)) and we rely on Phaneuf and Smith (2005) to keep the simplest accounting strategy: we set a share equal to 1/3 of the hourly wage that is certainly the most commonly used rate (Parsons (2003), Bujosa Bestard and Riera Font (2009))[5]. For simplicity, we have chosen to consider the time spent on the recreation site as being not costly and the travel time for people coming on foot or by bicycle as being not costly as well[6] (McConnell (1995)). The $OCT$ is then:

$$OCT = \frac{T}{60} * \frac{1}{3} * \frac{R}{135} * 2$$

Where $T$ is the individual travel time in minutes to reach the site, $\frac{1}{3}$ is the share of the hourly wage rate, and $R$ is the individual monthly wage[7]. The cost is also multiplied by 2 to take into account the go and return travel.

Thirdly, the TCM assumes that the travel is realized with regards to a single purpose, *i.e.*, recreation (Haspel *et al.* (1982)). Indeed, it is supposed that individuals make the decision to visit the site before leaving their residence place, and then travel directly to visit the site (Loomis *et al.* (2000)). However, undergoing a visit on a recreation site is not always the sole motivation. As a consequence, the TCM is not adapted to assess multi-purpose trips and then split the expenses made between each purpose. Furthermore, the multi-destination trips assessment is an analogous issue that have to be tackled in the same manner. In the literature, a few solutions are available. The first one consists in making the hypothesis that the travel expenses are set to the site visit in a single purpose way (Haspel *et al.* (1982)). This is assumed that all the visits are set for a single purpose and this drives to overestimate the users surplus, and thus the value allocated to the site. The second one eliminates from the sample all the multiple-destination visitors (Smith and Kopp (1980)).

[5] According to Phaneuf and Smith (2005), this strategy gives results close to the most complex strategies such as the latent variable of Englin and Shonkwiler (1995), or the shadow values of Feather and Shaw (1999).

[6] For these travel modalities, travel time can be a part of the recreation activity.

[7] Note that we set a basis of 135 hours of work per month.

This solution leads to underestimate the users' surplus, and therefore the value, because individuals are selected with regards to particular socio-demographic and socio-economic characteristics. In our framework, we choose to cope solely with the multiple-destination issue through the individual influence revelation of the recreation site in the decision to make the trip (Martìnez-Espiñeira and Amoako-Tuffour (2009)). Martìnez-Espiñeira and Amoako-Tuffour (2009) applied this methodology in a application of the TCM to the Gros Morne National Park (Canada) and introduced the following question in their survey by questionnaire: "*On a scale of 0 (zero) to 10, where 0 indicates no influence and 10 indicates the main single reason, how much influence would you say that the Gros Morne National Park area had in your decision to vacation in Newfoundland and Labrador? (For NL residents, this refers to your decision to vacation within the province versus opting for a trip outside of the province.)*". This information allows to weight the costs between the various destinations. We have applied the same methodology and built the variable $INFLU$ from the answer which weights the $TC$. Once the cost is weighted, we could obtain the share of the costs which can be allocated to the site.

The Weighted Travel Cost ($WTC$) is then given by:

$$WTC = \frac{TC}{10} * INFLU$$

Where $TC$ is the full Travel Cost as the sum of $tC$, $OCT$ and other costs (accommodation costs and equipment costs).

For sufficiency, we split the $WTC$ into two parts (Martìnez-Espiñeira and Amoako-Tuffour (2009)): the weighted travel cost infered by the travel between the residence place and the accommodation place ($WTC_1$); and, the weighted travel cost infered by the travel between the accommodation place and the recreation site ($WTC_2$). This weighting process is only effective for $WTC_1$ as we assume that individuals make this second travel with the aim of visiting the recreation site. Moreover, we apply this process for tourist trips and we relieve this for local individuals (residential trips). As a result, the tourist $WTC$ is equal to:

$$WTC = \frac{WTC_1}{10} * INFLU + WTC_2$$

Hereafter, we refer solely to $TC$ to simplifly the scripture whilst meaning $WTC$ regarding the status of the visitors (tourists, local population).

