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ORAL CONTRIBUTIONS

Monetary Valuations of Monumental Trees and Other Natural Resources between Demand for Conservation and Recent Requirements for Outdoor Activities: Some Case Studies in the Madonie and Nebrodi Regional Parks of Sicily.

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Summary

The focus of this paper is on the valuation of the benefits that local communities living in protected areas may perceive with regard to some specific natural resources, and in particular to Monumental Trees. The current economic crisis which involves countries at world level, leads to think that in the near future the financial resources to be destined for interventions in favour of these environmental goods will be more and more scarce, with the result that most monumental trees will not be protected and this natural heritage will be totally degraded and therefore lost to local communities. Three Sicilian case studies were investigated, two concerning the Madonie Regional Natural Park, and the third one referring to an area of the Nebrodi Regional Natural Park. The monetary valuation of these environmental goods was carried out by using the Contingent Valuation Method (CVM), which belongs to the category of Direct Methods and of Expressed Preferences Method.

For each of these case studies a survey was designed, identifying the targeted population from which to select a sample, from two to four different questionnaires were structured, with the description of the current and proposed supply of these environmental goods, where a suitable payment vehicle for the bids (expressed as Willingness to Pay, WTP) was chosen, where WTP elicitation "open" and "payment card" formats were used.

A pre-testing of the CVM survey was carried out in order to check the questionnaire as to timing, flow of the questions, ease of understanding and delivery, and to identify any specific problem areas.

The three CVM final surveys have the ultimate aim of estimating average and median WTPs expressed by local resident households and day-trippers to purchase the qualitative improvement of monumental trees supply and the additional services offered in the surrounding scenario of nature trails.

Keywords*: *Contingent Valuation Method (CMV), monumental trees, willingness to pay (WTP), Regional Parks, Sicily.

1. INTRODUCTION

Five regional parks have been founded in Sicily up to now: Alcantara, Etna, Madonie, Nebrodi and Sicani, taking an area of about 230.000 hectares, equal to the 9% of the regional territory. All of them aim at protecting biodiversity and cultural heritage and promoting the valorization of territory.

In the last years their financial situation has become rather precarious both because of a drastic reduction of national and regional funds, which have made their ordinary management difficult, and a lack of planning in terms of preservation, restoration and economic and touristic promotion of the territory.

Some of the projects proposed by the Parks Management Plans will not be carried out and some unique resources, like monumental trees[1], are in danger of degradation because no efforts are made in order to protect them (for example, a net of paths is at present inadequate or even nonexistent).

This study aims at evaluating the benefits linked to the existence value of monumental trees in some areas of the Madonie Park, the benefits related to the presence of some important natural resources in the Nebrodi Park, and the benefits connected with the present and future use of a net of paths capable of increasing the value of all natural resources.

As it has not a real market, the utility variation derived from a change in the good consumption has to be measured in order to evaluate an environmental good.

The obtaining of these utility functions allows to estimate the existence and use values of the resources here studied.

This work intends to evaluate the perception of the benefits deriving from these resources, both for people living in the territory and regular users. The use and existence values may help public decision makers to estimate the investments to be destined to natural resources.

Among the monetary valuation methodologies enabling to appraise environmental resources, the Contingent Valuation is the only direct method allowing to evaluate all the factors of the Total Economic Value (TEV) of a resource, that is both use and non-use values.

This method is based upon the preferences expressed by the interviewees whom are asked to state their willingness to pay for an environmental good for which a supply variation, either in positive or negative terms, is prospected.

First the interviewees are given a questionnaire illustrating the resource and its present condition, then some hypothetical changes are described and they are asked to express their willingness to pay (WTP) to make changes either possible, in case of a better scenario, or not possible, in case of a worse one.

To fully describe the resource and all the critical points which concern it, in addition to an extensive bibliography concerning the flora, vegetation and geo-morphology of the places, there have been made short interviews to both people working inside the parks and users well acquainted with the many issues connected with the preservation of natural heritage.

Then some field surveys have been carried out in order to assess the state of the places and the assets examined. During the excursions, the precise geographic position of the resources has been calculated by a GPS receiver and paths traced in Google Earth. At the same time, some pictures to be combined with the questionnaire were taken.

The next step was to draw up the questionnaire, in different sections. It starts with the description of the studied resource in its present condition, including the map to localize the path and the territory where the environmental assets reside. Then it contains some questions investigating about aptitude and use of the resource so as to assess an acquaintance with it and eliminate all questionnaires showing "protest-no" and "outliers" values. There it follows the description of the hypothetical scenarios proposed to the interviewees,

[1] In scientific literature there are a multitude of definitions around monumental trees: here we report the definition published in the paper by Schicchi and Raimondo (2007), which seems to be the most comprehensive as to meaning, quoted in full as follows: *"In the plant kingdom the concept of "monumentality" is generally used with trees and it is ascribable to various elements which make them outstanding from the biological, historical and landscape, and therefore cultural, point of view. The approach to a monumental tree is firstly related to its size, and in particular to its height and circumference - surveyed both in the point of maximum diameter and at breast height, generally correspondent at around 1.30 m above the ground. These two parameters are, among other things, closely related to the tree age. Other factors concur in the definition of monumentality, such as shape and growth habit of the tree, its relationships with art, literature, surrounding landscape, particular events of history, myths, legends and local traditions, besides the botanical rarity. This definition also takes into account the environmental context where the tree is localized and the architectural function a monumental tree can perform in relation to other elements such as buildings of historical importance".*

all different in the three case studies, and the questions to elicit the WTP. Here in the pre-test phase an open-question format has been used, while in the final version we have preferred a payment card.

The last section contains questions about the socio-economic characteristics of the interviewee so as to test the adequacy of the data by building a personal profile for each respondent.

In the last page the interviewees are given the possibility to express their doubts and/or remarks both on the subject and the questionnaire itself.

2. THE CASE STUDIES: RESULTS AND DISCUSSION

2.1 The three case studies and the CVM surveys

The study on the "Monumental trees of Isnello Forest" (Case study no.1) aims to assess both the existence value and the use value of these monumental trees, in relation to a new trail planned for their valorisation and fruition as an important eco-tourist resource.

After that a clear definition was given of the current conditions relative to monumental trees, and of the hard economic situation the Madonie Park is going through, a positive future scenario was outlined for the respondents.

The part of the questionnaire dealing with the monetary evaluation was set up into two different programs addressed to the interviewees:

- a program of "monumental trees conservation", describing some possible interventions aiming to restore the monumental trees. The payment vehicle adopted for the interested respondents is a one-off donation for the creation of a Fund for the monumental trees of Isnello Forest only. The WTP elicitation format chosen is the open-ended either for the pre-testing or for the final survey.

- a program of "monumental trees fruition", where all the interventions aimed to promote their efficient fruition were fully described. The proposed payment vehicle is an annual fee to be paid for ten years in a financial Fund exclusively destined to the improvement of Isnello Forest monumental trees' conditions. Two different WTP elicitation formats were used, the open-ended one in the pre-testing, and in the final survey a payment card containing 25 WTP values, identified on the basis of the results of pre-testing survey, among which respondents are asked to choose the bid correspondent to their actual WTP for supporting the program.

From the pre-testing we found out quite a strong disapproval concerning the administrators of the economic Funds destined to collect the bids for improving state of health and fruition conditions of Monumental Trees of Isnello Forest. The risk of an exaggerate presence of "protest zeros", directly related to the unwelcome presence of a specific category of administrator, has suggested the opportunity to diversify the questionnaires, identifying two different compositions of people, each of which to be contained in 50% of total questionnaires. The first group was organised as a technical-scientific Panel, constituted by professors from University of Palermo and by delegates of UNESCO and WWF, international organisations working in the environmental field. The second group was made up of delegates of the Madonie Park Board, of Isnello Town Council and of the Regional Forest Farm.

The selection of respondents for the final survey was carried out by using a non random sampling design due to budget and time constraints. The selected sample was sorted out among all the family units with school-age children present in the Madonie area. The number of households for each village was determined by applying the proportion existing between the local residents and the overall population of Madonie territory. The questionnaires, after a preliminary description of the research and of the natural resource, were distributed to a random sample of students in the Madonie schools, who delivered them to their parents. The

questionnaires were supposed to be brought back to school after 10 days, after their filling out by the households.

