ESTIMATING ENVIRONMENTAL BENEFITS OF AFFORESTATED AREAS. CASE STUDY IN THE IBERIAN PENINSULA

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ABSTRACT

This paper reports the results from a case-study around the environmental economic value provided by afforested areas with distinct management objectives. The application sheds light on some of the problems in considering the non-market output associated to different forest uses. The goal is to learn more about the benefits for society derived from the provision of public recreational facilities and public afforestation programmes, in a unique context, that of Galicia (North-western Spain) and Portugal, where rotation periods in forestry plantations are short, and land previously used for agriculture as well as native woodlands that have been cut or burnt down are being replanted with fast-growing species. Since the paper supports the view that Contingent Valuation (CV) is an appropriate technique for the valuation of the benefits, yet to be refuted, the results of the study are accompanied by a discussion of the way the method is applied.

RÉSUMÉ

Ce travail illustre les résultats d'une étude de cas sur la valeur économique environnementale des aires boisées et poursuit des objectifs de gestion bien distincts.
La discussion porte sur des problèmes se référant à la production non marchande associée à différentes utilisations forestières. Le travail vise à la connaissance des bénéfices que la société peut tirer de l'offre de structures récréatives publiques et des programmes de reboisement publics, dans un seul contexte, qui est celui de la Galicie (nord-ouest de l'Espagne) et du Portugal, où les périodes de rotation des plantations forestières sont courtes et la terre précédemment utilisée pour l'agriculture ainsi que les bois naturels qui ont été coupés ou brûlés sont replantés avec des espèces à croissance rapide.
Le travail soutient la thèse que l'Evaluation Contingente (CV) est une technique appropriée pour évaluer les bénéfices, quand même à réfuter, et les résultats de l'étude sont accompagnés par une discussion sur l'application de la méthode.

The use of land in both Galicia and Portugal is unique, conditioned by climate, soil, social and economic aspects, as well as by administrative action by the relevant authorities.

Until the 60s agriculture and cattle farming had an important weight in traditional rural economy.

Land uses for cattle or non-agricultural activities were closely connected to rural economy: pasture for cattle, vegetation for manure, and timber and firewood made this area an important "factory" whose output were intermediate goods for the rural community. Migration towards urban areas together with changes in farming practice made this land less and less needed for traditional purposes.

The forestry authorities and paper mills began to take over the barren areas and proceed to forest them. At first mostly with maritime pine, later on with eucalyptus and insignis pine. Such plantations are very profitable, especially when subsidised by forestry policies, although the extent of this afforestation has gone far beyond the objectives laid out by the forestry authorities. Today, eucalyptus plantations determine the woodland landscape of coastal provinces, with rotations below 15 years.

They are practically the only kind of forested land in some districts (Prada Blanco and González Gómez, 1993, 1996, 1997; Americo, 1998; CESE, 1996; González Gómez, 1998) and make up to 50 percent of wooded areas in coastal provinces (e.g. Coruña and Lisbon), where population density is great and where urban population and tourism of the Region is concentrated. These factors generate demand for recreational land use. Besides, the hinterland is less suitable for fast-growing species such as eucalyptus or insignis pine, and so much space there totally lacks any agricultural, cattle or forestry uses. Other features are the fact that there are many forest fires, that burn down on average, between 1990 and 1995, 1.2 per cent annually of non-agricultural land; there is also much random clear cutting, and the land dedicated to nature reserves (0.7%) lies below the mean values for Spain and other European countries. Afforestation has depended on public programmes, part of which are funded by the European Union (European Commission, 1997).

The relevant public expenditure needs to be justified against other strong demands on the exchequer, that is, the Administration needs to be assured that the public enjoying the amenities offsets the public cost provision or the cost derived from compensating owners who forgo private benefit by obtaining less income or incurring greater costs. Two major effects should be tested: the provision of recreational facilities and the preservation of woodlands (basically fast-growing species plantations). It would also be possible to undertake afforestation with different species. The alternative could bring about a significant change to the landscape.

Therefore it is important to know the value of the benefits derived from an improved landscape.

Survey techniques are used in CV to estimate the value of non-market goods and services. The Demand for these goods may be elicited by describing a simulated market for the goods and directly asking respondents

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how much they would be willing to pay for a specific quantity or quality change (Mitchell and Carson, 1989). We use a sample of visitors to a forest to estimate the present benefits from visits. Contrary to other valuation techniques (travel cost and hedonic pricing) the CV method is also able to estimate the potential benefits derived from increasing the presence of broad-leaved species and the implementation of measures to preserve woodlands.

