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DEVELOPMENT AND PROTECTION OF THE MEDITERRANEAN FOREST: IMPLEMENTATION OF CHOICE MODELLING IN CORSICA

Like other Mediterranean forests, the Corsican forest is associated with transhumance and pastoralism, both activities which have greatly decreased. Timber sales are too low to compensate for management expenses and the development perspectives of marketable production (picking of berries, mushrooms, aromatic plants) or hunting are limited. The social justification for public expenditure in favour of the Corsican forest must be found in the non-market services linked to leisure activities and the protection of the environment. But can the protection of the forest and tourist facilities be compatible? Is it possible to offer tourist facilities which respect biodiversity? Can we face the tourist pressure while preserving natural equilibriums? Must we welcome everybody or limit access? These are the difficult issues that the representatives, public authorities and citizens are confronted with. The research work carried out in Bonifatu brings factual data and areas of reflection in order to define a strategy of sustainable development in the Mediterranean mountainous area.

The Bonifatu Forest

This forest, located in Balagne 20 kilometers from CALVI, covers 3000 hectares, at an altitude of between 300 and 2000 meters. It enjoys exceptional flora and fauna and remarkable landscapes. Walkers may happen to see nuthatches, royal eagles or bearded vultures, meet wild boars and mouflons. In spring, visitors are struck by the diversity of flora, with lilies and peonies in the undergrowth, and also notice the afforestation diversity. As they climb, they admire the maritime pines, holm oaks and laricio pines.

The forest is no longer used by stockbreeders and the conditions of tree growth as well as the limits of access reduce the possibilities for wood production. As a result of the closeness to the shoreline where the tourist pressure is high, the forest is very busy with hikers and swimmers from June to September. Lots of hikers take the GR 20 (Corsican footpath) which goes south of the island. The rest of the year, visitors are residents who come to walk, hike, and hunt or pick mushrooms.

This natural heritage is firstly threatened by fires. The typical problems of the Corsican forests are intensified in Bonifatu which is quite vulnerable to fire: over the past century, 25 hectares have been burnt every year on average. The big fire of 1982 destroyed 1000 hectares, that is to say one third of the forest, and four hikers were trapped and died. The scales of the events in 2004 and 2005 reminded us how big fire hazards are. With increasing tourist pressure, fires accidentally break out inside the massif. Steep slopes make intervention by firemen very difficult. A well-kept road leads through the forest to a car park, with an admission fee in summer. There is a forestry house, a forest restaurant which is under concession and a picnic area. Footpaths leave from the car park and guided tours are organized by a forest warden or ranger ?. However, the car park has gradually reached its maximum capacity and the access road is sometimes blocked by vehicles. Accidents happen because of walkers who are badly-informed of mountain hazards. In summer, most of the forest warden's working time is dedicated to surveillance.

Projects and programs

To guide further reflection, the residents and visitors' preferences were tested by submitting four management and protection projects defined after interviews with local actors:

Reinforced protection against fires

- Prevention: increased clearing, maintenance of fire-breaks and tracks
- Protection: new water points and fire-breaks

Fauna and flora protection

- Protected area with forbidden access over a third of the surface
- Awareness-raising actions

Organization of Public access

- Car park transferred outside the site
- Set-up of shuttles

Improvement of Public facilities

- New facilities: picnic areas, nature trails
- New activities: tree-climbing, horse-riding, canyoning

These stylized projects may be complementary or competitive, a factor which raises trade-off difficulties. For instance, the reinforced protection against fires and the creation of a protected area both contribute to the preservation of natural heritage. Conversely, the creation of new recreational activities may entail congestion effects resulting in damage to the natural heritage and people's safety.

A forest management and protection programme is characterized by the implementation of one or more projects. Therefore, a project is an attribute of the programme, each attribute having two levels here, respectively associated with the fulfilment or non-fulfilment of the corresponding project. The implementation of a programme will be expressed by a cost, and thus a price to be paid by the residents and visitors. This is the payment vehicle concept in the contingent valuation method. For visitors, the natural payment vehicle is the parking fee due in summer. For the residents who mainly spend time in the forest in the off-season and therefore do not pay any fee, the payment vehicle is the voluntary contribution to a specific fund.