In the case study no. 2, "The monumental trees of Piano Sempria and Piano Pomo", the existence value of the monumental trees present in a nature trail was estimated.

In the questionnaire, respondents were presented a future negative scenario which would occur in the absence of silvicultural and protection techniques addressed to these monumental trees. The negative effects would consist in structural downfalls and in a rapid worsening of monumental trees health conditions, due to the combined action of fungi, insects, hemyparasites, wild pigs and non-controlled human activities.

The loss of such a heritage could be avoided by carrying out the interventions targeted to conservation and valorisation of monumental trees, recommended in the Madonie Park Management Plan.

The two intervention programs might be launched only by recovering alternative sources of funding, in consideration of the hard financial situation brought about by funding reduction concerning the protected areas at both regional and national level.

Respondents - selected among the residents in the Park area - were asked to state their WTP in the shape of a one-off payment with the aim to set aside financial sums for a monetary fund intended to the achievement of conservation projects concerning the monumental trees heritage, and managed by an association coordinated by several Boards.

The two programs were diversified in order to detect possible part-whole bias: the first one concerned just the protection of the hollies population, while the second program would allow the conservation of all the monumental trees present in the environs of the nature track.

Sample selection was carried out following the same scheme adopted in the case study no. 1, nevertheless it is noteworthy to point out that 4 groups of questionnaires were administered: two differed by the order of presentation of the programs in the questionnaire, two by the board composition of the association managing the monetary fund.

The strict budget constraints have actually prevented to post explanatory pictures in the questionnaire, therefore an open forum was set up on Internet - whose website was provided in the questionnaire (http://alberi.monumentali.forumfree.it/) - where respondents could find the pictures of the monumental trees relative to case studies no.1 and 2.

The case study no. 3 examined the diverse natural and cultural resources present along a stretch of the nature trail called "Dorsal of Nebrodi", localised in the Nebrodi Regional Park, which represents one of the main routes of the Park. The aim of the study is to estimate existence and bequest value and, moreover, the use value of the above mentioned resources, since they are usable by excursionists due to the presence of a nature path.

In the questionnaire the proposed scenario concerns improvements in the levels of the resources and of the relative paths that could be carried out to ensure an increased conservation of the resources and the possibility of fruition for day-trippers and excursionists.

The correct interventions to be included in the hypothetical scenario were chosen after a thorough bibliographical search among territorial studies and technical texts, and in coherence with the Park Territorial Plan.

In the questionnaire section concerning the monetary valuation, respondents are informed about recent regional provisions that impose the payment of an entry ticket for the fruition of services in the Parks. Soon after they are asked to express their WTP in the shape of an additional amount on the contribution to be paid

for each excursion. Respondents are also asked if this overcharge can be destined to the program of interventions regarding the natural and cultural resources, to the program for paths improvement or to both programs (in the latter option respondents are asked to distribute the total WTP expressed between the two programs). In case of refusal to pay any amount of money, motivations are important in the process of identification of protest-zeros, therefore respondents are asked to motivate their zero bids.

Questionnaires were first administered to a focus group, made up by experts in forestry and in protected areas management, and to a random sample of residents in the areas investigated, approximately amounting to 25 people.

In the final survey, the payment card is used as a format for the WTP elicitation: the range of values included in the matrix (1-20 euro) is chosen according to the results of pre-testing.

The final survey is being carried out on a non-probabilistic sample constituted by excursionists who attend the naturalistic visits organised by an Outdoor Network of Associations operating within the Nebrodi Park. These associations distribute the questionnaire among the participants, who fill out and return it at the end of the excursion.

The adoption of a non-random sampling method - although it generates systematic errors - was motivated by several limiting factors: lacking financial resources, short time for the survey, need of wider guarantees concerning the rate of return of the questionnaires.

2.2 Some preliminary results: the pre-testing phase of the survey

The only results currently available are those obtained from the pre-testing interviews. Here a brief summary of these data will be reported.

The three CVM surveys, and in particular the questionnaires collection, are still in progress, especially with regard to the Case study no. 3, therefore the results here reported, besides a summary of pre-test survey, represent just a first draft of final data processing.

2.2.1 Case study no. 1: "The Monumental Trees of Isnello Forest"

2.2.1.1 Some pre-test results

From the pre-test phase, here briefly described, it emerged that about the 70% of the interviewees, with an average age of 40, asserted to be acquainted with or to have read something about monumental trees, and the totality of the sample claimed to be favourable to the protection of forest resources for future generations.

Zero WTP values were expressed by the 25% of the sample as to the question related to the safeguard of monumental trees and by the 35% as to the question about fruition.

Apart from the "protest no" (almost all motivated with sentences like "it's local administration's competence"), the remaining part of zero values was expressed by people who, though they were interested on the subject, asserted they could not contribute because they had a low family income (either lower to 1000 € per month or between 1,000 € and 1,499 € per month).

30 € is the average value of the WTP for the question concerning the protection of monumental trees, where a one-off contribution was asked for, while it decreases to 15.50 € for the second question on the fruition of monumental trees, in which an annual fee was requested for a 10 year- period.

Excluding the "protest-no" from the overall zero values in the average calculation, the WTP values rise to 43 € for the first question and to almost 24 € for the second one.

2.2.1.2 Preliminary results from final CVM survey

Five hundred questionnaires were delivered to the schools of the Madonie towns which had previously accepted to collaborate on the CV research. On a whole the response rate was equal to 42.4% (212 questionnaires returned), whereas EAC and UWU returned questionnaires were respectively 44.0% and 56.0% of total returned questionnaires.

It is important to remind of the above acronyms meanings: in the EAC questionnaires, the economic fund built to plan and implement the interventions of the future scenario is supposed to be managed through a Controlling Authority made up of Madonie Park Board, Regional Forest Board and Isnello Town Council, while in the UWU questionnaires, the Managing Authority is constituted by University of Palermo, WWF and UNESCO.

Table 1. Delivered and returned questionnaires

Category of questionnaire	Delivered (no.)	Returned (no.)	Response rate (%)	Percentage frequency of EAC and UWU questionnaires on the total returned questionnaires (%)
EAC	250	93	37.20	43.90
UWU	250	119	47.60	56.10
Total	500	212	42.40	100.00

Source: our elaboration on own primary data.

In the screening phase, the returned questionnaires were carefully read and the first step was carried out by separating the empty or incompletely filled in questionnaires from those properly (correctly) filled in.

A further selection allowed to remove the questionnaires where significant inconsistencies or bias were identified through the answers given by the respondents to some preliminary (cross-check) questions.

Table 2. Questionnaires – First sample selection

		Questionnaire typology		Total (no.)
		EAC (no.)	UWU (no.)	
Filling	Complete	68	89	157
	Incomplete	21	24	45
	Empty	4	6	10
Total Questionnaires		93	119	212

Source: our elaboration on own primary data.

Subsequently, from the total number of filled-in questionnaires, the questionnaires (29) where respondents refused to answer the income question were removed from the sample, as it would not be possible to analyze the truthfulness of the WTP values.

Among the remaining 128 questionnaires, 19 possible protest-zeros and 4 potential free-riders with false WTP answers were identified.

The mean and the median of the expressed WTP were subsequently calculated for both the monumental trees “conservation” and “fruition” proposed programs, either with the sample including the Protest Zeros or with the sample without the Protest Zeros, as it appears from the economics literature.

Table 3. Sample questionnaires grouped per zero and positive WTPs

		Absolute frequency (no.)	Percentage frequency (%)	Cumulative Percentage frequency (%)
WTP = 0	Low income	14	10,9	10,9
	Unconcern towards the environmental asset	7	5,5	16,4
	Protest Zeros	19	14,8	31,3
	Free Rider	4	3,1	34,4
	Temporary financial difficulties	5	3,9	38,3
Positive WTP		79	61,7	100
Total questionnaires		128	100	

Source: our elaboration on own primary data.