The survey was undertaken between June 1994 and July 1995. This information allows for an objective comparison between the different types of output derived from land use. Furthermore, it is also possible to carry out a cost-benefit-analysis of the non-market output and consider it for forest management decisions. First we will introduce the use of forest lands in this region. Section 3 describes the area relevant to our case study, and the conceptual framework pursued. Then, we will present our results, and finally, we will carry out an assessment and interpretation of our findings.

Forestry in Galicia and Portugal

In 1995, the area of woodlands in Portugal and Galicia was 3,306,100 and 928,002 ha, respectively. This represents 37.2 and 31.5 per cent of the total land area. Forested areas show a clear trend to grow in Portugal during this century, whereas they have decreased in Galicia in the last decades (**tables 1 and 2**).

The most abundant species is maritime pine (*Pinus Pinaster*), at 31.1 per cent in Portugal and 32.4 per cent in Galicia.

This percentage has declined from around 45 per cent in the 1960s. Eucalyptus plantations were started in the 1960s to meet the demands of the paper-pulp industry, reaching 21 per cent of the forested land in Portugal and 29 per cent in Galicia. Another abundant species in Portugal is cork oak (*Quercus suber*) that represents 22 per cent of woodlands. In Galicia the insignis pine (*Pinus radiata*) is an emerging species, demanded by the plywood industry. Forest coverage may still increase substantially through afforestation of non-cultivated lands and agricultural lands that are less suitable for farming, or in the process of being abandoned in both Galicia and Portugal.

The data for eucalyptus and insignis pine evidence that the goal set by the forest authorities has been exceeded.

Afforestation with said species is economically attractive for private forest owners without the need for public financial support (1). With Regulation EEC 2080/92, it is receiving much more support in Galicia (2) than in Portugal, where public subsidies to eucalyptus and maritime pine plantations were drastically cut back, to foster the plantation of cork oak and other broadleaved species, together with multiple use forest management. The forestry incentive system in Galicia is not compatible with the objectives that had been set.

Afforestation policies (planned species composition in **table 3**) and natural conditions (potential species composition in **table 3**) provide a substantial potential growth for all tree species except eucalyptus. Planned or potential afforestation seems to be dependent on grants from the public sector.

These are funded with the participation of the European Union, who may maintain or increase its funding subsequent to the current and future adjustments under the Common Agricultural Policy (CAP), the Environmental Policy or the Rural Development Policy that may

(1) 27,000 Pts/ha/year for eucalyptus and 20,000 Pts/ha/year for insignis pine (González Gòmez, 1999b).

(2) The Equivalent Annual Annuity for Eucalyptus plantations are under this grant scheme three times greater, and more, than for broadleaved and conifers.

Table 1 ***Trends in forest lands in Portugal.***

	1939		1974		1982		1995	
	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%
Maritime pine	1,161	47	1,294	43.8	1,306	41.3	1,029	31.1
Eucalyptus	–	–	214	7.2	386	12.2	695	21.0
Cork oak	690	27.9	653	22.1	664	20.1	721	21.8
Other	616	24.9	793	26.8	806	25.5	861	26.0
Total	2,467	100	2,954	100	3,162	100	3,306	100
Forest cover rate	27.8		33.3		35.6		37.2	

Table 2 ***Trends in forest lands in Galicia.***

	1972		1986		1995	
	1,000 ha	%	1,000 ha	%	1,000 ha	%
Maritime pine	493	43.7	303	27.3	301	32.4
Eucalyptus	131	11.6	234	21.2	271	29.1
Insignis pine	32	2.8	23	2.1	74	8.4
Other	295	41.8	547	49.4	278	29.9
Total	1,122	100	976	100	928	100
Forest cover rate	38.1		33.1		31.5	

Table 3 ***Current, planned and potential species composition.***

	Portugal						Galicia					
	Current		Planned		Potential		Current		Planned		Potential	
	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%
Conifers	1,136	34.3	1,325	35.4	2,917	52.8	411	44.2	734	52.9	550	43.7
Eucalyptus	695	21.0	570	15.2	531	9.6	271	29.1	246	17.6	239	19
Cork oak	721	21.8	880	23.5	917	16.6	—		—		—	
Other Broadleaved	754	22.8	975	26.0	1,075	16.6	246	26.5	408	29.4	470	37.4
Total	3,306	100	3,750	100		100	928	100	1,731	100	1,256	100
Forest cover rate	37.2		42.2		62.2		31.5		58.8		42.7	

be included in Agenda 2000 (European Commission, 1997a).