### 2.3 Survey by questionnaire and sample biases

Our survey by questionnaire aimed at collecting information that we can classify such as: (i) the visitor's profile in terms of frequency of visits; (ii) the influence of the site in the visit decision; (iii) the travel and transport modality; (iv) the main recreation activity practiced on site; (v) the visitor's socioeconomic characteristics. In our research strategy, we have conducted a survey by questionnaire through the on-site way instead of the off-site one (which is using telephone, postmail or web-based surveys). The on-site survey allows to select directly the targeted population, *i.e.*, the users of the recreation site. Nevertheless, this kind of survey by questionnaire leads to several issues and sample biases.

The first issue is the truncation one as there is a zero-truncation of the number of visits, because solely individuals making a certain number of visits upper or equal to one are sampled. A truncated sample implies non-negative integer and compromises the goodness-of-fit of the intercept in the demand function (Parsons (2003), Phaneuf and Smith (2005)), which could bias the results interpretation to the general population.

The second issue is the endogenous stratification as frequent visitors have a stronger probability to be sampled than the others. The consequence of the endogenous stratification is that the expected number of visits for an individual interviewed in the on-site sample is greater than the expected number of visits of a random individual in the general population; consequently, the sample is not representative of the general population (Egan and Herriges (2006)).

Last, there is an overdispersion issue as data in TCM are frequently over-dispersed, *i.e.*, the variance exceeds the mean because a few visitors make many trips whereas most visitors make only a few trips (Martìnez-Espiñeira and Amoako-Tuffour (2009)).

These issues can be corrected by suitable econometric models (Shaw (1988)) that we describe in sub-section 2.4.

## 2.4 Econometric model and data specification

Since Shaw's seminal paper (Shaw (1988)), count data models are widely used to estimate recreation value of single site models (Cameron and Trivedi (1986), Creel and Loomis (1990), Englin and Shonkwiler (1995), Grogger and Carson (1991), Shresta *et al.* (2002), Martìnez-Espiñeira and Amoako-Tuffour (2008)).

TCM studies use count-data models as the dependent variable, *i.e.*, the annual number of trips to the site as this takes a few countable values. The Poisson model as well a the Negative Binomial (NB) model allow to take into account the non-negative integer of the dependent variable. The basic count data model routinely used for recreation models is the Poisson Model. This model defines occurrence likelihood stemming from a counting process. $y_i$ is the dependent count variable representing the number of trips to the site taken by visitor $i$ over the last year, and $x_i$ its vector of individual characteristics (travel cost, income, gender, age, activity, etc). Every $y_i$ is a realization of a Poisson rule with a parameter $\lambda_i$, which depends on explanatory variables $x_i$ (Parsons (2003)). The probability given by the Poisson distribution that $y_i$ is equal to a non-negative integer $k$, noted $p_i$, is given by:

$$\forall k \geq 0, p_i = \Pr(y_i = k) = e^{-\lambda_i} \frac{\lambda_i^k}{k!}$$

The $\lambda_i$ parameter is the distribution parameter and its formulation is log-linear:

$$\lambda_i = \exp(x_i \beta)$$

and then

$$\ln(\lambda_i) = x_i \beta$$

And, $\lambda_i$ is equal to the conditional mean and conditional variance of the number of trips:

$$E(y_i/x_i) = Var(y_i/x_i) = \lambda_i = \exp(x_i\beta)$$

Then $\lambda_i$ represents the mean number of trips to the site for visitor $i$, $E(y_i/x_i)$ is the expected number of trips to the site for visitor $i$, and $\beta$ is the parameter vector to estimate.

This restrictive condition, *i.e.*, equality between the mean and the variance in the Poisson model is not realistic for recreation demand models (Shresta *et al.* (2002)), as recreational data are frequently over-dispersed (Cameron and Trivedi (1986)). This is why, the NB model is prefered whilst introducing an individual term of heterogeneousness into the conditional mean of the Poisson model. The density for the NB model $q_i$ is:

$$\forall k \geq 0, q_i = \Pr(y_i = k) = \frac{\Gamma(k + 1/\alpha)}{\Gamma(k+1)\Gamma(1/\alpha)} \left(\frac{1/\alpha}{1/\alpha + \lambda_i}\right)^{1/\alpha} \left(\frac{\lambda_i}{1/\alpha + \lambda_i}\right)^{k}$$

Where $\Gamma$ is the Gamma distribution widely used for the term of heterogeneousness and $\alpha$ reflects the degree of dispersion in the predictions. If $\alpha > 0$, there is overdispersion in the sample set and the Poisson model is rejected to the NB model. If $\alpha = 0$, the negative binomial model is then reduced to a Poisson model.