The mean and the median of the expressed WTP were subsequently calculated for both the monumental trees "conservation" and "fruition" proposed programs, either with the sample including the Protest Zeros or with the sample without the Protest Zeros, as it appears from the economics literature.

Table 4. WTP Statistics: Mean and Median with and without "protest zeros"

		Protest Zeros included (No. 124)		Without Protest Zeros (No. 105)	
		WTP (One-off donation)	WTP (Annual donation for 10 years)	WTP (One-off donation)	WTP (Annual donation for 10 years)
No.	Valid	124	124	105	105
	Missing	0	0	19	19
Mean		14,41	10,94	17,02	12,92
Median		2,00	5,00	5,00	9,00

Source: our elaboration on own primary data.

In the sample with 124 observations, the average WTP is nearly 14.50 € for a one-off donation and just less than 11 € for the annual contribution for a ten-year period. The median WTP value is 2 € for the monumental trees conservation program and rises to 5 € for the "monumental trees fruition" program. In both cases the mean is far higher than the median, and this evidence indicates that the frequency distribution curve is asymmetric and in detail it is positively skewed, as the scores tend to cluster toward the lower end of the scale (the median WTP is 2 € or 5 €, whereas the mean values are approximately 14 € and 11 €) with increasingly fewer scores at the upper end of the scale (that is, the larger numbers).

In the sample without the protest zeros (no. 105 observations), the mean WTP rises to over 17 € and to nearly 13 € with regard respectively to "conservation" and "fruition" programs. Also with this second sample the median WTP is sensibly lower than the average WTP, showing a positively skewed distribution curve.

After the description of the current scenario, respondents were asked to answer 8 introductive questions, which have the twofold objective: on one hand to obtain information on respondent's habits, interest for nature and knowledge on environmental issues, and on the other hand to allow the detection of the respondent's inconsistencies in behavior and attitudes towards environmental goods.

Nearly 68% of respondents answered yes to the first question (See Table 5), which aimed to investigate the knowledge of respondents about the Monumental Trees, that is if they had ever heard about the Monumental Trees.

Table 5. Knowledge of Monumental Trees

	Absolute frequency (no.)	Percentage Frequency (%)	Cumulative Percentage Frequency (%)
No	29	23.40	23.40
I don't remember	11	8.90	32.30
Yes	84	67.70	100.00
Total	124	100.00	

Source: our elaboration on own primary data.

The following question investigated the respondent's opinion on the size of state and regional funds assigned to environmental protection projects; almost 42% of respondents answered that these funds are enough but badly administered, while about 30% was not informed enough and would rather not answer.

The above results, together with the reasons expressed for a few protest zeros, seem to highlight a widespread distrust towards the administration of the funds assigned to environmental goods or anyhow that respondents do not consider these funds as managed in a clear and effective way.

Table 6. Respondents' opinions on the current administration of regional and State funds for environmental protection

Funds for environmental protection	Absolute frequency (no.)	Percentage frequency (%)
Sufficient	10	8.1
Insufficient	21	16.9
Sufficient but badly administered	52	41.9
Extortionate and to be downsized	3	2.4
I have not enough information to answer	38	30.7
Total	124	100.0

Source: our elaboration on own primary data.

The sample is mostly represented by people with a high secondary school diploma (45%) or with a low secondary school diploma (33%). The presence of graduates in the sample is rather marginal, about 10%.

Table 7. Sample statistics: respondents' qualifications

Qualifications	Absolute frequency (no.)	Percentage Frequency (%)
Primary school	7	5.6
Low secondary school	41	33.1
High secondary school	56	45.2
Vocational school	7	5.6
Undergraduate or Postgraduate University Degree	13	10.5
Total	124	100.0

Source: our elaboration on own primary data.

As it can be observed from table 8, as much as 61% of the interviewees stated to have an average household income lower than 1,500 € per month, and nearly 72% of respondents an average household income below 2,000€ per month.

Table 8. Sample statistics: distribution of respondents' households income

Classes of monthly household income (€/month)	Absolute frequency (no.)	Percentage frequency (%)	Cumulative Percentage frequency (%)
<1,000 €	31	25.0	25.0
between 1,000 and 1,499 €	45	36.3	61.3
between 1,500 € and 1,999 €	13	10.5	71.8
Between 2,000 € and 2,499 €	18	14.5	86.3
Between 2,500 € and 2,999 €	10	8.1	94.4
Between 3,000 € and 3,999 €	4	3.2	97.6
Between 4,000 € and 5,000 €	3	2.4	100.0
Total	124	100.0	

Source: our elaboration on own primary data.

With regard to the interviewees occupation (see Table 9), civil servants and teachers are the most represented (29% of total sample).

Table 9. Sample Statistics: respondents occupation

Occupation	Absolute Frequency (no.)	Percentage Frequency (%)[1]	Percentage frequency (excluding housewives)[2]
Other (specify)	6	4.90	6.74
Executive	1	0.80	1.12
Entrepreneur	4	3.20	4.49
Civil servant/Teacher	36	29.00	40.45
Professional	11	8.90	12.36
Self-employed	16	12.90	17.98
Labourer	12	9.70	13.48
Cooperative member	3	2.40	3.37
Housewife/In search for employment	35	28.20	
Total sample number	124	100.00	100.00

Source: our elaboration on own primary data.

Percentage Frequency[1]: in this column of the table, people in search for employment and housewives are accounted for and represent about 28% of total usable sample.

Percentage Frequency[2]: percentage distribution of employed respondents.

2.2.2 Case study no. 2: "The monumental trees of Piano Sempria and Piano Pomo"

2.2.2.1 A brief report on pre-test results

From the data collected in the pre-test phase it appears that the 30% of the interviewees (6 out of 20) expressed a WTP equal to 0 €. Among them, one because of low income, another one because he thinks a ticket payment would be a better solution and the remaining four because they maintained that the Regional Administration or Park Boards should manage their funds in a better way.

The average WTP, with the exclusion of the 5 "protest-zeros", is equal to 12.1 € as to the protection of holly population (some beech and maple trees are also included in the holly population) and to 15.2 € as to the protection of all the monumental trees along the nature trail. Six interviewees out of 14 expressed the same value of WTP for both questions.

2.2.2.2 Some preliminary results of final CV survey

The overall response rate of questionnaire administration in the final CVM survey was over 40% (41.4%), with 207 questionnaires returned out of 500 ones delivered to the schools.

Table 10. Delivered and returned questionnaires

Questionnaire typology	Delivered (no.)	Returned (no.)	Response rate (%)
EA	125	46	36.80%
ET	125	45	36.00%
WA	125	65	52.00%
WT	125	51	40.80%
Total number of questionnaires	500	207	41.40%

Source: our elaboration on own primary data.

It is worthwhile to point out that four different questionnaires were delivered, differing by the Boards administering the hypothetical fund (Park, Regional Forest Board and Castelbuono and Petralia Municipalities in a first questionnaire, University of Palermo, UNESCO and WWF in another one) and by the order of presentation of the two valuation questions, the first one concerning the protection of the Holly population and the second asking respondents to express their WTP for the protection of all the monumental trees in the surroundings of the nature track.

The 207 questionnaires were so distributed: 171 properly filled out (82.6%), 29 unfinished (14.0%) and 7 questionnaires empty (3.4%).

Table 11. Questionnaires filling out

Questionnaire filling out	Absolute frequency (no.)	Percentage frequency (%)
not filled-out	7	3.4
filled-out	171	82.6
incomplete or badly filled-out	29	14.0
Total	207	100.0

Source: our elaboration on own primary data.

After a careful reading of the 171 filled-in questionnaires, 41 of them (about 24%) were removed from the sample because respondents had stated not to be willing to answer the question on the household income, 4 questionnaires (correspondent to 2.3%) due to major inconsistencies among the answers, and 6 ones (equal to 3.5%) because these respondents were identified as possible free-riders.

Among the remaining questionnaires (120), considered usable in the analysis of the WTP, 18 were identified as protest zeros (15%) on the grounds of the reasons given for their zero WTP.