ELEMENTS IN THE APPLICATION

The site

We are focusing on a 20,000 hectare area, 3.7 per cent of which has been declared a natural park (NPA of 746 hectares).
There are no significant wildlife species and the situation is typical of other woodlands in Galicia and Portugal (Inventario de recursos Baixo Miño, 1992).
Eucalyptus and conifers plantations occupy 79.5 per cent of the land that is not set out for other productive uses (Agriculture, urban development or Industry), 20 per cent of it is treeless and broadleaved species cover 0.5 per cent.
During the period from 1982 to 1993, there were on average 155 forest fires each year, that burnt down 4 per cent of the land, 79 per cent of which was covered by trees. Forest use inside the natural park (longer rotation periods, lower tree density and greater diversity of species) as well as the existence of infrastructures for the development of leisure activities are an exception in the case of Galician forests, although elsewhere in Europe they may be the norm.
The land is owned by two local communities and managed by the forest authorities.
The natural park area did not suffer from wildfires during the period researched. According to the classification of FAO, its recreational use is important since it is visited over ten days per hectare/year ([3]). 15 per cent of visitors are residents of the municipality where it is located (Tui), 21 per cent are residents of the remaining four municipalities in the Baixo Miño district, 33 per cent in Vigo (the major urban centre in the vicinity), 10 per cent in the rest of the province of Pontevedra, 7 per cent in the rest of Galicia, the remainder are residents of other parts of the Iberian Peninsula, mostly from Portugal, Madrid and Barcelona.
Visitors are attracted to the NPA first and foremost by nature and quietness, then by its scenic views, by the fact that there are no cars and also the opportunity of hiking and walking in nature.
The average duration of visits is longer during the Summer and shorter in Winter: in the Summer, 40 per cent of visitors spend the entire day at the park, whereas in Spring and Autumn 20 per cent spend less than one hour, and 75 per cent of Winter visitors spend less than one hour. The percentage of university graduates among the visitors is five times above the average for Galicia's population.
The average number of visits made annually is 6.3, and 10 per cent are first-time visitors.

The relevant population and concepts of value

Forested spaces may provide satisfaction to visitors that use them for recreational purposes. But both visitors, irrespective of how many times they may come to visit, as well as non-visitors may also be satisfied merely because the forests are there. Such a benefit is associated to the reassurance that future visits may take place, both of actual and eventual visitors, but also that certain environmental functions may be sustained, such as erosion control, water quality, wildlife habitat, etc. The motivation lies in the altruistic behaviour of individuals toward their families, friends, the population in general or even future generations, but also in the responsibilities that individuals may feel toward the preservation of the environment, and especially of forest ecosystems. The literature outlines different concepts to measure the degree of satisfaction that visitors and non-visitors may obtain from increasing the probability of survival for woodlands (use and non-use values) ([4]). Budget constraints to the realisation of the application do not allow us to take both the non-visitor and visitor population into account. There are some advantages, however, in considering the visitor population. They are in contact with the object valued and this decreases the degree of uncertainty, chance replies and the effort to respond; efficiency thus increases and moreover, relevant information may be obtained about the ways in which visitors make use of the services provided. In practice there may be some difficulties when attempting to separate the non-use and use values for people who are visiting the site. These differences have little practical relevance to our objective, that is, to estimate the benefits from the provision of recreational facilities and the benefits that visitors may obtain from improving landscapes in the recreational area and also from implementing measures to preserve woodlands. In order to establish a framework for evaluation, we must first define the consequences of the provision of recreational facilities, landscape improvement and measures to preserve the woodlands. In all three cases visitors are invited to assess the change from the current situation of woodlands to a hypothetical scenario. For the case of providing recreational facilities, interviewees are confronted with a new situation were the current free access to the NPA would not be maintained and visitors would have to pay. In the case of landscape improvement we give the visitors to the NPA the option to substitute the actual conifer-eucalyptus prevalence in the landscape by broadleaved species. Finally, in the last case we offer to the visitors a scenario in which forest authorities would implement afforestation and conservation measures that would reduce the risk of lossing forested area from the 20,000 ha district. The first value, the monetisation of

([3]) FAO (1986) Each day equals 12 hours of visit. At the NPA approximately 82,000 visits were made and the average duration of each visit was 4 hours.
([4]) Nielsen (1992).

the benefits of "recreational service" that the NPA provides to the visitors, is calculated according to the Equivalent Surplus (Johansson, 1987; Hanley *et al.* 1997). This measurement corresponds to the willingness to pay (WTP) or forgo income in order to maintain visit levels. Formally, given the prices p and the income level Y, the first change proposed in the questionnaire for the public good Z from the initial situation 1 to the proposed alternative 0 (termination of current free access), may be expressed:

$$U (p,Y-ES,Z^1) = U (p,Y,Z^0)$$

where ES is the monetary value of decreased visits per annum from Z^1 to Z^0 or the maximum WTP in order not to forgo visiting the park.