Englin and Shonkwiler (1995) adapted this model to correct for zero-truncation and endogenous stratification whilst designing the so-called Truncated Stratified Negative Binomial (TSNB) model. The truncated density adjusted for endogenous stratification $q_i$ becomes:

$$\forall k \geq 0, q_i = \Pr(y_i = k) = \frac{k\Gamma(k + 1/\alpha)}{\Gamma(k+1)\Gamma(1/\alpha)} \left(\frac{1/\alpha}{1/\alpha + \lambda_i}\right)^{1/\alpha} \left(\frac{1}{1/\alpha + \lambda_i}\right)^{k} \lambda_i^{k-1}$$

The final aim of the TCM modeling is to estimate the recreation value. To this aim, we estimate the visitors welfare as the consumers welfare in computing the individual surplus mean per site visit allowing to assess the individual maximum Willingness to Pay (WTP). A common valuation process is to compute the mean surplus of the sample. In count data models, the Consumer Surplus (CS) per visit is computed by $-1/\beta_{CT}$ (Creel and Loomis

(1990)). In the TSNB model, Englin and Shonkwiler (1995) show that the expected number of visit is:

$$E(y_i/x_i) = \lambda_i + 1 + \alpha\lambda_i$$

This takes into account the value of the overdispersion parameter ($\alpha$) and also the expected number of trips $\lambda_i$ through all the values of significant coefficients.

# 3 Econometric results

In this study, we have chosen to: (i) use the single site model; (ii) use the individual method; (iii) proceed through the on-site survey by questionnaire; (iv) integrate the $OCT$ within the total cost; (v) deal with the multi-destination issue by weighting the tourist travel costs between their residence place and the accommodation place; (vi) mainly use the TSNB model to correct for zero-truncation, overdispersion and endogenous stratification. We present our case study and our econometric results in the following sub-sections.

## 3.1 The "Espaces Naturels Sensibles (ENS)" public policy: national policy and specificities of the Département de l'Hérault (Hérault Department) case study

Since the law of December 31, 1976, the French Departments have been in charge of a protecting tool for natural areas within the national environmental policy framework, that is the "Espaces Naturels Sensibles (ENS)" public policy. To fund this environmental protection policy, they set and levy an environmental tax called "Taxe Départementale des Espaces Naturels Sensibles (TDENS)"[8] on real estates. These areas "*must be constituted by zones where the natural character is threatened or rendered vulnerable regarding the urban pressure or the development of economic and leisure activities; these areas can also be designed towards a particular interest, regarding the quality of the site, or the characteristics of the*

[8] "Taxe Départementale des Espaces Naturels Sensibles" means literally "Departmental Tax for the Sensitive Natural Areas".

*animal or vegetable species located in these areas"* (GIP ATEN (2010)). They recover other conservational zoning as Natura 2000 or ZNIEFF and ZICO dedicated to bird protection.

This public policy allows to acquire and restaure natural areas, and has two main objectives: on the one hand, preserving natural habitats and landscape; on the other hand, opening them to the public (except if the site is particularly fragile)[9]. In practice, this policy aims at:

- Protecting the quality of sites and the natural fields of expansion for the floods;
- Protecting the natural habitats;
- Creating walk and hike paths;
- Creating areas, sites and routes relative to outdoor sports.

In 2005, 73 Departments had set up the TDENS; this policy is currently applied by 95 Departments, which account for 3,050 sites through 170,000 ha managed, for roughly €150 million per year (Assemblée des Departments de France (2011)). Figure 1 below synthethizes and maps the ENS through the french territory.