Figure 1 provides a set of choices presented to visitors. What they have to do is compare programme 1 and programme 2 and say which one they prefer, knowing that they have the option of not doing anything by choosing programme 3 which corresponds to a *status quo* and is used as a reference. The implementation of programme 1 would involve the achievement of three out of the four projects and would involve a 3€ increase in the parking fee. Programme 2 would imply the achievement of the fauna and flora protection project, but with an additional 1€ increase in the parking fee.

Surveys and questionnaire

Two surveys with interviews were carried out, using more or less the same questionnaire. The first one concerns a random sample of 98 resident households interviewed at home in June 2003, the second one concerns 103 visitors interviewed at the end of their visit in July 2003.

Interviewees were given a file on the Forest of Bonifatu context and stakes. This file combined a relatively short text with colour photographs and pointed out the existing risks in the absence of a protection programme. Before going on, the interviewer made sure that the respondents did not want any additional information. A more detailed file with maps and figures on land use and vegetation was at their disposal if required.

After a reminder of the general purpose of protecting the forest, its fauna and flora and of providing visitor facilities in conditions of maximum safety, respondents were presented by the interviewer with a series of programmes to select from (Figure 1). In order for the game to be as realistic as possible, it was indicated that the cost of each programme would be an annual contribution to a specific fund for residents and an increase in the parking tariff for visitors. To carry out the exercise, each person was presented with a series of options, the investigator asking them each time what their preferred programme was, reminding them of the possibility of opting for the *status quo*. After selecting the successive programmes, respondents gave the investigator their estimation on the clarity of the information provided and the difficulty of the exercise. This part of the questionnaire helped check that the evaluation process was globally well understood and accepted by the respondents. Questions about leisure activities and common socio-economic characteristics ended the questionnaire. In spite of the cognitive effort and the length of the interview, respondents willingly took part in the assessment phase.

The total number of project combinations is equal to 2^4 since each of the four projects may be carried out or not. A previous study helped determine realistic values of parking fees. Four levels were selected: 5, 6, 7 and 8 €. Four different programmes (one per fee level) corresponded to each combination of projects, that is to say to a total of 64 programmes giving, by matching

them at random (the *status quo* always being present), (64x63)/2 or 2016 possible choices similar to Figure 1. By using the statistical theory of experimental design, 16 different programmes were selected, leading, via a random draw, to the suggestion of eight successive choices, similar to figure 1, to each interviewed visitor, multiplying in proportion the number of observations. This procedure helped identify the parameters of the linear approximation of the utility random model, and therefore estimate the direct effects of the different projects on the utility of the respondents (frame 2). The same methodology was applied to residents, selecting four levels (5, 15, 25 and 35 €), for their voluntary annual contribution to a specific fund.

Choice of participants and value of the projects

The surveys showed the respondents' interest in forest management and a good understanding of the assessment exercise. The legitimacy of a specific fund dedicated to the forest is acknowledged by the vast majority of the interviewed residents, since only two of them are opposed to the principle of a contribution. In addition, the visitors' willingness-to-pay for a parking fee, even if it were to increase, must be underlined.

Though both samples are opposite in socio-economic terms (residents are much older and have a much lower income than visitors), the respondents express similar preferences through their choices of programme. They give the expected priority to reinforced protection against fires and express a clear preference for the protection of the fauna and flora to the projects for access and improvement of tourist facilities. However, the choice of the *status quo* is more frequent among residents than it is among visitors, which may be due to the difference in payment vehicles. The annual contribution is more significant for the low-income residents than the car park ticket is for the better-off visitors.

The programme ratings given by respondents do not give us any information on the willingness-to-pay for the different projects. For a given person, the rejection of a project is linked to its disutility and is indicated by a negative value of the willingness-to-pay. High positive values follow on for projects which provide this person with an increase in utility. This point may be illustrated using the example of selections in Figure 1. A person who prefers the first programme is willing to pay at least 6€ for its achievement. However, he rejects the projects for the improvement of access and public facilities, the willingness-to-pay being equal to -2 €. Therefore this person is ready to pay at least 10 € for the implementation of the reinforced protection against fires, that is to say a value higher than the top value of the parking fee.

