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Recreation Demand Analysis of the "Sensitive Natural Areas" (Hérault District, France): A Travel Cost Appraisal using Count Data Models

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Abstract

Natural areas are essentially multifunctional, contributing in 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 evaluate the recreation demand of the "Sensitive Natural Areas" (SNA) public policy in the Hérault District (Languedoc-Roussillon Region, France). These natural areas are acquired as land ownership by the Hérault District to ensure their protection from urban pressure and making them free to access. We highlight the recreation benefits in a Cost-Benefit Analysis (CBA) whilst measuring

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the direct use value set by visitors, and then we economically ground this SNA conservation policy. We show that the Consumer Surplus (CS) mean value is estimated at €58.82 (US$78.03) per visitor and per trip, from a range of €34.60 (US$45.90) to €83.04 (US$110.16). According to identified number of visitors, this result may show this SNA policy to be cost-efficient.

JEL classification: Q26 - Q51 - R14.

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

1 Introduction

1.1 Current issues

Natural areas are essentially 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 US 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 evaluate the recreation demand with regards to the Hérault District (Languedoc-Roussillon Region, France) "Sensitive Natural Areas" (SNA) public policy[1][2][3]. These natural areas are acquired as land ownership by the Hérault District to ensure their protection from urban pressure and making them free to access. Our objective is then to economically ground this SNA conservation policy.

Since the law of December 31, 1976, the French Districts have been in charge of a protecting tool for natural areas within the national environmental policy framework, that is the "Sensitive Natural Areas" public policy. To fund this environmental protection policy, they set and levy an environmental tax called "District Tax for the Sensitive Natural Areas" (DTSNA)[4] 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 animal or vegetable species located in these areas*" (GIP ATEN (2010)). They recover other conservational zoning as Natura 2000[5] or ZNIEFF dedicated to natural habitats and fauna and flora protection, and ZICO dedicated specifically to bird protection. This public policy allows acquiring and restoring natural areas, and has two main objectives: on the one hand, preserving natural habitats and landscape; on the other hand, opening them to the general public (except if the site is particularly fragile)[6].

[1] "Sensitive Natural Areas" refer to "Espaces Naturels Sensibles" (ENS).

[2] French administrative hierarchical top down organisation and requirements through decentralization: Government / Ministries and local bodies of the Ministries, Regions, Districts, Community of Municipalities, and Municipalities. The Districts have the authority on the following public policies: health through disabilities, secondary school / junior high school, environment (of which, *e.g.*, "Sensitive Natural Areas", coastal erosion for a district with a coastal zone, etc.).

[3] At the European scale, the SNA refers to "Terrestrial or aquatic area or other fragile natural setting with unique or highly-valued environmental features" (Environmental Terminology and Discovery Service (ETDS), European Environmental Agency (EEA)).

[4] "District Tax for the Sensitive Natural Areas" refers to "Taxe Départementale des Espaces Naturels Sensibles" (TDENS).

[5] Natural or semi-natural sites of the European Union (EU) having a particular patrimonial interest, through the exceptional fauna and the flora they contain (The Habitats Directive, Council Directive 92/43/ECC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora).

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

In practice, this SNA 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 Districts had set up the DTSNA; this policy is currently applied by 95 Districts (out of 101 Districts), which account for 3,050 sites through 170,000 ha managed, for roughly €150 Million (US$199 Million) per year (Assemblée des Départements de France (2011)).

We 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.

Our first contribution is to highlight one dimension of the potential benefits regarding recreation through the SNA conservation policy in a CBA whilst measuring the direct use value set 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 (US$78.03) per visitor and per trip, from a range of €34.60 (US$45.90) to €83.04 (US$110.16)[7]. Our second contribution is to enhance the set of empirical environmental non-market valuation analyses carried out in France. According to identified number of visitors, this result may show this SNA policy to be cost-efficient.

[7] For simplicity and to draw on comparisons, hereafter we set our results in US$ from 2010 € as we carried out our field work in 2010.