*Insert Figure 1*

The Hérault Department represents 1.1% of the national territory and is located in the South of France nearby the Mediterranean Sea, within the Languedoc-Roussillon Region. Natural areas in the Department are a reservoir of species (*e.g.*, 42% of the French vascular species of plants are represented in the Hérault as well as 65% of the species of nesting birds) gathers a wide variety of landscapes and habitats. Population growth is particularly high in this Department mainly through migration from other regions (roughly + 1,500 inhabitants/month) with peaks during the summertime for holiday motivations. Consequently, urban pressure and public infrastructures are the main drivers of biodiversity erosion and

[9] Articles L.142-1 to L.142-13, and R.142-1 to R.142-19 of the French urbanism code.

habitat destruction or fragmentation. These phenomena come along with trendy modifications of the ecological systems and their spatial heterogeneousness modifying the biodiversity dynamics.

The Hérault Department has been implementing its ENS policy since 1981. From now on, this policy contributes to biodiversity conservation by insuring an ecological continuity. The lands acquired constitute a network of natural areas connected by the green and blue corridors for biodiversity. Trame verte et bleue. The ENS cover more than 8,000 ha through 124 departmental properties. They are constituted by a wide range of natural habitats (coastal wetland, scrubland, limestone plateau, lake, etc.) and 31 % of these ENS are contained in Natura 2000 sites[10]. Regarding the recreational dimension, there are 500 kilometers of paths for hikers and riders through bicycle and horse backers. The main ecosystem services provided by the ENS are gathered in the following Table (Table 1).

| | |
|---|---|
| Environmental | Protection against natural risks (landslides, floods, erosion) and pollutions |
| | Biodiversity conservation |
| Economic | Jobs inferred by their touristic attractiveness |
| Social | Recreational areas (outdoor recreation activities, children facilities) |
| | Free access |
| | Natural and cultural heritage |

Table 1: Main ecosystem services supplied by the "Espaces Naturels Sensibles (ENS)"

One of the aim of the Héault Department is to promote peri-urban leisure activities as the ENS are located close to main cities (Montpellier, Béziers). The ENS studied offer various leisure activities (Table 2). Individuals can go on hiking (on the green network), and accomodations are available for hikers overnight for a low fee (*e.g.*, on the sites of Roussières and Vernède). Moreover, four of the studied ENS are located nearby water resources as

[10] Natural or semi-natural sites of the European Union having a particular patrimonial interest, through the exceptional fauna and the flora they contain (DIRECTIVE 92/43/CEE, Directive Habitat Faune-Flore, 1992).

rivers or lake (as the Salagou lake, the Hérault river (Fesquet), the Orb river (Réals and Savignac)). People can practice nautical activities as canoeing or bathing (Réals and the Salagou Lake). They can also come on-site for recreational fishing (especially Savignac). Furthermore, individuals can come over for other leisure picnic, tables and trash being at disposal, to observe the fauna and the flora, or to come to take advantage of children facilities (Fesquet and Restinclières).

| ENS areas | Recreational services |
|---|---|
| Cazarils- Roussières | Hike - Walk - Picnic |
| Fesquet | Walk - Picnic - Fishing -Swimming - Children activities |
| Réals | Walk - Picnic - Fishing -Swimming - Canoeing - Children activities |
| Restinclières | Walk - Hike - Picnic - Children activities |
| Salagou | Walk - Picnic - Fishing -Swimming - Canoeing - Children activities |
| Savignac | Walk - Picnic - Fishing |
| Vernède | Hike - Walk - Picnic |

Table 2: Recreational services supplied by the seven ENS areas

Treating accurately multi-destination trips is particularly meaningful in our research. We have in our sample a significant part of tourists: 20% of visitors do not come either from the Hérault Department, or from the Languedoc-Roussillon Region, and either are french or foreigners (*e.g.*, from Switzerland, Germany, Netherland, Belgium, Spain). It is likely that their trip is a multi-destination one, not to travel and visit the sole ENS. As a consequence, attributing the totality of the costs born to visit the ENS to assess the recreational benefits supplied may be disproportionate.

## 3.2 Sample characteristics

The survey by questionnaire was conducted between April and July 2010 over a sample of 200 visitors ($n = 200$). The questionnaire is available upon request.