For the second value, we propose making broadleaved species dominant in the park. Visitors experiment an improved landscape in the park by increasing the presence of broadleaved species, although this entails income loss if compared to the present situation, as they are obliged to pay in order to maintain the current level of visits but with landscape improvement. This is proposed in terms of a Hicksian compensating surplus.

Formally, given the prices p' and the income level Y', the change proposed for the landscape from the current levels of conifer-eucalyptus plantation Q^0 to broadleaved species prevalence Q^1 may be expressed:

$$U (p',Y',Q^0) = U (p',Y'-CS,Q^1)$$

where CS is the maximum WTP that would bring a visitor back to the original level of utility prior to the improvement U^1.

Finally, measures to preserve or reforest areas increase the utility for visitors because the risk of losing forested areas decreases (Freeman III, 1993). We are taking the 20,000 hectares of the district into account. The NPA is not representative enough to our purposes, as it is small in size and it enjoys the maximum protection levels applied in Galicia. First of all we assume the possibility that the woodlands of the Baixo Miño, that are currently used for timber harvesting but not for recreational-landscape purposes, may become forests where preservation goals are implemented in order to maintain the current situation. Let Z_1^1 be the forest area that would exist if preservation goals were to be implemented, and Z_1^0 the same without preservation. The equivalent surplus (ES) is the maximum amount of money that the consumer would be WTP to secure Z_1^1 or prevent deterioration of these woodlands. ES contains the exchange between money income (Y) and availability of woodland in order to maintain the initial utility level U^1. Formally, we may write the change as:

$$U (p,Y-ES,Z_1^1) = U (p,Y,Z_1^0)$$

where U(.) is the utility function.

Secondly we propose the possibility of reforesting barren areas, given the fixed level of woodland area Z_1^1 we are considering increasing to Z_1^2. To ensure reforestation and the change from Z_1^1 to Z_1^2, a visitor would forgo income to reach the original utility level, that is

$$U (p,Y,Z_1^1) = U (p,Y-CS,Z_1^2)$$

where CS is the monetary value of changing from the initial situation to another where barren areas are reforested.

The survey

The CV method allows us to estimate the values above in a hypothetical market, using structured surveys. These were made by means of questionnaires aimed at obtaining visitors' WTP. Personal interviews were conducted following the recommendations of the influential report on CV by the NOAA (Arrow *et al.*, 1993) (Willis, 1995). In order to obtain a conservative design, we used WTP, also recommended, as well as open-ended questions ([5]). In order to reduce the chances of zero response we used a payment card proposing several values. The format chosen for the payment card followed the requirement whereby the values displayed would not induce differences in the probability of choosing any one of them.

The questionnaire was structured to obtain three main types of information:

1. details of people's use of the NPA (e.g. frequency of use, opportunity costs) and the attributes of the NPA that they valued (landscape, peace and quiet etc.);
2. socio-economic information on users (e.g. income, household size etc.);
3. individuals' WTP;

Prior to trying to elicit individuals' WTP, interviewees were asked their opinion about spending more money to conserve the actual recreational facilities in the forest, to maintain it without paying additional money, to reduce public expenditures on the forest or to pay more to increase the forest quality and/or quantity, so that they could begin to think about their income allocation, budget constraints and forest management before being confronted with the hypothetical scenarios and WTP questions. Interviewees were then asked to consider the first scenario of WTP to continue to use the NPA. Once their first WTP was elicited and after being asked to indicate which option they preferred (conifer-eucalyptus landscape or broadleaved landscape), visitors were asked about their WTP in the case broadleaved

([5]) Although the NOAA Panel recommends the binary or closed format of the "conservative design" group, other authors find the open format to be even more conservative (Walsh et al., 1989; Kriström, 1993; Mitchell and Carson, 1995; Kriström and Riera, 1997).

species were to prevail in the park. The presentation of "improved landscape for the visitors" was made by showing colour photographs of landscapes with broadleaved species in different seasons along the year. Finally, in the last scenario and after being asked if they wanted to preserve the forest only for wood production and landscape/recreational use, individuals were asked about the willingness to pay for the preservation of woodlands that are not visited, by subjecting them to protective measures in the cases where there is tree cover and to afforestation where barren.