1.3 Literature review and methodology used

The TCM methodology is widely recognised 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 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 that 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 site models and 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), Martìnez-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 showed 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 US$540.54 to US$869.57 per trip, that is a relatively high value compared to other parts of the world. On their side, Martìnez-Espiñeira and Amoako-Tuffour (2008, 2009) analysed in a set of papers the recreation demand of the Gros Morne National Park (Canada) and got a CAN$535 (US$567.66) 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. Besides Anderson (2010) assessed the demand for ice climbing in Hyalite Canyon (Montana, USA) and estimated individual per trip values in a range of $76 to $135. Likewise, du Preez and Hosking (2011) estimated the consumer surplus per day and per trip to the Rhodes trout fishery at respectively ZAR2,668 (US$334) and ZAR13,072 (US$1,634) in 2007, and the total consumer surplus generated was set at ZAR18,026,288 (US$2,253,286). In France, Garcia and Jacob (2010) made a rigorous econometric analysis of the forest recreation function and reach a value a bit greater than €22.61 (US$29.99).

Methodologically speaking, we consider the Hérault District SNA public policy whilst applying the TCM to seven representative SNA, assuming they constitute the same and single site characterizing the Hérault District SNA diversity. We suppose that these seven chosen areas are well standing for the whole SNA of the Hérault District, in terms of recreational use, landscapes and environmental goods provided. This is the most efficient way to capture the SNA heterogeneity[8].

To estimate the demand function, we use count data models, and particularly Truncated and Stratified Poisson model (TSP) (Shaw (1988)), Negative Binomial model (NB), and 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 to 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 consumer 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 ongoing SNA 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

[8] 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.

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-market valuation, which measures the value granted to a natural area through users effective behaviour. This is an indirect valuation method as the recreation service valuation 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 other 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 (Martìnez-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. 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 Combined Travel Cost (CTC) (Cesario (1976), Martìnez-Espiñeira and Amoako-Tuffour (2008)). The CTC 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-site), and can therefore be set as:

$$CTC = tC + OCT + other\ costs$$

In the remainder of this sub-section, we review the methodology we have retained to design the CTC as well as the Weighted Combined Travel Cost ($WCTC$) that we estimate.

Firstly, we calculate the tC for individuals reaching the site by motor-driven vehicles 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 kilometre published annually by the fiscal administration[9], $Toll$ is the potential toll road cost, and P refers to the group size during the visit. The effective distance and related costs as well as 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 and a half of a hourly wage rate as individuals may have flexible jobs and can substitute work

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

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))[10]. For simplicity, we have chosen to consider the time spent on the recreation site as not being costly and the travel time for people coming on foot or by bicycle as not being costly as well[11] (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[12]. These costs are 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 user 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)). This solution leads to underestimate the user surplus, and therefore the value, because individuals are selected with regards to particular socio-demographic and socio-economic characteristics. In our

[10] 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).

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

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

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 (Amoako-Tuffour and Martìnez-Espiñeira (2008)). 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 weighting the costs between the various destinations. We have applied the same methodology and built the variable $INFLU$ from the answer, which weights the CTC. Once the cost is weighted, we could obtain the share of the costs which can be allocated to the site.

The $WCTC$ is then given by:

$$WCTC = \frac{CTC}{10} * INFLU$$

We split the $WCTC$ in two parts (Martìnez-Espiñeira and Amoako-Tuffour (2009)): the weighted travel cost inferred by the travel between the residence place and the accommodation place ($WCTC_1$); and, the weighted travel cost inferred by the travel between the accommodation place and the recreation site ($WCTC_2$). This weighting process is only effective for $WCTC_1$ 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 do not use this for local individuals (residential trips). As a result, the tourist $WCTC$ is equal to:

$$WCTC = \frac{WCTC_1}{10} * INFLU + WCTC_2$$

Hereafter, we refer solely to CTC to simplify the scripture whilst meaning $WCTC$ 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 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. The on-site survey allows selecting 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 only 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, which could bias the results interpretation toward the general population (Parsons (2003), Phaneuf and Smith (2005)).

The second issue is the endogenous stratification as regular 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)).

Suitable econometric models to correct these issues (Shaw 1988) are described 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 as the Negative Binomial (NB) model allows taking 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 is a vector of visitor i individual characteristics (travel cost, income, gender, age, activity, etc.). Every y_i is a realization of a Poisson rule with a parameter λ_i, which depends on explanatory variables x_i (Parsons (2003)). The probability given by the Poisson distribution, noted p_i, implies that y_i is equal to a non-negative integer k, and is given by:

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

The λ_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, λ_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 λ_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 β 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 preferred 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 Γ is the Gamma distribution widely used for the term of heterogeneousness and α reflects the degree of dispersion in the predictions. If $\alpha > 0$, there is an 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. They 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 α and also the expected number of trips λ_i through all the values of significant coefficients.