Table 12. Validity of questionnaires

Validity of questionnaires	Absolute frequency (no.)	Percentage Frequency (%)
Usable questionnaires	120	70.2
I have no intention to answer to the question on household income	41	24.0
Unusable questionnaires due to inconsistencies in the answers	4	2.3
Free Rider	6	3.5
Total	171	100.0

Source: our elaboration on own primary data.

Table 13. WTP Bids of valid questionnaires

WTP Bids	Absolute frequency (no.)	Percentage frequency (%)
Positive bids and zero real bids	102	85.0
Protest zeros	18	15.0
Total	120	100.0

Source: our elaboration on own primary data.

The n= 120 sample, including also the "protest zeros", will be named sub-sample A and, with reference to school qualifications, is composed of people who hold a primary school certificate (5.0%), of graduated (15.0%), of people who have the low (43.3%) and high (30.8%) secondary school diploma and finally by respondents with a vocational school certificate (5.8%).

The sample A, after the removal of the protest zeros, decreases to 102 people and will be subsequently named sub-sample B. As to school qualifications, 5.9% of sub-sample B is represented by people with the primary school qualification, 38.2% by people with low secondary school, 5.9% by respondents who have a vocational school certificate, 33.3% by people with high secondary diploma, and finally by graduated in the amount of 16.7%.

Table 14. Sample statistics: respondents' qualifications

Qualifications	Sub-sample A		Sub-sample B	
	Absolute frequency (no.)	Percentage Frequency (%)	Absolute frequency (no.)	Percentage Frequency (%)
Elementary school	6	5.0	6	5.9
Low secondary school	52	43.3	39	38.2
High Secondary school	37	30.8	34	33.3
Vocational school	7	5.8	6	5.9
Undergraduate or Postgraduate University Degree	18	15.0	17.0	16.7
Total	120	100.0	102	100.0

Source: our elaboration on own primary data.

Among the employed (who represent 54% of the interviewees) of the sub-sample A, clerks and teachers are significantly present in the amount of 52% of the working respondents, followed by workers (22.0%), self-employed (11.0%) and professionals (8.0%). In the sub-sample B the percentage ranking is exactly the same as in sub-sample A, although percentages are slightly different, as it can be observed in Table 15.

Table 15. Sample Statistics: respondents occupation

Occupation	Sub-sample A		Sub-sample B	
	Absolute frequency (no.)	Percentage Frequency (%)	Absolute frequency (no.)	Percentage Frequency (%)
Other (specify)	1	2	1	2
Entrepreneur	2	3	1	2
Civil servant/Teacher	34	52	31	61
Professional	5	8	5	10
Self-employed	7	11	5	10
Labourer	14	22	6	12
Cooperative member	2	3	2	2
Total sample number	65	100	51	100

Source: our elaboration on own primary data.

With regard to respondents' household income, in sub-sample A

In the sub-sample A, 35.8% of respondents declared a monthly household income of less than € 1,000, 27.5% of interviews an income between € 1,499 and 1,000, 13.3% between 1,500 and € 1,999, 12.5% between 2,000 and € 2,499, 5.8% between 2,500 and € 2,999, 2.5% between 3,000 and € 3,999, 1 .7% between 4,000 and € 5,000, a 0.8% monthly income higher than € 5,000.

In the sub-sample B 36.3% of respondents stated a monthly household income lower than 1,000 €, 25.5% stated an income between 1,000 and 1,499 €, 12.7% between 1,500 € and 1,999 €, 14.7% between 2,000 and 2,499 €, 5.9% between 2,500 € and 2,999 €, 2.9% between 3,000 € and 3,999 €, l'1% between 4,000 and 5,000€, finally 1% of sub-sample an income higher than 5,000€ per month.

Table 16. Sample statistics: distribution of respondents' households income

Average household income (€/month)	Sub-sample A		Sub-sample B	
	Absolute frequency (no.)	Percentage Frequency (%)	Absolute frequency (no.)	Percentage Frequency (%)
<1,000 €	43	35.8	37	36.3
Between 1,000 € and 1,499 €	33	27.5	26	25.5
Between 1,500 € and 1,999 €	16	13.3	13	12.7
Between 2,000 € and 2,499 €	15	12.5	15	14.7
Between 2,500 € and 2,999 €	7	5.8	6	5.9
Between 3,000 € and 3,999 €	3	2.5	3	2.9
Between 4,000 € and 5,000 €	2	1.7	1	1.0
More than 5,000 €	1	0.8	1	1.0
Total	120	100.0	102	100.0

Source: our elaboration on own primary data.

As to the sub-sample A, 70.8% of the sample answered yes to the question on the knowledge of monumental trees, whereas the percentage slightly rises (71.6%) when considering sub-sample B, where protest zeros were removed.

With regard to the respondents' perception on the financial resources addressed to the environmental protection, 42.5% of the sub-sample A states that funds are "sufficient, but badly administered", 26.7% of respondents considers them "insufficient", 21.7% answers that "has no sufficient information to answer", 9.2% thinks that funds are "sufficient". As to sub-sample B, 40.2% of respondents considers that funds are "sufficient, but badly administered", 27.5% is convinced that they are "insufficient", 21.6% of the sample states "I have no sufficient information to answer", and 10.6% thinks funds are "enough".

The high incidence of respondents who consider the environmental funds "sufficient, but badly administered", is ascribable both to the regional policies - considered costly and ineffective – and to local policies carried out by the Madonie Park Board, which are seen as too restrictive and not at all aimed to the socio-economic development of the area.

Table 17. Respondents' opinions on the current administration of regional and State funds for environmental protection.

Respondents perception on size and administration of funds assigned to environmental protection projects	Absolute Frequency (no.)	Percentage frequency (%)	Absolute frequency (no.)	Percentage frequency (%)
Sufficient	11	9.2	11	10.8
Insufficient	32	26.7	28	27.5
Enough, but badly administered	51	42.5	41	40.2
No sufficient information to answer	26	21.7	22	216
Total	120	100.0	102	100.0

Source: our elaboration on own primary data.

The average (WTP) Willingness to Pay of the sub-sample A (120 respondents), including the "protest zeros", was 20.50 € for the protection of the holly population and equal to 21.56 € for all the monumental trees in the environs of the Nature Trail, including the holly population. The median WTP was respectively 2.50 € and 5.00 €.

Table 18. WTP Statistics: Mean and Median with and without "protest zero".

Statistics	Sub-sample A		Sub-sample B	
	WTP for Holly Protection (€)	WTP for protection of all monumental tree (€)	WTP for Holly Protection (€)	WTP for protection of all monumental tree (€)
Mean	20.50	21.56	24.12	25.36
Median	2.50	5.00	5.00	9

Source: our elaboration on own primary data.

Although the average WTP showed sensibly higher values in the sub-sample without the "protest zeros", there are not significant differences between the two proposed protection programs, the first concerning the Holly population and all the other monumental trees within the population area, and the other program regarding the protection of all the monumental trees in the environs of the Nature Track, including the Hollies themselves.

The values of the median WTP, on the contrary, are nearly double for both samples when dealing with the second protection program, concerning all the monumental trees close to the Nature Track.

As in the case study no. 1, average values of WTP are far higher than median values, highlighting an asymmetric frequency distribution curve (positively skewed, with values which are more concentrated in the lower end of the scale).

2.2.3 Case study no. 3: The nature trail "Dorsal of Nebrodi"

With regard to this case study, it is not possible to report on the results of final CVM survey, as data collection is still in progress. The delay in the development of the survey in comparison with the other two

case studies is mostly due to a different way to carry out the questionnaire administration, based on direct interviews to day-trippers and excursionists. A series of problems, ranging from unstable weather conditions - which have limited the number of excursions – to a little cooperation in the carrying out of the survey, did not allow the researchers to complete the questionnaires administration.

2.2.3.1 Pre-test results

About the 26% of the questionnaires administered in this phase has proved not to be suitable for the statistical analysis of data. In this percentage value are included: "protest-no", incomplete questionnaires, "outliers" observations.