We may not estimate the total value and divide it into categories (i.e., recreational facilities provision, landscape improvement and measures to preserve the 20,000 ha woodlands) given that the first and second value components refer to the 746 ha NPA and the last component to a 20,000 ha area. Another reason in favour of this strategy is the advantage of using an entrance fee as a means of payment to enter the NPA, it could not be applicable to the overall forest lands in the district. The experience of an entrance fee for a forest lying close to the NPA makes this instrument more credible for the application. The question of how much an individual would be WTP in order not to give up visiting under the current circumstances, or with improved landscape, was followed by another question where emphasis was placed on either forgoing visits if an entrance fee were to be higher, or up to what extent would visitors be willing to pay. Thus we intended the interviewees to establish their maximum WTP. 402 interviews were conducted, using a carefully designed questionnaire. Two pre-tests of 25 subjects were necessary in order to obtain the final version of the survey instrument. In this process we pre-tested the wording of the questionnaire, the photographs and other aspects of the constructed market such as the payment vehicle, the changes to be valued, and the information content of the market design. In order to prevent bias from taking only certain types of visitors with specific characteristics into account (such as crowds during holiday periods: Summer and Easter; Sundays or certain hours of the day when there may be more visitors visiting the park), the interviews were made between June 1994 and June 1995: 153 during Spring and Autumn, 26 in Winter and 223 in Summer, on different days of the week and times of the day. The days and interviewees were randomly selected.

FINDINGS

Out of the population interviewed, 81 per cent accepted to answer to the questionnaire but out of these, 0.4 per cent did not answer fully. To the first question (recreational value of the NPA), 15.7 per cent gave a zero answer. In order to distinguish protest bidders from true zero bidders, non positive answers are asked why they do not want to pay. Only 19 per cent may be admitted as being true zero value (that is, preferring to give up visiting rather than to pay an entrance fee). To the question relating to a landscape improvement, 33 per cent give a positive answer whereas 49 per cent would not be willing to pay more than the WTP given to continue to use the park. To the questions referring to the last scenario, zero values were given by 31 per cent and 29 per cent, respectively. As shown in **table 4**, the average willingness to pay to access the natural park amounts to 382 pesetas (Pts). The average willingness to pay for landscape improvement is 71 Pts. In order to implement conservation measures, individuals would be willing to pay up to 1,733 Pts, and 1,468 Pts for reforesting (6).

Causes of willingness to pay

In order to assess their validity, answers should be checked to see if they are casual. One way would be to repeat the survey and thus verify if answers are consistent in time. This is a difficult process, in terms of cost as well as its practical implementation. Thus it has been used only exceptionally for some studies (Loomis,

Table 4 ***Willingness-to-pay responses (WTP) (Pts).***

	Recreation	Landscape imp.	Conservation	Afforestation
Mean	382	71	1,733	1,468
Std dev.	453	258	2,925	2,594
Median	250	0	1,000	1,000
95% C. I	337-426	45-96	1,446-2,020	1,214-1,722
5% Trim	324	32	1,244	1,041

Table 5 ***Factors affecting WTP (t-ratio in brackets).***

	Recreation (OLS)	Landscape imp. (Heckman's second stage)	Conservation-Afforestation (Heckman's second stage)	
C	123.4	593	4,829	3,908
INCOME		2.7 (1.6)	7.6 (1.5)	13.9 (2.0)
LENGTH	24.1(2.8)	24.1 (1.6)		
OUTSIDE	127.4(1.8)	185 (1.7)	1,130 (2.4)	878 (1.5)
CORRECT	2,51.4(6.9)			
NOTHING	–2,51.6 (–9.15)			
R^2	0.19	0.14	0.08	0.08
R^2 (adj)	0.19	0.11	0.07	0.07
MILLS		–585 (–2.57)	–6,670 (–3.5)	–5,501 (–3.1)
Probit: positive willingness to pay Heckman's first stage				
C		–0.63	0.52	0.55
MORE		0.41 (2.9)	0.24 (1.7)	0.42 (2.9)
AGE			–0.29 (2.1)	–0.28 (1.9)
OUTSIDE		–0.34 (–1.7)		

(6) The results obtained with the zonal and individual versions of the method of travel costs are slightly above those of the CVM for the concept of the recreational benefits of the NPA, and they coincide with the majority as per the literature.

1990). A regression analysis method may be used to test the validity instead of proceeding to repeat the survey. The validity refers to whether the measured WTP can be explained by the theoretically expected socio-economic variables. An econometric analysis may be proposed by means of OLS (Ordinary Least Squares). The value for the White and Breusch-Pagan statistical test detects that the terms of error in estimating OLS show a heterocedastic structure for the entrance fee regression. In order to correct for heterodasticity whose structure we ignore, we use the White covariance matrix (Kmenta, 1986; Greene, 1993). The positive value in the variable "LENGTH" tells us that the individuals who spend a longer time at the park tend to be more willing to pay for this. The positive values in the variables "CORRECT" and "OUTSIDE" show us that the individuals correcting the first WTP and who are spending the night away from home are more willing to pay more than those who do not change their first WTP and arrive from home, respectively. For these three variables and the dummy "NOTHING" that reflects if answers are complaints or strategic, it is possible to reject the null hypothesis of non-influential significance over the WTP. R^2 and adjusted R^2 are well above the value to which the literature refers for these estimates (**table 5**).