Table 3 below gathers all the variables and their meaning (with a few Dummy Variables (DV)), whereas we show the sample characteristics through the descriptive statistics in Table 4.

| Variable | Description |
|---|---|
| TC | Travel Cost |
| INCOME | Income of the visitor's household |
| PERCEPTION_1 | DV: 1 if the visitor feels financially "comfortable"; 0 otherwise |
| PERCEPTION_2 | DV: 1 if the visitor feels financially "tight"; 0 otherwise |
| NBAH | Number of Adults in the Household |
| NBCH | Number of Children in the Household |
| NBASITE | Number of Adults within the group visiting the site |
| NCSITE | Number of Children within the group visiting the site |
| TRANSP_1 | DV: 1 if the visitor goes to the site on foot or by bicycle; 0 otherwise |
| TRANSP_2 | DV: 1 if the visitor goes to the site by car or camping-car; 0 otherwise |
| ACT(1,2,3,4,5,6,7,8) | DV: 1 if the main reason of the visitor's venue is resp.: bicycle; 0 otherwise |
| ENSU | DV: 1 if the visitor is an ENS user other than this one; 0 otherwise |
| ENSI | DV: 1 if the visitor does not know that he is visiting an ENS; 0 otherwise |

Table 3: Variable name and description

| Variable | Mean | Standard Deviation |
|---|---|---|
| TC (€) | 45.59 | 106.61 |
| Mean Household income (€) | 2758.75 | 1431.31 |
| NBAH | 1.9 | 0.6 |
| NBCH | 0.7 | 1.1 |
| NBASITE | 2.2 | 1 |
| NCSITE | 0.8 | 1.3 |
| Visitors socio-economic characteristics | Number of individuals | Percentage (%) |
| TRANSP_1 | 9 | 4.5 |
| TRANSP_2 | 191 | 95.5 |
| ACT_1 | 6 | 3 |
| ACT_2 | 8 | 4 |
| ACT_3 | 85 | 42.5 |
| ACT_4 | 24 | 12 |
| ACT_5 | 4 | 2 |
| ACT_6 | 33 | 16.5 |
| ACT_7 | 17 | 8.5 |
| ACT_8 | 23 | 11.5 |
| ENSU | 54 | 27 |
| ENSI | 106 | 53 |

Table 4: Sample descriptive statistics

The interviewed visitors have visited 7 times on average the ENS over the last year of the study. We can observe that there is a significant dispersion within our sample: the $NBAH$ and $NBCH$ variables are featured with a standard deviation almost three times greater than the mean.

To visit the ENS, visitors have traveled 123 kilometers on average. 20% of visitors do not come from the Hérault Department or from the whole Languedoc-Roussillon Region, and 4% come from foreign countries (of which Switzerland, Germany, Netherland, Belgium, Spain). However, ENS users are mainly locals living in the Hérault Department (73% of the interviewed visitors). Main activities are walk, hike, picnic and then enjoying children facilities. Retired people are oversampled that is a standard result in these kind of studies dedicated to recreation uses. Last, the visitors interviewed are generally well-informed that they visit an ENS (53% of visitors interviewed).

$TC$ are worth €63 on average and the $OCT$ is worth €7, leading to a total costs set at $70 (without accomodation costs). Our weighting process (through $INFLU$) lowers the $TC$ to the $WTC$ to €45.59 on average.

## 3.3 Econometric results

In Table 5, we present our econometric estimate and results. We present successively: the Truncated Stratified Poisson model correcting for zero truncation and endogenous stratification (TSP), the Negative Binomial model correcting for overdispersion (NB), and the Truncated Stratified Negative Binomial (TSNB) correcting for zero-truncation, overdispersion and endogenous stratification[11].