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 modelling is to estimate the recreation value. To this aim, we estimate the visitor welfare as the consumer welfare in computing the individual surplus mean per site visit to allow assessing 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 $-1/\beta_{CTC}$ where β_{CTC} is the coefficient of the CTC variable in the estimate (Creel and Loomis (1990)).

3 Case study and 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 "Sensitive Natural Areas" (SNA) public policy: features of the Hérault District case study

As already stated, the SNA public policy is currently applied by 95 Districts gathering 3,050 sites through 170,000 ha managed, for roughly €150 Million (US$199 Million) per year (Assemblée des Départements de France (2011)). The Hérault District 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 District 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) and gather a wide variety of landscapes and habitats. Population growth is particularly high in this District mainly through migration from other regions (roughly +1,500 inhabitants/month) with French seasonal peaks during the summertime for holiday motivations. Consequently, urban pressure and public infrastructures are the main drivers of biodiversity erosion and 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 District has been implementing its SNA policy since 1981. From now on, this policy contributes to biodiversity conservation by insuring an ecological continuity. According to the Hérault District, its SNA policy costs roughly €7 Million (US$9.29 Million) per year. The DTSNA allows to acquire, to manage and to plan recreation activities (paths, picnic facilities, etc.). The lands acquired constitute a network of natural areas connected by the green and blue corridors for biodiversity. The SNA cover more than 8,000 ha through 124 district properties. A wide range of natural habitats (coastal wetland, scrubland, limestone plateau, lake, etc.) constitutes these SNA of which 31% are contained in Natura 2000 sites. Regarding the recreational dimension, there are 500 kilometres of paths for hikers and riders through bicycle and horse backers. The main ecosystem services provided by the SNA 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 “Sensitive Natural Areas” (SNA)

The SNA we have studied are mapped in Figure 1 below and gathered in Table 2.

Insert Figure 1

One of the aims of the Hérault District is to promote peri-urban leisure activities, as the SNA are located close to main cities (Montpellier, Béziers). The SNA studied offer various leisure activities (Table 2). Individuals can go on hiking (on the green network), and accommodations are available for hikers overnight for a low fee (*e.g.*, on the sites of Roussières and Vernède). Moreover, four of the studied SNA are located nearby water resources as rivers or lakes (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 activities as picnic (facilities are at disposal), to observe fauna and flora, or to come to take advantage of children facilities (Fesquet and Restinclières).

SNA	Recreational services
Cazarils- Roussières	Walk - Hike - Picnic
Fesquet	Walk - Picnic - Fishing -Swim - Children activities
Réals	Walk - Picnic - Fishing -Swim - Canoeing - Children activities
Restinclières	Walk - Hike - Picnic - Children activities
Salagou Lake	Walk - Picnic - Fishing - Swim - Canoeing - Children activities
Savignac	Walk - Picnic - Fishing
Vernède	Walk - Hike - Picnic

Table 2: Recreational services supplied by the seven SNA

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. The recreational activities undergone are $ACT(1,2,3,4,5,6,7,8)$, with respectively: $ACT1$: ATV biking; $ACT2$: Performance animation; $ACT3$: Walk; $ACT4$: Outdoor children activity (children game area); $ACT5$: Nautical activity; $ACT6$: Picnic; $ACT7$: Fishing; $ACT8$: Hiking.

Variable	Description
NBV	Number of Visits
CTC	Combined Travel Cost
INCOME	Income of the visitor 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.: ACT; 0 otherwise
ENSU	DV: 1 if the visitor is an SNA user other than this one; 0 otherwise
ENSI	DV: 1 if the visitor does not know that he is visiting an SNA; 0 otherwise

Table 3: Variable names and description

Variable	Mean	Standard Deviation
NBV	7.15	19.44
CTC (€ and US$)	€45.59	€106.61
	(US$60.48)	(US$141.43)
INCOME (€ and US$)	€2758.75	€1431.31
	(US$3659.66)	(US$1898.73)
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 SNA over the last year of the study. We can observe that there is a significant dispersion within our sample: the NBV variable is featured with a standard deviation almost three times greater than the mean

(19.44 over 7.15).