From the data obtained it emerged that the respondents willing to pay for both the programs are about 87%, with some differences as to the distribution of the WTP between the two programs: in 70% of cases the value is equally distributed, 20% expresses a higher WTP for the improvement of a net of tracks, while a remaining 10% would destine a higher amount of their WTP for the improvement of the natural and cultural resources. The 5% out of the total pre-test sample has expressed a willingness to pay for only one of the programs. The overall average WTP appears to be just over 12 €, with values ranging between a maximum of 40 € and a minimum of 0 €.

Table 19. WTP pre-testing results per proposed program

	Case study no. 3: The nature trail "Dorsale dei Nebrodi"		
	Natural Resources Improvement Program1	Trail Improvement Program1	Natural Resources and Trail Improvement Program[1]
Average WTP (Euro)	6.41	5.72	12.13
Protest Zeros (%)	3.20	3.20	3.20

Source: our elaboration on own primary data.

[1] Overcharge on the contribution to be paid for each excursion.

3. FINAL CONSIDERATIONS

Firstly it is necessary to point out again that the surveys are still in progress, therefore the following brief series of remarks concerning the case studies dealt with in this paper can be considered as preliminary.

In the case studies 1 and 2, questionnaire response rates vary definitely depending upon the Boards included in the administration of the economic fund: response rates are far higher where Managing Authority was constituted by the University of Palermo and two internationally renowned Organizations such as WWF and UNESCO. In the questionnaires where the members of the fund were local Boards such as the Madonie Park, some local Municipalities and Regional Forest Administration, return rates values are sensibly lower, as showed in the previous chapter.

The above mentioned findings could be put in relation with the distrust of these Boards, already observed in the pre-test phase of the survey, often seen as bad fund administrators.

This argument seems to be strongly supported by the high percentages - always higher than 40% - of respondents who believe that the funds currently assigned to environmental goods are enough but badly administered by local and state Boards.

Nevertheless, a large majority of respondents – over 60% - expressed a positive Willingness To Pay, which is an indication that conservation demand for monumental trees is quite important to residents of Madonie area.

As to WTP values, the clearly visible differences in the means found out in the two case studies are likely to be attributable to a deeper knowledge of the Monumental Hollies and of all the Monumental Trees which are along an existing and more beaten trail.

The decision to administer the CV survey through the schools of the Madonie area allowed to achieve questionnaires return percentages that are far higher than those obtainable by a standard mail survey (cfr. Asciuto et al., 2004).

The final CV survey for the case study no. 3, "Nebrodi Dorsal" - addressed to a sample of excursionists in the Nebrodi Park area - suffered a heavy delay compared to the scheduled time and just a small number of questionnaires is currently being filled out. The main reasons are ascribable firstly to the adverse weather conditions which have brought about the cancellation of various excursions; secondly, up to now the excursionists showed a propension to collaborate on the survey which is lower than expected in the planning phase of the research.

From the questionnaires already collected, it turns up a far higher percentage of protest zeros compared to that one observed in the pre-test survey. The possible reason for this could be identified in the deep aversion of excursionists (most of whom are resident in the Park area) to the area management carried out by the Nebrodi Park Board.

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The Life Project + DINAMO to increase the supply of ecosystem services in a rural area in southern Italy

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Summary

The various ecosystems present in the natural landscape of southern Molise (southern Italy), characterized by the presence of cultivated land, trees and hedges, offer several important ecosystem services to the community. In January 2010, the three-year Life+ DINAMO project began, with the aim of conserving and increasing biodiversity and the ecosystem services related to it in southern Molise Area.

Keywords: rural areas, ecosystem services, Life+, southern Italy

1. INTRODUCTION

In January 2010, the three-year project Life+DINAMO (Increasing endangered bioDIversity iN Agricultural and semi-natural areas: innovative Management mOdel) began, coordinated by the S.T.A.T. Department of the University of Molise in partnership with CIA, ENEA and IGEAM DD and financed by the European Commission, with the aim of conserving, increasing and monitoring biodiversity and the ecosystem services related to it in the agricultural and seminatural areas of southern Molise, availing itself of the collaboration of farmers and local administrations (Marino et al., 2010). Some of the conservation actions specifically regard the planting of autochthonous trees shrubs on riverbanks and ditches, and extended areas.

Through the conservation actions and the biodiversity increase, DINAMO aims to amplify the supply and the flow of ecosystem services in the rural area which the project regards. For this reason, we are carrying out a study on the monetary individuation and valuation of the ecosystem services within the territory, in parallel with said ecosystem services. Additionally, we are preparing modellings of ecosystem services through GIS, with the goal of extending the valuation of ecosystem services from the areas in which DINAMO operates to the entire southern Molise area.

The monetary valuation of the ecosystem services allows for the integration of conservation policies and the agricultural policies in order to induce farmers to supply and maintain ecosystem services, as well as to encourage organized behavior among the various public and private actors involved in the agriculture and conservation of biodiversity. In our case, the Policy for Rural Development has been developed through actions which aim to favor the forest and trees outside the forest, using the LIFE project as its instrument.

2. METHODOLOGIES

2.1 Ecosystem services in agriculture

Ecosystem services are the benefits that man receives from ecosystems (MA, 2005; Daily, 1997). Ecosystem services are supplied by ecosystem functions which are the capacities of the processes and the structures of an ecosystem to offer goods and services which satisfy, directly or indirectly, human needs (de Groot et al., 2002; Costanza et al., 1997). Besides said ecosystem services, society can receive ecosystem disservices, if their effects are considered undesirable.

Agriculture receives and offers both ecosystem services and disservices. We can, therefore, identify ecosystem services (and disservices) which are done to agriculture and services and ecosystem services (and

disservices) which come from agriculture. Based on the classification of ecosystem services as proposed by the Millennium Ecosystem Assessment (MA, 2005) a flow of ecosystem services regarding support, regulation, purchasing and culture to and from agriculture can be identified. The supply services offered by agriculture, and therefore agricultural production, depend on the support and regulation services received by the agroecosystems.

2.2 The economic valuation of ecosystem services in agriculture

Unlike food, fibers and fuels produced by the agroecosystems, the other ecosystem services in agriculture do not have a market which gives them a monetary value. In order to economically quantify these services, evaluative methods which allow the assignment of value must be used: (1) the estimate of the farmers' willingness to pay to give up a part of their income, changing their agricultural practices in order to generate more ecosystem services (DAC), or (2) based on the willingness of the consumers of the ecosystem services to pay in order to have more services (DAP) (Pearce & Turner, 1991; Swinton et al., 2007).

The evaluative techniques used for the ecosystem services in agriculture are (Pearce & Turner, 1991; de Groot et al., 2002; Swinton et al., 2007):

- *Avoided costs:* the ecosystem services allow society to not face social costs which they would have to sustain if said services were inexistent.
- *Substitution costs:* some ecosystem services can be substituted with technological systems which carry out the same functions.
- *"Factor income" approaches:* the ecosystem services can increase agricultural activity income. For example, the *Water supply* support service can increase the yield of the harvest without modifying costs, and therefore increase the farmers' income.
- *Hedonistic price:* this evaluative technique estimates the valued of ecosystem services to and from agriculture, based on the willingness that individuals have to pay for land property, where it is possible to benefit from services, upon the variation of the characteristics that the services confer upon the property itself.
- *Travel costs:* in order to visit an area of ecological prestige, people have to cope with the cost of reaching said area, staying there, paying for meals and possible taxes. Based on these costs which express the willingness to pay for uses ecosystem services, the value of the services offered by agriculture can be derived.
- *Contingent valuation:* this technique consists in asking individuals, through the use of specific questionnaires, how willing they are to pay for the benefits offered by ecosystem services from agriculture or how much they would like to receive as compensation for the loss of said benefits.

If the context, the biophysical characteristics and the socioeconomic characteristics allow, it is possible to resort to "benefit transfer", for which the monetary value of an ecosystem service, estimated in an area as an approximation of the value of the same service in another area is used (TEEB, 2008).

A well-known study published at the end of the 1990s attributes an economic value of $92 per hectare per year to cultivated land, including the services of *Food production* ($54 $ha^{-1} yr^{-1}$), *Pollination* ($14 per hectare per year), and *Biological control* ($24 per hectare per year) (Costanza et al., 1997). Other studies have also attributed a monetary value to other important ecosystem services in agriculture.