[11] We have usaed the STATA 9.1 software with the NBSTRAT command for TSNB models (Hilbe and Martínez-Espiñeira (2005)).

| | TSP | NB | TSNB |
|---|---|---|---|
| TC | $-0.045***$ (0.007) | $-0.006***$ (0.001) | $-0.017***$ (0.007) |
| INCOME | 0.0001 (0.00002) | $3.66e-06$ (0.000) | $-0.00003$ (0.0001) |
| PERCEPTION_1 | *Reference* | | |
| PERCEPTION_2 | $0.244**$ (0.078) | 0.332 (0.226) | $0,616**$ (0.316) |
| NBAH | $-0.105**$ (0.047) | $-0.070$ (0.072) | $-0.103$ (0.095) |
| NBCH | $-0.055***$ (0.123) | $-0.280**$ (0.140) | $-0.551**$ (0.028) |
| NBASITE | $-0.539***$ (0.049) | $-0.385***$ (0.069) | $-0.547***$ (0.104) |
| NCSITE | $0.117***$ (0.032) | $0.168**$ (0.076) | $0.231**$ (0.102) |
| TRANSP_1 | $0.848***$ (0.097) | $1.202***$ (0.409) | $1.306***$ (0.448) |
| TRANSP_2 | *Reference* | | |
| ACT_1 | $-0.923**$ (0.304) | 0.156 (0.692) | 0.895 (1.467) |
| ACT_2 | $-0.685***$ (0.196) | $-0.524$ (0.419) | $-0.732$ (0.581) |
| ACT_3 | *Reference* | | |
| ACT_4 | $-1.653***$ (0.130) | $-1.029***$ (0.269) | $-1.310***$ (0.371) |
| ACT_5 | $0.985***$ (0.205) | 0.292 (0.665) | $-0.054$ (0.837) |
| ACT_6 | $-0.741***$ (0.118) | $-0.661***$ (0.238) | $-0.882***$ (0.339) |
| ACT_7 | $0.897***$ (0.083) | $0.684**$ (0.321) | $0.645**$ (0.372) |
| ACT_8 | $-1.426***$ (0.146) | $-0.921***$ (0.252) | $-1.435***$ (0.398) |
| ENSU | 0.141 (0.084) | 0.325(0.213) | 0.446(0.287) |
| ENSI | $-0.797***$ (0.073) | $-0.603***$ (0.173) | $-0.942***$ (0.255) |
| Dispersion ($\alpha$) | – | 0.707(0.079) | – |
| LR Khi$^2$ Test | – | $969.48***$ | – |
| Pseudo $R^2$ | 0.56 | | |
| Log Likelihood | $-975.728$ | $-511.69678$ | $-439.70678$ |

Standard-error estimated in brackets; $p\ values: * = p < 0.10; ** = p < 0.05; *** = p < 0.01$.

$\alpha$ is the dispersion parameter ($\alpha > 0$ implies over-dispersion)

Table 5: Estimated parameters

The first estimated model is the TSP (Shaw (1988)). According to Grogger and Carson (1991), standard deviations are underestimated leading to reject frequently the null hypothesis of coefficients significancy ($\beta$). To tackle overdispersion, we have implemented a "Likelihood Ratio" (LR) test on $\alpha$. We get that $\alpha > 0$ and that the Khi-squared statistics has a high degree of freedom, and the LR test shows that this is preferable to choose to use a NB model in lieu of the TSP. Whilst observing the NB and TSNB models, the LR are getting higher in correcting for overdispersion and endogenous stratification. As a result, this is preferable to focus on the TSNB estimates to interpret the results.

$TC$ has a negative effect on the number of visits undergone confirming that the recreation demand function is decreasing. Income has no significant impact on the number of visits made, and this is quite standard in the TCM literature (Shresta *et al.* (2002), Parsons (2003) Martínez-Espiñeira and Amoako-Tuffour (2008), Garcia and Jacob (2010)). However, the income perception variable (meaning that the visitor feels financially comfortable or tight) has a significant impact. Results show that people feeling tight financially have a higher frequency of visits than people feeling financially well-to-do. This variable seems to show that the ENS have a social role allowing tight budget people to benefit from the recreative amenity through ENS free access.