To visit the SNA, visitors have travelled 123 kilometres on average. 20% of visitors do not come from the Hérault District or from the whole Languedoc-Roussillon Region, and 4% come from foreign countries (of which Switzerland, Germany, the Netherlands, Belgium, Spain). Treating accurately multi-destination trips is particularly meaningful in our research. As there is a significant part of tourists in our sample, it is likely that their trip is a multi-destination one. As a consequence, attributing the totality of the costs born to visit the SNA to assess the recreational benefits supplied may be disproportionate. However, SNA users are mainly locals living in the Hérault District (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 kinds of studies dedicated to recreation uses. Last, the visitors interviewed are generally well-informed that they visit an SNA (53% of visitors interviewed).

tC are worth €63 (US$83.57) on average and the OCT is worth €7 (US$9.29), leading to a total cost set at €70 (US$92.86) (without accommodation costs). Our weighting process (through $INFLU$) lowers the CTC to €45.59 (US$60.48) 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[13].

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

	TSP	NB	TSNB
CTC (β_{CTC})	$-0.045***$ (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)
Log Likelihood	-975.728	-511.69678	-439.70678

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

Table 5: Estimated parameters β

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 significance β. To tackle overdispersion, we have implemented a "Likelihood

Ratio" (LR) test on α. 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.

CTC 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 SNA have a social role allowing tight budget people to benefit from the recreational amenity through SNA free access.

Whereas going on-site with children has a positive impact on the number of visits, the number of adults within the group has rather a negative impact on SNA visits. It seems that people undertake more visits alone independently of their marital status. Besides, people going on-site on foot, riding a bicycle or by bus are more likely to carry out a high number of visits compared to visitors coming by car or camping-car. This is probably explained by the fact that these people are locals and live nearby the SNA. People having outdoor activities such as ATV biking, nautical activities, or special performance events occurring on-site do not behave differently than walkers. Nevertheless, people coming for picnic motivations visit more often the site than the walkers, 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 SNA 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 Hérault District body.

3.4 Consumer Surplus (CS) estimate

The main aim of our study is to assess the recreation economic value provided by the SNA 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
β_{CTC}	-0.045	-0.017
Expected number of visits (λ_i)	3.6	1.06
Consumer Surplus per visit (€ and US$)	€22.22	€58.82
	(US$29.48)	(US$78.03)
Consumer Surplus per year (€ and US$)	€80.13	€61.44
	(US$106.30)	(US$81.50)

Table 6: Visitors' surplus estimation

Within our TSNB framework, the mean surplus is €58.82 (US$78.03) per individual and per visit with a confidence interval equal to [€34.60; €83.04] ([US$45.90; US$110.16]), and the standard deviation is set to €4.92 (US$6.53). The yearly mean surplus per individual is then set to €61.44 (US$81.50) 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[14].

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

[14]The SP model correcting for endogenous stratification compute a mean surplus per individual and per visit to €22.22 (US$29.48) with a confidence interval equal to [€10.28; €34.16] ([US$13.64; US$45.32]), and the standard deviation is set to €3.46 (US$4.59). The yearly surplus per individual is set to €80.13 (US$106.30) as the expected number of visits is 3.6.

$$Pop\_Surplus = CS * Pop$$

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

As our modelling considers the zero-truncation and the endogenous stratification, we could compute the yearly recreational 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 SNA users. We have made two hypotheses of site traffic (regarding reliable information provided by the Hérault District: 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 in the TSNB model (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 numbers of visits are then multiplied by the mean surplus per visit (€58.82 (US$78.03)) 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 (€ and US$))	€58.82	€58.82
	(US$78.03)	(US$78.03)
Expected number of visits	212, 000	424, 000
Pop. Surplus (€ and US$)	€12, 469, 840	€24, 939, 680
	(US$16, 542, 053)	(US$33, 084, 107)
Confidence interval (at 0.05)	[€7, 335, 200;€17, 604, 480]	[€14, 670, 400;€35, 208, 960]
	[US$9, 730, 619;US$2, 335, 348]	[US$19, 461, 239;US$46, 706, 974]

Table 7: Recreational value estimation

As a result, the Hérault District SNA social recreation value would be worth over €12 Million per year (€12,469,840 in 2010) (over US$16 Million per year (US$16,542,053)) for the low hypothesis and over €25 Million per year (€24,939,680 in 2010) (over US$33 Million per year (US$33,084,107)) for the high hypothesis.