The estimation of willingness-to-pay confirms the project ranking and leads to a finer analysis (Table 1). However, there is no comparison in absolute value between the values obtained for the residents and visitors since payment vehicles are different. The homogeneity of the sample of visitors did not highlight an effect of the socio-economic variables. On the other hand, these variables as well as the frequency of visits have significant effects on the residents.

We must emphasise the significant values associated with the *status quo*. They are positive for residents (32.7 to 39.5 €) but negative for visitors (-4.3 €). The choice of the *status quo* may indicate a classical aversion to change but also results from cognitive problems. Without any decisive element to conclude, it should be noted that among residents, those who go to the forest more often (and so have the best knowledge of the context) as well as those who are better educated (with the ability to figure out complex situations) do not choose the *status quo*. The visitors with a better level of education have a tendency to reject the *status quo*. A negative value of the *status quo* means that the implementation of an alternative programme would lead to additional utility.

Estimations confirm the priority given to the reinforced protection against fires (39.5 to 47.2 € for residents and 5 € for visitors) and to fauna and flora protection (30.8 to 38.6 € for residents and 3.2 € for visitors) and convey a relative rejection of the other two projects for which the willingness-to-pay is negative. For the protection against fires, we may talk of a consensus insofar as socio-economic characteristics have no significant effect on the willingness-to-pay for the project. On the other hand, for the fauna and flora the conclusion is more balanced, as shown by the assessments on the sample of residents. The value of this project increases with income and decreases with age and frequency of respondents' visits. Moreover, the biggest forest users are more likely to reject the project to improve tourist facilities than the other residents, which is consistent because it would put them to the greatest inconvenience. Lastly, the value of the project to improve tourist facilities decreases with income.

Conclusion

Residents and visitors favour the heritage value of the forest of Bonifatu and express a consensus for the reinforced protection against fires and a pronounced preference for the protection of the fauna and flora. The group of respondents tends to reject the projects for access and tourists facilities. The annual willingness-to-pay for a programme focused on the prevention of fires and the creation of a natural reserve is estimated, depending on the models, format between 70.3 and 85.8 € per household resident. In Corsica, this is a significant contribution to be compared with the average amount of council tax which is equal to 630 €. For the same programme combining the protection against fires and the protection of the fauna and flora, visitors would be ready to pay a parking fee of 8.2€ instead of 3€.

An aggregation of the residents' willingness-to-pay, taking all households from Balagne, and the visitors' willingness-to-pay, based on the number of vehicles using the car park in the summer time, allows us to calculate total willingness-to-pay for these projects. Their annual values per hectare are indicated in Table 2 to make it easier to compare with public expenditure in

favour of the forest. The expenditure for infrastructure maintenance (roads, tracks and firebreaks, water points, car park) and fire prevention is about 75 €/ha. Therefore, it is significantly lower than the residents' willingness-to-pay for reinforced protection against fires. So such a project, taking into account the residents only, appears to be socially justified, while the integration of visitors into the calculation increases its social profitability further. A programme extended to the protection of the fauna and flora would be all the more justified.

François Bonnieux, Alain Carpentier, INRA-ESR, Rennes
Et Jean-Christophe Paoli, INRA-SAD, Corte
Francois.bonnieux@rennes.inra.fr – alain.carpentier@rennes.inra.fr – paoli@corte.inra.fr

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Further information

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Figure 1. Example of a choice card for the visitors

Projects (or attributes)	Programme 1	Programme 2	Programme 3
Fire protection improvement	**Yes**	**Yes**	No
Creation of a nature reserve	No	**Yes**	No
Move of the a parking lot	**Yes**	**Yes**	No
New recreational facilities	**Yes**	**Yes**	No
Car-park fee	6 €	7€	3€
Check the selected programme			

Table 1. Estimated willingness-to-pay for the projects (or attributes) and the *status quo* (€)