Whereas going on-sites with children have a positive impact on the number of visits, the number of adults within the group have unlike a negative impact on ENS visits. It seems that people undertake more visits alone independently of their marital status. Besides, people going on-sites on foot, riding a bicycle or by bus are more likely to carry out a high number of visits compared with visitors coming by car or camping-car. This is probably due to the fact that these people are locals and live nearby the ENS. People having outdoor activities such as mountain biking, nautical activities, or special events occuring on-sites do not behave differently than wanderers. Nevertheless, people coming for picnic motivations visit more often the site than the wanderers, whilst people coming to practice recreational fishing, hiking, and to offer outdoor recreation to their children come over more often. Last, people knowing that they visit an ENS have a higher probability to visit than not knowing it. Individuals are therefore sensitive to this information and then to this conservation policy implemented by the CG34 body.

### 3.4 Consumer Surplus (CS) estimate

The main aim of our study is to assess the recreation economic value provided by the ENS through the TCM, and then we compute the individual mean surplus per visit. This mean surplus is then considered as a reliable proxy to assess the individual value allowed to the site.

| | TSP | TSNB |
|---|---|---|
| $\beta_{TC}$ | $-0.045$ | $-0.017$ |
| Expected number of visits ($\lambda_i$) | 3.6 | 1.06 |
| Consumer surplus per visit (€) | 22.22 | 58.82 |
| Consumer surplus per year (€) | 80.13 | 61.44 |

Table 6: Visitors' surplus estimation

Within our TSNB framework, the mean surplus is €58.82 per individual and per visit with a confidence interval equal to [34.60; 83.04], and the standard deviation is set to €4.92. The yearly mean surplus per individual is then set to €61.44 as the expected number of visits is 1.06. The TSP model estimates a higher expected number of visits than the TSNB and provides therefore a greater surplus per year. This means that it is necessary to consider overdispersion as this leads to overestimate the yearly surplus[12].

To estimate the yearly recreation social value that people allow to the ENS, we compute the overall Consumer Surplus (CS) for the whole population of ENS users. According to Parsons (2003), the Population Surplus is then:

$$Pop\_Surplus = CS * Pop$$

[12] The SP model correcting for endogenous stratification compute a mean surplus per individual and per visit to 22.22 Euros with a confidence interval equal to [10.28; 34.16], and the standard deviation is set to 3.46 Euros. The yearly surplus per indivisdual is set to 80.13 Euros as the expected number of visits is 3.6.

With $CS$ the total mean surplus per visit and $Pop$ the ENS population users.

As our modeling consider the zero-truncation and endogenous stratification, we could compute the yearly recreative value for the whole population. This would make the hypothesis that non-users have the same recreative demand functions as the effective visitors (Hellerstein (1991), Martínez-Espiñeira and Amoako-Tuffour (2008)). As this is difficult to define this population, and we have computed the social recreation value only from the potential and estimate ENS users. We have made two hypotheses of site traffic (regarding reliable information provided by the CG34: a low hypothesis of 200,000 users per year; and, a high hypothesis of 400,000 users per year. In using the expected number of visit per individual (1.06), we have estimated the total number of visits over a year at 212,000 visits for the low hypothesis, and 424,000 visits for the high hypothesis. These number of visits are then multiplied by the mean surplus per visit (€58.82) providing the yearly recreation social value. The figures are gathered in Table 7.

| | Nber of Visit. - 200,000 / year | Nber of Visit - 400,000 / year |
|---|---|---|
| CS per visit (€) | 58.82 | 58.82 |
| Expected number of visits | $212,000$ | $424,000$ |
| Pop_Surplus (Recreation value, €) | $12,469,840$ | $24,939,680$ |
| Confidence interval (at 0.05) | $[7,335,200; 17,604,480]$ | $[14,670,400; 35,208,960]$ |

Table 7: Recreational value estimation

As a result, the Hérault Department ENS social recreation value would be worth over €12 Million per year (€12,469,840 in 2010) for the low hypothesis and over €25 Million per year (€24,939,680 in 2010) for the high hypothesis.

# 4 Discussion

According to the CG34, the Hérault Department ENS policy costs €7 Million per year. The TDENS allows to acquire, to manage and to plan recreation activities (paths, picnic facilities, etc.). As a consequence, several trade-offs appear for a policymaker. Firstly, the policymaker has to decide how to use the TDENS between either acquiring new lands, or planning how to use owned lands. Secondly, when the lands are already under ownership, the policymaker has to decide how to use the TDENS between recreation activity enhancement, and site environmental protection. As a result, there is an opportunity cost associated with these decisions.