4 Discussion

As a reminder, the Hérault District SNA policy costs roughly €7 Million (US$9.29 Million) per year. As a consequence, several trade-offs appear for a policymaker. Firstly, the policymaker has to decide how to use the DTSNA 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 DTSNA 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 Hérault District needs economic information on the SNA 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 SNA social recreation value are set between roughly €12 Million (US$16 Million) and €25 Million (US$33 Million); this result may show this SNA policy to be cost-efficient. 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 SNA. Moreover, SNA policymakers are watchful of the environmental information carried by the SNA as a label inducing a higher number of visits. Thanks to this SNA policy, the Hérault District contributes to social cohesiveness. We have indeed shown that feeling financially "tight" increases the number of visits as the SNA are open and in free access. This is complementary to other objectives pursued by the Districts in France, as the Districts are for example in charge of the minimum wage allocation[15]. The income perception variable could lead to an interpretation of the SNA as a kind of inferior good, decreasing whilst income perception is getting higher. In addition, regarding the extent of our results towards the SNA to the other Districts in France, we can argue that this is useful as recreational activities are generally similar, and as individuals are sensitive to knowing that they visit an SNA and then to this conservation policy.

Regarding our methodology, we can state that 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 SNA. Furthermore, travel costs imply sensitivity to pricing and demand elasticity assessment would induce robustness in our results. The associated surplus would certainly be modified, and this would require a sensitivity analysis. In addition, one would say that people who are interested in natural areas as SNA could have chosen to live nearby the sites; this would reduce the travel costs and this does not bring the real SNA value.

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

Comparing our results with other studies is quite difficult in terms of scale issues. Our CS (individual surplus per visit at €58.82 (US$78.03)) is indeed small compared to Shresta *et al.* (2002) who estimated an individual surplus from US$540.54 to US$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 CAN$535 (US$567.66) per visit for the Gros Morne National Park (Canada). The main explanation probably relies on the UNESCO classification and labelling 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 US$25 and US$38) and Garcia and Jacob (2010) figure set at €22.61 (US$29.99) as a mean of the forest recreation value in France (from a range of €0 (US$0) to €47 (62.35US$)).

5 Concluding remarks

In this paper, we have shown how recreation demand analysis can be derived through count data models on French data from the Hérault District SNA policy. The mean surplus per visit is €58.82 (US$78.03) providing the yearly recreation social value worth from €12 Million (US$16 Million) to €25 Million (US$33 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 SNA 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 SNA. Integrating these sites in the analysis would lead to a better surplus estimate whilst limiting the CS overestimate.

Secondly, multivariate count data models would allow controlling for on-site sampling with individual panel data (Egan and Herriges (2006)). The assessment of actual trips to a specific site 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 carried out 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 visitors characteristics on their individual degree of overdispersion (Martìnez-Espineira and Amoako-Tuffour (2008)).

References

[1] Amoako-Tuffour J., Martınez-Espiñeira R. (2008), Leisure and the opportunity cost of travel time in recreation demand analysis: A re-examination, *MPRA paper from University library of Munich*, 1-43.

[2] Anderson D.M. (2010), Estimating the economic value of ice climbing in Hyalite Canyon: an application of travel cost count data models that account for excess zero, *Journal of Environmental Management*, 91, 1012-1020.

[3] Assemblée des Départements de France (2011), Espaces Naturels Sensibles: une politique des Départements en faveur de la nature et des paysages, Assemblée des Départements de France (ADF) Editions.

[4] Bateman I.J., Willis K.G., (1999), Valuing environmental preferences: theory and practice of the contingent valuation method in the U.S, E.U., and developing countries, Oxford University Press, New York.

[5] Bocksteal N.E., Strand I.E., Hanneman W.M. (1987), Time and the recreational demand model, *American Journal of Agricultural Economics*, 69(2), 293-302.

[6] Brown W.G., Nawas F. (1973), Impact of aggregation on the estimation of outdoor recreation demand functions, *American Journal of Agricultural Economics*, 55(2), 246-249.

[7] Bujosa Bestard A., Riera Font A. (2009), Environmental diversity in recreational choice modelling, *Ecological Economics*, 68, 2743-2750.

[8] Cameron A.C., Trivedi P.K. (1986), Econometric models based on count data: comparisons and applications of some estimators and tests, *Journal of Applied Economics*, 1, 29-53.

[9] Cesario F. (1976), Value of time in recreation benefit studies, *Land Economics*, 52, 32-41.

[10] Chevassus-au-Louis B., Salles J.-M., Pujol J.-L. (Centre d'Analyse Stratégique (CAS)), Approche économique de la biodiversité et des services liés aux écosystèmes - Contribution à la décision publique, La Documentation Française, 376 p.