A large percentage of respondents did not answer the WTP-question for landscape improvement. We may not exclude these answers because the remaining cases could not be interpreted as a random sampling of the population but as a sample selection where only the positive results are represented. If an OLS estimate were to be made of the relevant parameters, it would be biased and inefficient. There is the problem especially of an explanation variable being significant although this only means that certain observations may be censored (Heckman, 1976; Greene, 1993). Heckman's two-stage estimation procedure (7) allows us to estimate selective models and, at the same time, to find out what characteristics of the visitors may determine the non-positive WTP in the first stage. In Heckman's first stage the probit model has been carried out using the variables "OUTSIDE" and "MORE". The probit estimate shows us, as regards the first variable, that the interviewees who visit the park arriving from locations that are not their habitual homes show a greater probability to manifest willingness towards zero payment than those who come to visit from their homes. This fact may indicate that individuals who live further away from the park find it more difficult to establish their differentiated WTP for landscape improvement, or that visitors from other regions simply find the actual green landscape agreeable in contrast to the predominantly dry Iberian landscape. As regards the second stage, it may indicate that the respondents who want to pay more resources to improve the condition of the forest also show greater probability of a positive WTP. In the first case, the variable is significant at 95 per cent and in the second one, at 99 per cent. The value of testing the ratio of maximum-likelihood leads us to admit that the explanation variables are jointly significant. In Heckman's second stage the variables "INCOME" (average income of each member in the family unit to which an individual belongs), "OUTSIDE" and "LENGTH" have a positive influence over the willingness to pay. The corrective coefficient (Mills ratio) for the selection is negative and significant to a level of confidence of 95 per cent.

The R^2 and adjusted R^2 are closed to the standard values in the literature, and consequently, it may hardly be sustained that WTP is established by the interviewees casually. In the regression analysis of preservation measures the value for R^2 is very low. It can be expected that many features or behaviours of the interviewees, not included in the questionnaire, determine the WTP that contributes towards such R^2 values. These factors may be in line with attitudes towards the preservation of the environment, such as the use of environmentally friendly products or participation in "green" associations. In Heckman's first stage we find that both by the WTP to devote part of the forested area for preservation, as by the WTP to increase forested areas, the variable "MORE" is significant at 99 per cent and 90 per cent respectively. This tells us that those individuals who prior to being questioned about values were willing to pay more to improve the condition of the forest have a greater chance of manifesting positive willingness to pay than those who chose other options. The variable "AGE" is negative and significant at 90 per cent and 95 per cent, showing that individuals above the age of 40 are also more likely to be willing to pay than oth-

(7) This is a type of tobit model (Maddala, 1983). The tobit model allows to analyse both the binary qualitative decision: to buy or not to buy recreational use, as well as the quantitative dependency towards willingness to pay (Blundell and Meghir, 1987).

Table 6 ***Benefits and costs (Pts/ha).***

Recreation + Landscape Benefits			Timber	Grant	Total cost
Baixo Miño	Preservation*	7.000	12.000	3.000	8.000
Natural park	Recreation	42.000-74.000	16.000	22.000	
	Preservation*	7.000			
	Recreation+Preservation*	64.800			
	Landscape Improvement	8.000			

* Preservation = Conservation or afforestation.

ers. In the second stage the explanation variables are significant in the worst case at a level of significance of 13 per cent.

IMPLICATION OF THE RESULTS

There is no differentiation in the management of the NPA between the expenditure necessary to produce the market output (timber) and the recreational facilities. This makes the comparison difficult between the costs and benefits associated to recreational use. The total expenses per hectare are 23,000 Pts of which the forest authorities pay 22,000 Pts. According to Ruiz Urrestarazu (1992) the total average annual cost for each hectare of timber forest of maritime pine-eucalyptus is 8,800 Pts (**table 6**).

With these data we would conclude that recreation services cost 14,200 Pts/hectare. However, they may hardly be ascribed totally to the non-market output of the NPA, that is to say, those that exceed the expenses necessary in order to obtain timber from normal harvesting. According to a study made for the United Kingdom (Forestry Commission, 1992), maintenance costs to sustain recreational provision in the forests generates a cost of approximately 27£/hectare (5,100 Pts).