One example regards the ecosystem services supplied by soil biodiversity. Soil makes up a dynamic and complex ecosystem (Daily et al., 1997; Caporali, 1991), as its functioning is essential in determining the quality and quantity of agricultural production, as well as where and which cultivations can be realized

(Zhang et al., 2007). It has been calculated that services regarding the formation of the agricultural soil (support service for *Soil structure and fertility*) supplied by micro and macro invertebrates in soil has a global economic value (for the 4.5 billion hectares of cultivated land) of 25 billion dollars per year (Pimentel at al., 1997).

3. RESULTS AND DISCUSSION

The DINAMO Project has set itself the target of economically evaluating the value of some ecosystem services which are increased through conservation actions.

Biodiversity conservation is pursued by DINAMO through the carrying out of 8 concrete conservation actions which aim to: favor the nidification and reproductive success of several bird species connected to agroecosystems and help the populations of some species of threatened amphibians; restore habitats through the planting of autochthonous trees and shrubs (in areas along rivers, torrents and ditches and within extended areas); collect, keep and propagate seeds of native shrub and tree species. One of the expected results is the realization of an ecological network with integrates the rural areas with the SIC and ZPS areas of the Natura 2000 network. In Table 1 the conservation actions are described in detail.

Table 1. Conservation actions of biodiversity of DINAMO.

Action C.1	Action C.2	Action C.3	Action C.4	Action C.5	Action C.6	Action C.7	Action C.8
Artificial nests for Red Kite (Milvus milvus)	Artificial nests for the European roller (Coracias garrulus)	Protection of Calandra lark (Melanocrorypha calandra), Tawny pipit (Anthus campestris) and Short-toed Lark (Calandrella brachydactyl) nesting in cereal crops and lucerne and seed grass parcels through flushing bars	Restoration of through to increase availability of suitable habitats for the Appennine Yellow bellied Toad (Bombina pachypus) and the Italian crested newt (T. carnifex)	Planting with native trees and shrubs trench and river edges in public areas (with the aim to improve the habitat of the animals in the areas near the Natura 2000 sites)	Forested patches planting (with the aim to improve the habitat of the animals in the areas near the Natura 2000 sites)	Native vegetation recover in marginal areas and along farm boundaries (with the aim to improve the habitat of the animals in the areas near the Natura 2000 sites)	Ex-situ conservation and propagation of native shrubs and trees ecotypes

For the supply, maintenance and improvement of the ecosystem services, DINAMO avails itself of a PES mechanism through the financing of farmers of make part of their land and labor available for the realization of conservation activities. One of the project goals is the economic valuation of some services. Specifically, services regarding the agriculture of *Soil retention* and *Pollination* are considered, as well as the services supplied by the agriculture of *Aesthetic landscape, Recreation, Wildlife habitat,, Carbon sequestration.* In Table 2 ecosystem services are related to single conservation actions.

To reach these goals, DINAMO puts two participation instruments into practice, the Agriforum (the organism in which all actors participate to define and share conservation interventions) and the Action Network (made up of farmers, its goal is to carry out the activities decided upon by the Agriforum), to favor the supply of ecosystem services on the landscape scale and to guarantee the continuation and maintenance of the conservation initiative beyond the project end date.

Table 3. Ecosystem services from agricultural and seminatural areas of southern Molise of interest for DINAMO and Conservation actions for which we would like to increase the monetary value of the services generated by the Project.

	C.1	**C.2**	**C.3**	**C.4**	**C.5**	**C.6**	**C.7**	**C.8**
Wildlife habitat	X	X	X	X	X	X	X	
Atmospheric regulation					X	X	X	
Carbon sequestration					X	X	X	
Soil retention					X	X	X	
Pollination					X	X	X	
Recreation						X	X	
Aesthetics					X	X	X	X

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The analysis of the recreational function of the Walloon forest: a rural forest in a periurban environment.

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Summary

An analysis of the recreational function of the Walloon forest was undertaken on the regional scale. The analysis of public demand was completed using three methods of enquiry: a telephone survey, a survey within the 40 areas and over 6 periods, and finally a survey amongst the officials of the regional forestry administration to record the level of activity throughout the entirety of the Walloon forest areas. Recreational supply was also analysed with the main focus on the touristic attractions and accommodation capacity.

The data on demand and supply were used to develop a model to estimate the number of visits for the whole of the Walloon forests, distinguishing between local inhabitants, day-trippers, and holiday-makers.

An economic estimate of these visits and the entire recreational function of the Walloon forests was calculated by adapting the travel cost and contingent evaluation methods to the Walloon regional context and to the available data.

The range of methods of enquiry used allowed a quantification of the size of the recreational function at the regional level while also revealing local variations. Recommendations on the recognition which should be given to recreational function in forest policy at both the regional and local levels could then be made.

Keywords: Wallonia, forest recreation, survey, economics, policy

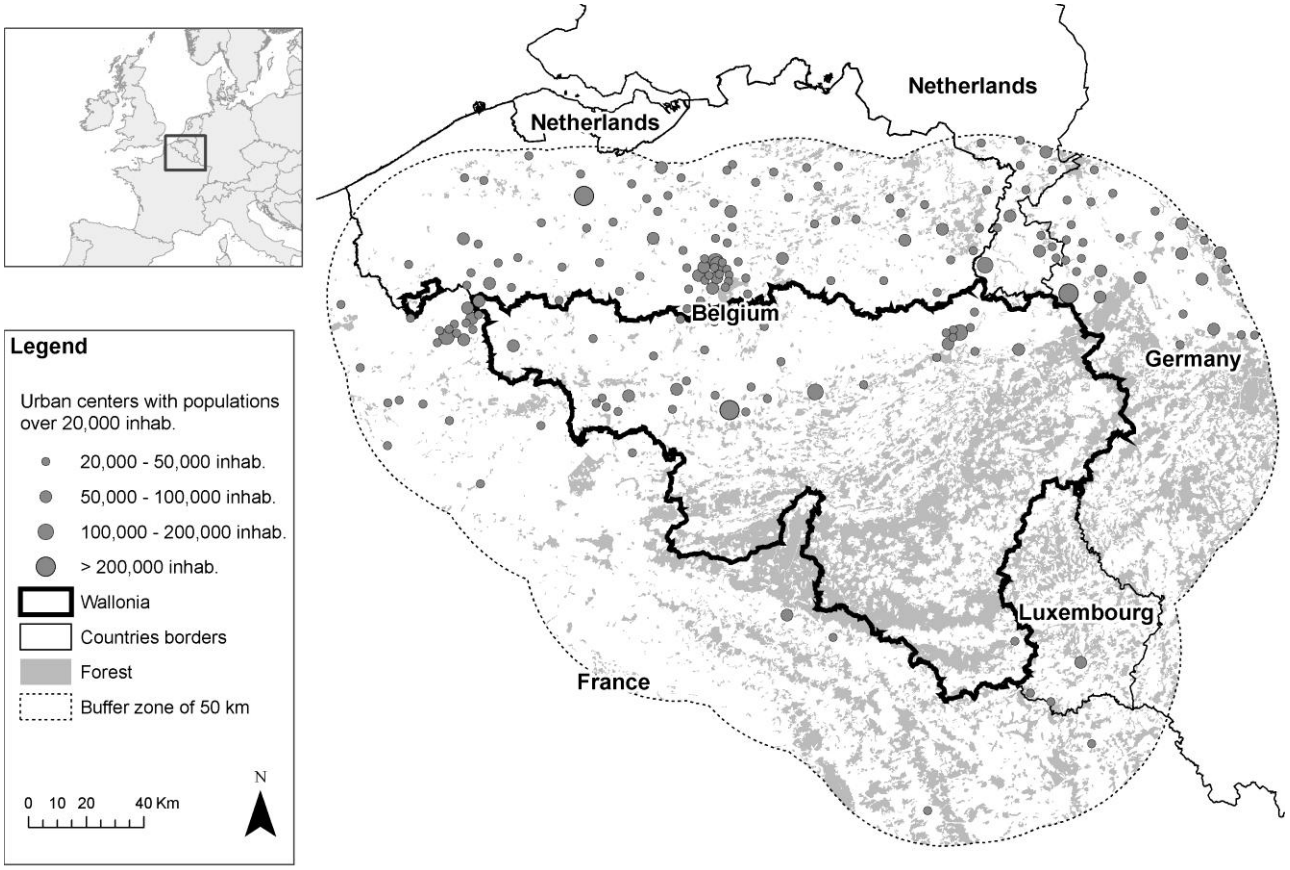
1. INTRODUCTION

1.1 The specific context of Wallonia

Wallonia is one of the three regions which make up the federal Belgian state. Its population density (198 inhab./km²), its level of forestation (32%, 540,000 hectares) and the density of its roadways (4,73 km/km²) mean that Wallonia is a region of transition between more populous and less forested regions located to the north (Atlantic Europe) and more forested and rural regions lying further south (central Europe).