[11] Clawson M. (1959), Methods of measuring demand and value of outdoor recreation, Resources For the Future (RFF), Washington DC.

[12] Clawson M., Knetsch J.L. (1966), Economics of outdoor recreation, John Hopkins Press, Baltimore.

[13] Costa J.P., Climaco J.C. (1999), Relating reference points and weights in MOLP, *Journal of Multi-Criteria Decision Analysis*, 8, 281-290.

[14] Creel M.D, Loomis J.B (1990), Theoretical and empirical advantages of truncated count data estimators for analysis of deer hunting in California, *American Journal of Agricultural Economics*, 72, 434-441.

[15] de Groot R.S., Wilson M.A., Boumans R.J.M. (2002), A typology for the classification, description and valuation of ecosystem functions, goods and services, *Ecological Economics*, 41, 393-408.

[16] du Preez M., Hosking S.G. (2011), The value of the trout fishery at Rhodes, North Eastern Cape, South Africa: a travel cost analysis using count data models, *Journal of Environmental Planning and Management*, 54(2), 267-282.

[17] Egan K., Herriges J. (2006), Multivariate count data regression model with individual panel data from on site sample, *Journal of Environmental Economics and Management*, 52, 567-581.

[18] Englin J., 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, *Review of Economics and Statistics*, 77, 104-112.

[19] Feather P., Shaw W. D. (1999), Estimating the cost of leisure time for recreation demand models, *Journal of Environmental Economics and Management*, 38(1), 49-65.

[20] Freeman A.M. (1993), The measurement of environmental and resource values: theory and methods, Resources For the Future (RFF), Washington DC.

[21] Garcia S., Jacob J. (2010), La valeur récréative de la forêt en France : une approche par les coûts de déplacement, *Revue d'Etudes en Agriculture et Environnement*, 91(1), 43-71.

[22] Grogger J.T., Carson R.T. (1991), Models for truncated counts, *Journal of Applied Econometrics*, 6(3), 225-238.

[23] Haspel A., Johnson R. (1982), Multiple destination trip bias in recreation benefit estimation, *Land Economics*, 58, 364–372.

[24] Hellerstein D.M. (1991), Using count data models in travel costs analysis with aggregate data, *American Journal of Agricultural Economics*, 73, 860-866.

[25] Hilbe J., Martìnez-Espineira R. (2005), TSNB: STATA module to estimate negative binomial with endogenous stratification, Software Components, Boston College Department of Economics.

[26] Loomis J., Yorizane S., Larson D. (2000), Testing significance of multi-destination and multi-purpose trip effects in a travel cost method demand model for whale watching trip, *Agricultural and Resource Economic Review*, 29 (2), 183-191.

[27] Mäler K.G. (1974), Chapter 5. Estimating the demand for environmental service: weak complementarity, in John Hopkins, Environmental Economics: A Theoretical Inquiry, Baltimore, University Press for Resources For the Future (RFF), 183-191.

[28] Martìnez-Espiñeira R., Amoako-Tuffour J. (2008), Recreation demand analysis under truncation, overdispersion, and endogenous stratification: An application to Gros Morne National Park, *Journal of Environmental Management*, 88(4), 1320-1332.

[29] Martìnez-Espiñeira R., Amoako-Tuffour J. (2009), Multi-destination and multi-purpose trip effects in the analysis of the demand for trips to a remote recreational site, *Environmental Management*, 43, 1146-1161.

[30] McConnell K.E. (1985), Chapter 15. the economics of outdoor recreation, in Kneese A.V., Sweeney J.L., Handbook of Natural Resource and Energy Economics, Vol. II, Maryland, Elsevier Science, 677-722.

[31] Parsons G.R. (2003), Chapter 9. The travel cost model, in Champ P. A., Boyle K. J., Brown T.C., A primer for non-market valuation, London, Kluwer Academic Publishers, 1-66.

[32] Phaneuf D.J., Kerry Smith V. (2005), Chapter 15. Recreation demand models, in Mäler G. K., Vincent J.R., Handbook of Environmental Economics, Vol. II, North Carolina, Elsevier Science, 672-751.

[33] Rapport du Groupement d'Intérêt Public (GIP) Atelier Technique des Espaces Naturels (ATEN) (2010), "Espaces Naturels Sensibles (ENS) des Départements".