Timber-related revenue in the natural park is similar to that of the remainder of forest farms in the district and to that which is used by authors for woods with a similar composition of pine and eucalyptus trees. There are no opportunity costs for owners linked to alternative exploitation such as housing developments, given that law prevents the privatisation of common woodlands except for reasons of public interest (8). The park also has free-roaming horse and bovine cattle, as is the case for other forests in the district.

This and the fact that owners hardly invest in forest activities lead us to declare that in this case the existence of the park does not reduce the income for the owners, therefore it does not generate opportunity costs either. Thus, we also verify how administrative actions become an implicit subsidisation to the owners. Their plantation and maintenance costs end up being substantially lower than those of other forest owners in the district. And so they make more profit than owners outside of the park. But even in such a situation of high costs, the profit per hectare generated by the visitors to the park is twice the cost derived from its maintenance: the recreational-landscape output supplied by the park to the visitors adds up to 43 million Pts/year or 58,000Pts/hectare/year, being far greater than the costs ascribable to maintenance (10.6 million Pts/year or 14,200 Pts/hectare/year), or even than the total expenditure made by the administration on the park itself (16 million Pts/year or 22,000) Pts/hectare/year).

(8) Law 13/1989 of October, governing common ownership of woodlands.

Table 7 ***IRR for recreation and landscape improvement (per cent).***

	Timber	Recreation	Landscape Imp.	Preservation*
Quercus Rubra	3,4	10,9	4	3,9
Pinus Radiata	4,4	8,7	4,4	5,2
Fagus Sylvatica	1,8	9,5	2,5	2,8
Quercus Robur	1,6	8,6	2	2,1
Pinus Pinaster	1,4	9,4	1,4	2,3

* Preservation = Conservation or afforestation

The elevation of the WTP of the overall visitors to the park for improved landscape amounts to 6 million Pts/year. We analyse the substitution of the currently dominant species (maritime pine) for oak, maintaining the net present value of profit that owners currently make. The area to undergo such a substitution scheme depends on the scenario chosen for the behaviour of WTP, costs and timber revenue and on the discount rate used. We take the data for costs and revenue for these species from Ruiz Urrestarazu (1992). By maintaining the present annual WTP it would be possible to practically substitute the entire protected area (746 hectare), even at a high discount rate (7 per cent).

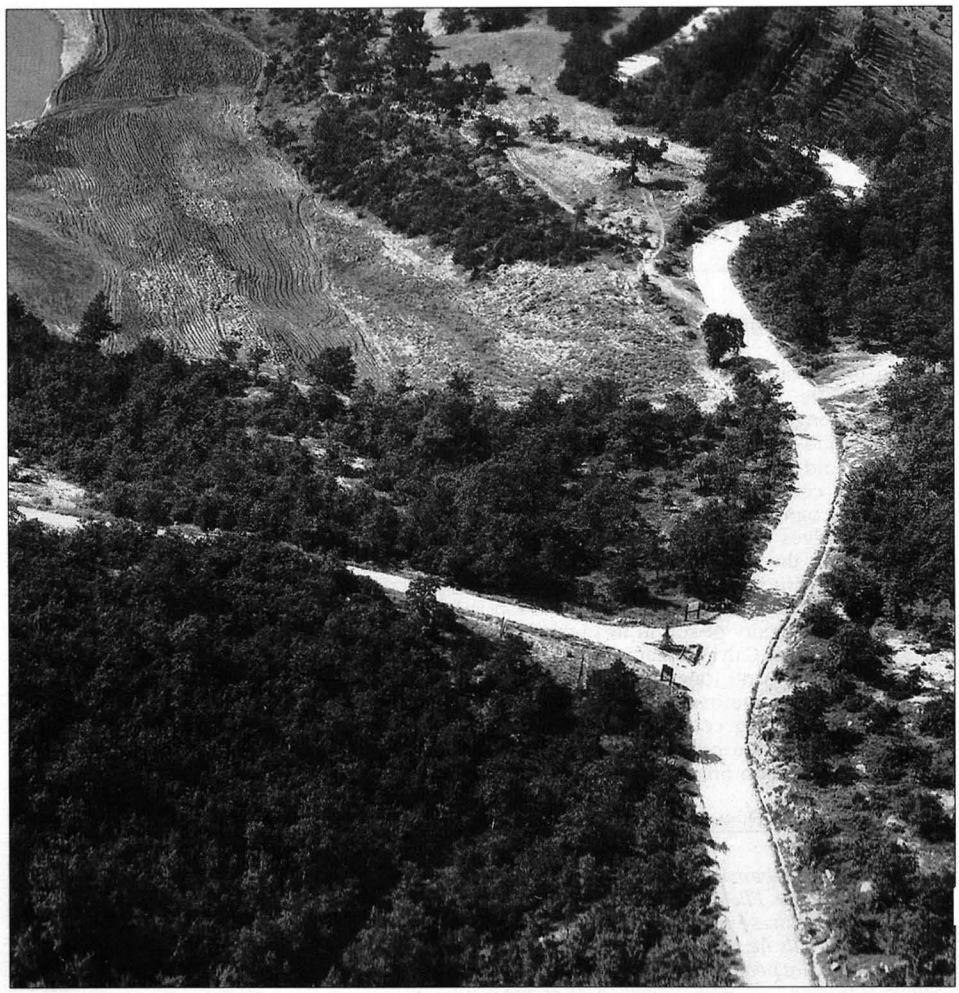
When speaking of the benefit to society from any measures directed towards ensuring the woodlands' survival (conservation and afforestation), we refer only to the visitors. We do not consider other individuals whom, without actually visiting the NPA, do however obtain some benefits. Their WTP to implement conservation and afforestation measures is 7,000 Pts/ha/year. The administration subsidises each hectare of forest land in the district with 3,000 Pts, that represent 21 per cent of the WTP (**table 7**).