Local visits by nearby residents combined with an increasing tourist activity characterise the Walloon forests at the recreational level. The description « rural forest in a periurban environment » is particularly apt. Local visits appear to predominate in north/north-west Wallonia, while tourist activity involving day-trippers and holiday-makers is more marked in the south and east, mainly in the Ardenne (figure 1).

Figure 1: Forest cover and urban centres with populations over 20,000 in Wallonia and areas less then 50km from its borders.



1.2 Aims of the study

The study which is being presented here aimed to analyse, at the regional level, the volume of activity in forested areas for recreational purposes (Colson, 2009). The study begins with the analysis of demand and supply which is used to make a quantitative assessment of the number of visitors and of the economic value of this recreational function. This regional analysis should make it possible to establish the current importance of the recreational function for the purposes of steering any integrated forest management policy and, more broadly, any rural development policy.

2. METHODOLOGIES

2.1 Analysis of public demand and recreational supply

The first stage of this study consisted of analysing public demand and supply of recreational forest activities. The regional approach has had an impact on the methods used.

Public demand of forests was analysed mainly through a telephone survey (1005 individuals interviewed) (Colson, 2006) and by face-to-face interviews (4046 individuals interviewed) within 40 woodland areas representative of the range of Walloon forest over the course of 6 periods throughout a single year (Colson, 2007).

A third survey, more original and cartographical in nature, was carried out amongst the heads of forest districts of the Nature and Forest Administration. The level of visitation was estimated for each forest region in Wallonia, based on a qualitative evaluation grid. A closer analysis (logistic regression) was conducted to identify the determinants of the level of visitation in the forest (Colson et al, 2009).

2.2 Evaluation of the number of visits to the Walloon forests

The second stage aimed to estimate the number of annual visits to the Walloon forests. Given the impossibility of implementing a counting procedure on the regional scale (Jacsman, 1991), this estimate was arrived at by means of a model. Two distinctive approaches were used according to whether the visits were made by non-holiday-makers (either locals or day-trippers) or by holiday-makers.

As far as visits made by non-holiday-makers are concerned, the model developed aims to redistribute the number of visits originating in population centres as points of arrival in forests. Foreign visitors residing less than 50 km from the Walloon Region were also taken into account. An "attractiveness" function allowed a preferential mapping, within an iso-temporal travel contour map, of visits to the different points of access. The parameters used in this attractiveness function are the degree of forestation, the accommodation supply, and the level of visits of the forest areas surrounding the point of arrival.

As far as visits by holiday-makers are concerned, these were estimated as a proportion of those made by non-holiday-makers, based on a relation expressing the percentage of holiday-makers as a function of the degree of forestation and the degree of urbanisation.

2.3 Estimation of the recreational value of Walloon forests

The difficulties associated with estimating the recreational value of the entirety of Walloon forests originate principally from the size of the area concerned, to the considerable fragmentation of the forest regions, and the combination of the two types of visits: local and tourist.

Two methods were used, adapted to the Walloon context. These consisted of the travel cost method and the contingent valuation method.

The application of this travel cost method (recreational value is a function of the expense incurred in getting to the forest) consisted of calculating a cost per visit taking into account:

- travel cost is the strict sense (price of the return in kilometres of vehicle use);
- the opportunity-cost of the duration of forest activity;
- the accommodation cost in the case of visits by holiday-makers.

The contingent valuation method aims by contrast to ask the public the value it ascribes to its activity. The survey conducted by means of face-to-face interviews within the 40 forest regions notably allowed an estimation the maximum willingness to pay (WTP) for the practised activity.

RESULTS

The analysis of demand revealed the proportion of people going to forests for recreational ends. The telephone survey did in fact show that close to half the respondents (45%) undertake a forest walk at least once a year but with varying frequency. This proportion varies considerably according to the degree of forestation of the place of residence.

The surveys conducted over the telephone as much as those conducted in situ revealed that walking and cycling are the main activities practised.

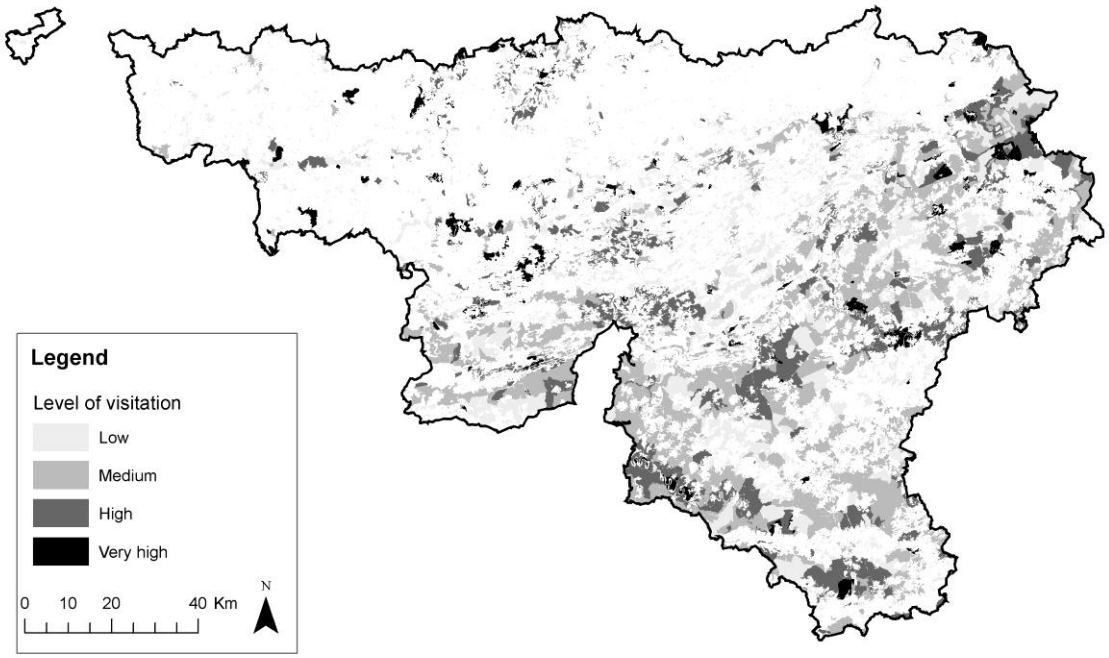
The in situ survey was specific in being able to distinguish between tourist and local visits. The proportion of holiday-makers based on this survey is estimated at 30% but varies considerably from one forest to another (from a proportion of zero in certain northern periurban forests to a markedly high proportion in the touristic forest areas in the south of the region). The existence of rural forests devoid of real tourist activity was also revealed.

Multiple regression analyses furthermore allowed the identification of groups of activity (according to distance and duration) and groups of the general public (according to age and frequency of activities).

As to the third survey, the main recreational centres are located in the touristic areas of the Ardenne valleys and the plateau of the Hautes-Fagnes, and equally in the periurban forests in the north of the region (figure 2). This survey was able, using logistic regression, to show that the level of activity is increases according to the degree to which:

- the areas consists of publicly-owned forest;
- the forests consist broad-leaved species;
- the areas are equipped, have sports trails or infrastructures, camping areas, and areas for youth organisations;
- hydrographic features are present (ponds, lakes, water-ways);
- the areas are situated on slopes which are neither too steep nor too shallow.