[34] Shaw D.G. (1988), On-site samples' regression: problems of non-negative integers, truncation and endogenous stratification, *Journal of Econometrics*, 37, 211-233.

[35] Shrestha R. K., Seidl A.F., Moraes A.S. (2002), Value of recreational fishing in the Brazilian pantanal: a travel cost analysis using count data model, *Ecological Economics*, 42, 289-299.

[36] Willig R.D. (1976), Consumer surplus without apology, *American Economic Review*, 66(4), 589-597.

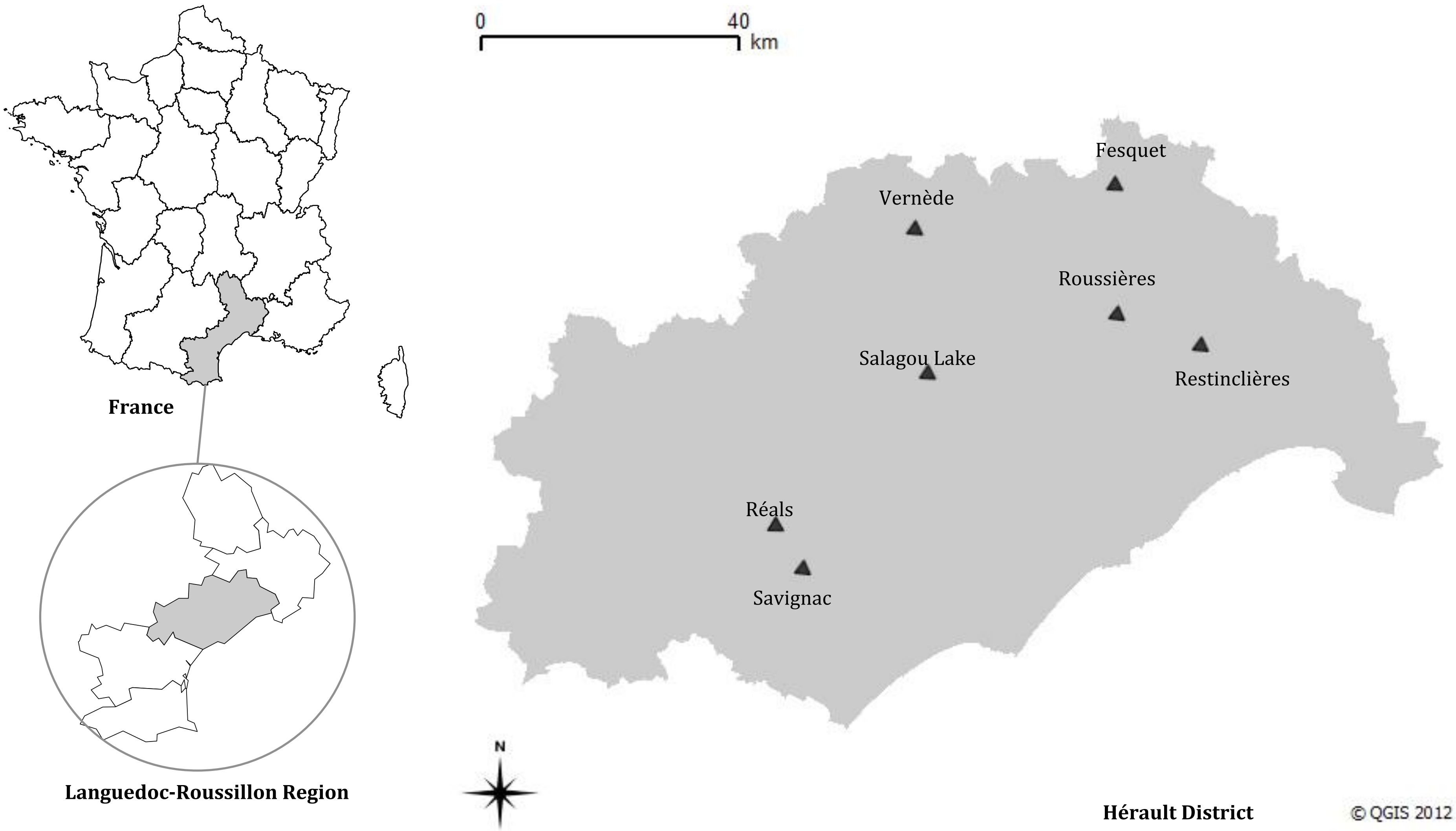

Figure 1: Location map of the Hérault District SNA under study

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