The average social internal rate of return (IRR) for oak, beech, American oak (*Quercus rubra*), maritime pine and pinus insignis is increased by seven points, going from 2.5 per cent to 9.5 per cent, if we consider the benefits that visitors derive from forest management with recreational facilities.

The value of improved landscape for visitors to this park is of 8,000 Pts/hectare/year. The consideration of this amount in the estimates of profitability for broad-leaved species implies that, without any subsidisation, the species of pinus pinaster, currently dominant in the park, would have a rather much lower IRR than that of oak, beech and American oak. The IRR for these species shall also be affected if the only guarantee is that the area shall remain forested.

CONCLUSIONS

The aim of this study has been to estimate the environmental benefits that visitors to the forest may obtain under different management objectives. The results refer to a forest reality that is very specific, featured by a dichotomy. On the one hand, vast areas of forested



land are devoted exclusively to fast production of timber through clear cutting, with no reforesting schemes in most cases. On the other, there are areas where the priority is the survival of environmental assets, including the recreational-landscape uses. These are small "islands" of forest, either offered voluntarily by private owners or managed by the Administration under the figure of Natural Parks or similar. The factors contributing towards such a dichotomy are the lack of non-market instruments to establish the minimum requirements for owners to provide the non-market output and the incentive system that makes fast growing species the most profitable (Portela, 1997; CESE, 1996) (González Gómez, 1998 and 1999c). The recreational benefit per visit defined lies closer to British studies (Willis *et al.*, 1988; Willis and Benson, 1989; Bishop, 1992; Bennet *et al.*, 1995) and Central European studies (Nielsen 1991), where the recreational use of peri-urban forests is also researched, lacking natural uniqueness. It differs from the Spanish applications where the object assessed is usually a National or Natural Park, very unique and visitors arriving from much further away (Kriström and Riera, 1997). For Spain our value is closer to what Perez *et al.* (1995) found at the Natural Park "Señorio de Bertiz", in Navarre. Moreover, the small size of the park compared to the number of visitors explains why the values per hectare that we obtained were higher than those for British forests or Perez *et al.* (1995). Our result is closer to the studies that analyse forests near urban centres (Nielsen, 1991; Bennet *et al.*, 1995) with higher density of visits than other areas of Spain ((Kriström and Riera, 1997) or Central Europe (Elsesser, 1997).

Based on the results of this application, a rough *ex post* cost-benefit analysis indicates that current recreational benefits outweigh the cost of providing them. The *ex ante* valuation of a landscape improvement in the NPA and of the preservation of the 20,000 ha woodlands in the district bring benefits in excess of their costs. We should note that this does not imply that current policies are efficient. The fact that providing recreational use in the NPA is more costly than in other European countries, and that forest owners spend less on forest activities and meet no opportunity costs suggests that the same objectives could be achieved at a lower resource cost, through a different set of measures (e.g. minimum requirement for owners, lower incentives for fast growing species). The findings in this study provide information that should be expanded with other studies in other districts, with a different typology and including non visitors to the forest, inside the peculiar situation of land use in Galicia and Portugal.

These results could help to enhance policy efficiency by structuring and targeting payment to owners in relation to specific objectives. ●

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References were not published for lack of space. People who are interested in the complete bibliography may address either to the Author or to the Publisher.