To manage efficiently this environmental policy, the CG34 needs economic information on the ENS whilst comparing the costs and the benefits of the current policy. The trade-off can be summarized as follows: protecting these areas is costly whereas the gains are difficult to assess. The comparison of the full costs and benefits is not feasible as this would need sharp accounting of the whole expenses since the introduction of the policy (in 1981), as well as the assessment of the comprehensive benefits. Nevertheless, our research shows that mean estimates of the recreation value are set between roughly €12 Million and €25 Million; this means that an extensive estimate of all the components of the Total Economic Value (TEV) through indirect use value, option value and non use value would a priori overstate the costs by far. Consequently, we can use this recreation value as a minimum value provided by the ENS. Moreover, ENS policymakers are watchful of the environmental information carried by the ENS as a label inducing a higher number of visits. Thanks to this ENS policy, the CG34 contributes to social cohesiveness. We have indeed shown that feeling financially "tight" increases the number of visits as the ENS are open and free access. This is complementary to other objectives pursued by the Departments in France, as the Departments are in charge of the minimum wage allocation[13].

Regarding our methodology, we can state a few limits could be enhanced. The TCM is a revealed-preference approach unlike a stated-preference approach that does not assess non use values. There is thus a need to carry out other valuation techniques to define the total value yield by the ENS. Furthermore, travel costs imply sensitivity to pricing and demand elasticity assessment would induce robustness in our results. The associated surplus would

[13] So-called "Revenu de Solidarité Active (RSA)".

certainly be modified, and this would require a sensitivity analysis. In addition, on would say that people who are interested in natural areas as ENS could have chosen to live nearby the sites; this would reduce the travel costs and this does not bring the real ENS value.

Comparing our results with other studies is quite difficult in terms of scale issues. Our CS (individual surplus per visit at €58.82) is indeed pretty small compared to Shresta *et al.* (2002) who estimated an individual surplus from \$540.54 to \$869.57 per trip for the Pantanal (Brazil), or compared to Martínez-Espiñeira and Amoako-Tuffour (2008) who provided an estimate of the individual surplus of \$535 per visit for the Gros Morne National Park (Canada). The main explanation probably relies on the UNESCO classification and labeling of these sites making them popular and attracting people from greater travel distance. However, our results are closer to Parsons (2003) figures dedicated to two North American National Parks ("Maumee Bay" and "Headland", with respectively \$25 and \$38) and Garcia and Jacob (2010) figure set at €22.61 as a mean of the forest recreation value in France (from a range of €0 and €47).

# 5 Concluding remarks

In this paper, we have shown how recreation demand analysis can be derives through count data models on french data from the ENS of the Hérault Department. The mean surplus per visit is €58.82 providing the yearly recreation social value worth from €12 Million to €25 Million. This information is necessary to guide policymakers and may allow a better guidance for conservation planning. Such an exercise constitutes an incomplete assessment of the Total Economic Value (TEV). However, we provide a first step to ground this public policy, and we describe a part of the contribution of this natural capital to society.

To complete our framework analysis, a few remarks have to be raised. The ENS public policy allows a free of charge access contributing to social affairs policy, and therefore plays a social function. The reassessment of tourist objectives and induced local effects could also be analysed in terms of regional economic policy. Furthermore, several methodological aspects could be considered to go further. Firstly, we do not integrate in our analysis substitute sites as it is difficult to find similar sites in competition with the ENS. Integrating these sites in the analysis would lead to a better surplus estimate not taking these sites currently lead to an overestimate of the CS. Secondly, multivariate count data models would allow to control for on-site sampling with individual panel data (Egan and Herriges (2006)). The assessment of actual trips to a specific sites as observed behaviour and future or anticipated trips as contingent behaviour (regarding current conditions or quality changes) would thus enhance the information on expected trips by visitors. Last, the overdispersion parameter and its parameterization regarding the demographic characteristics of the visitors through Generalized versions of the NB (GTSNB) would allow to evaluate the influence of visitor's characteristics on their individual degree of overdispersion (Martinez-Espineira and Amoako-Tuffour (2008)).

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