Socio-economic variables taken into account	Residents		Visitors
	yes	No	No
Status quo	39,5 (22,8)	32,7 (14,0)	-4,3 (0,9)
Reinforced protection against fires	39,5 (15,1)	47,2 (13,3)	5,0 (1,1)
Protection of the fauna and flora	30,8 (22,7)	38,6 (9,9)	3,2 (0,6)
Organisation of Public access	-17,8 (16,8)	-22,1 (8,8)	-1,3 (0,6)
Improvement of Public facilities	-11,2 (13,1)	-14,3 (7,8)	-4,1 (1,0)

NB. Standard deviations are in brackets. Residents' willingness-to-pay is per year and that of visitors per visit

Table 2. Residents and visitors' annual aggregated willingness-to-pay for two projects (€/ha)

Socio-economic variables taken into account	Residents		Visitors
	yes	No	No
Reinforced protection against fires	87,1	104,2	28,7
Protection of the fauna and flora	68,0	85,2	18,4
Total	155,2	189,4	47,1

François Bonnieux, Alain Carpentier, INRA-SAE2, Rennes, France
and Jean-Christophe Paoli, INRA-SAD, Corte, France
Francois.bonnieux@rennes.inra.fr – Alain.Carpentier@rennes.inra.fr – paoli@corte.inra.fr
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Frame 1. Conjoint analysis and choice modelling

Environmental economists recently turned to conjoint analysis, which offers methods aiming at modelling individual preferences for goods described by a set of attributes rating different values. Using surveys and contrary to contingent analysis, conjoint analysis does not implement any explicit mechanism to elicit willingness-to-pay. Interviewees are confronted with alternative descriptions of a good; these descriptions are differentiated by the value of attributes. According to the method, they are asked to classify the alternatives, to rate them or to select the most preferred (Holmes and Adamowicz, 2003). This exercise is repeated a defined number of times by each respondent for different choices of alternatives, the set of choices following the forms of an experimental design. From the moment that an attribute is of monetary nature, it is possible to infer from the answers the willingness-to-pay for the good and its attributes.

Choice modelling is based on the Lancaster theory (1966) according to which the utility provided by a good is equal to the sum of the utilities provided by its different characteristics. The respondent trades off two alternatives and the *status quo* at each repetition, which helps take explicitly into account the multi-dimensional aspects of environmental goods. Furthermore, it helps assess the variations of surplus due to the variations of attributes, which is important in a context of cost-benefit analysis.

Frame 2. Behaviour modelling

Choice modelling states that the utility level provided to an individual *n* by the programme *j* is given by:

$$U_j = U(a_{1j}, a_{2j}, a_{3j}, a_{4j}, v_j) \quad j = 1,2,3$$

Indicates the presence or absence of the project (or attribute) *k (k= 1,2,3,4)* in the programme *j*. It is a dummy variable which is equal to one if the implementation of the programme involves the achievement of the project *k*. *vj* is the price associated to the selected programme *j*. The rational individual chooses the programme which provides the higher utility among the three that are proposed to him.
The utility is not observable; we suppose it can be broken down into a determinist component and a random term whose mathematical expectation is zero. The determinist component depends on the characteristics of the individual and the projects in the selected programme. With a first order approximation, the utility is as follows:

$$U_j = \alpha + \sum_{k=1}^{4} \beta_k a_{kj} - \beta_v v_j + e_j$$

The parameters α, β_k et β_v are individual-specific and e_j indicates the random term. The parameter α measures the basic level of utility, β_k the effect of the project *k* on the utility and β_v the marginal disutility of the payment. This model is a linear one in the sense that the effect of the programme on the utility is equal to the sum of the effects of the projects. The introduction of a price of the programme allows us to normalize the parameters linked to the four projects and to calculate willingness-to-pay for each of them:

$$CAP_k = -\beta_k / \beta_v \quad k = 1,2,3,4$$

Therefore, this model allows us to come up with a monetary valuation of both projects and programmes of interest.
To switch to an econometric model, we specify a distribution of probability for the random term. Henceforth, a classical approach carries an extreme distribution of type I which leads to a conditional logit model.

François Bonnieux, Alain Carpentier, INRA-SAE2, Rennes, France
and Jean-Christophe Paoli, INRA-SAD, Corte, France
Francois.bonnieux@rennes.inra.fr – Alain.Carpentier@rennes.inra.fr – paoli@corte.inra.fr
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