Figure 2: Map of level of visitation obtained from survey amongst the heads of forest districts of the Walloon Nature and Forest Administration.



Furthermore, the analysis of recreational supply of Walloon forests was notably able to estimate that 67% of the Walloon population lives less than 700m (euclidian distance) from a forest area greater than 5

hectares. This particularly high proportion confirms both the high degree of accessibility of the Walloon forests and the rural character of Wallonia. Forest accessibility should however be qualified in terms of public access which, in contrast with the model of public access which is the rule in central European and Scandinavian countries (Gentin et al., 2008)], the real supply of open forest accessible to the public is essentially dependent on the type of roadway and landowner (private or public).

These different analyses led to a quantitative evaluation of the recreational function in Walloon forests not just in terms of the number of visits but equally in terms of their financial value.

The annual number of visits made by non-holiday-makers (local inhabitants and day-trippers) to Walloon forests is thus estimated at 93 million/year. As far as holiday-makers are concerned, the methodology allowed an estimation of the total annual number of visits made to Walloon forests at 20 million.

The calculation of the unit cost of each of these 113 million visits allowed us to obtain the regional recreational value, using the method of travel cost. This value is 1.727 billion Euros per year if we take into account a cost of use of private vehicle limited to fuel and tyres, and to 3.386 billion Euros taking into account the totality of costs (fuel, tyres, maintenance, and depreciation).

As far as contingent evaluation is concerned, its application demonstrates that the proportion of respondents who cited a non-zero amount is 54.5% and that the average cost is 4.40 Euros/activity. The regional recreational value was estimated based on willingness to pay relative to visits by local inhabitants (€3.82) and by holiday-makers (€5.82) and the number of corresponding visits. This regional value comes to 472 million Euros per year.

In conclusion, for the economic assessment, based on the methodologies selected, the adaptations made and hypotheses proposed in this study, the annual recreational value attributed by Society to Walloon forests is in the order of 2 billion Euros per year, based on the average of the values obtained. This very high value is particularly sensitive to methodology and to the hypotheses proposed, but it is nevertheless of the same order of size as that obtained for forest activity among the French population (Peyron et al., 2002).

DISCUSSION

The different analyses conducted in this regional study reveal the importance of the recreational function of the Walloon forests taken in their entirety. Forest recreational activities represent a societal phenomenon (45% of people say they go to forests) and should be considered in all forest policy-making. This phenomenon is, according to all indications, likely to be sustained or to increase in the course of time: Walloon forests are particularly accessible (in terms of density of road and motorway networks to reach them) and located close to one of the largest urbanised areas in Europe (Flanders, The Netherlands, and North-West Germany). Walloon forests remain, however, rural forests, owing to their inherent characteristics (composition, history of its stands, interconnections with agricultural areas, etc.) and to the importance of the tourist sector.

Furthermore, the recreational activities in Walloon forests and, more specifically, those undertaken by local inhabitants (notably in rural areas), appear to make up, like those in periurban forests, an essential service in day-to-day living (Tyrvaïnen, 2001), independent of the socio-economic level of the public, and therefore, of the economic context.

Regional forest policy, like any regional forest development plan, should emphasise the importance of this recreational function, without excluding the others (conservation, timber production, hunting) which also form part of the rural development of the Region.

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Evaluating the restorative potential of different urban green space typologies

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Summary

Within a global context of increasing urbanization urban green spaces are seen as fundamental in improving human well-being and quality of life. In this context, the study aims to model the relationship between the main ecological and psychological factors (e.g. naturalness; perceptions, attitudes, evaluations, behaviours, etc.) that are related to urban and periurban green spaces. We focused on the psychological benefits associated with the visual perception of green space scenes. We selected five typologies of green spaces in the city of Bari (southern Italy), ranging from minimum levels of naturalness (i.e., high level of man-made elements) to maximum levels (i.e., minimum of man-made elements). A questionnaire focusing on people's preference of different urban green space typologies (perceived restorativeness, visual perception, etc.) was administered to fifty undergraduate students of the University of Bari. Results show that the perceived restorative properties are higher in periurban green areas and significantly increasing as a function of naturalness levels.

Keywords: restorativeness, perceived restorativeness scale, naturalness, urban green spaces typologies, visual landscape perception

INTRODUCTION

A growing body of literature suggests that urban green spaces can significantly argument human well-being and quality of life in cities (Maller et al., 2002; Takano et al., 2002; Groenewegen et al., 2006). Green spaces play a key role in mitigating atmospheric pollution (Nowak, 1994; McPherson & Simpson, 1998), noise (Fang & Ling, 2005; Gidlöf-Gunnarsson & Öhrström, 2007), microclimate (Lafortezza et al., 2009; Dentamaro et al., 2010) and promoting social cohesion (Coley et al., 1997; Kuo, 2003), physical activity (Takano et al., 2002; Pretty et al., 2005), and psychological restoration (Ulrich, 1983; Ulrich et al., 1991; Grahn & Stigsdotter, 2003; van den Berg et al., 2007). Recent papers explored the restorative potential or restorativeness of different artificial places and natural areas (Peron et al., 2002; Hartig et al., 2003; Berto 2005). According to Scopelliti and Giuliani (2005: 426), restorativeness is the result of a complex experience, in which cognitive, affective, social and behavioural components are considered together with the physical aspects of the environment. Most studies assessed the perceived restorativeness in relation to a range of bio-physical features (e.g., complexity, openness, water features, presence of vegetation, etc.) of natural and urban spaces (see Han, 2003; Laumann et al., 2001; Peron et al., 2002). A number of authors suggest that natural spaces are more restorative than those built it up (Ulrich et al., 1991; Hartig et al., 1991; Korpela & Hartig, 1996; Hernandez et al., 2001; Purcell et al., 2001). Therefore, the most significant factor appears to be the degree to which a space is natural or man-made (see, for example, Kaplan et al., 1972; Kaplan & Kaplan, 1982, 1989; Purcell & Lamb, 1984; Herzog, 1985, 1987). Theoretical foundations on these findings come from the Attention Restoration Theory (ART) (Kaplan, 1995; Kaplan et al., 1998) that is a cognitive framework on recovery from mental fatigue or directed attention fatigue (DAF; Kaplan S., 2001). The ART aims at understanding what are the benefits of viewing visual images of natural environments.

For instance, Tennessen and Cimprich (1995) found that university dormitory residents with more natural views from their windows had better performance on attentional measures than those with less natural views.

Little research has addressed the issue of mixed natural and built scenes' restorativeness (e.g., Peron et al., 2002; Nordh et al., 2009, 2011). According to Kaplan et al. (1998) even urban and periurban green spaces may have substantial restorative values. Yet, we know little, in an empirical sense, about the visual perception and psychological response of people while viewing different types of urban green spaces (e.g. different typologies). In this context, this study illustrates the results from a two-year research project aimed to (1) assess the restorative outcomes of common typologies of urban green spaces and (2) understand the mechanisms underlying the relationship between green spaces typologies and restorative outcomes (e.g., intra-typology evaluation of the restorative potential).

For the scope, the following hypothesis will be tested: urban green space typologies with more natural elements have greater regenerative potential than those with less natural elements, regardless of the environment a person is most attached to. The results of this study represent an important contribution to the process of planning green spaces, in order to guide the design methods and sustainable use of these spaces in an urban environment.

1.1. Attention Restoration Theory and the Perceived Restorativeness Scale

Research in environmental psychology suggests that people's perception of natural spaces relates to important adaptive function, namely, psychological restoration (van den Berg et al., 2007). The term "restoration" means the renewal of cognitive resources and psychophysiological response capabilities (e.g., Hartig, 2004; Kaplan & Kaplan, 1989; Ulrich, 1983, 1993). It is a process tied to some previous deficit from which one recovers. There have been two well-known theoretical approaches to understanding the restoration process and the effects of restorative environments on psychological well-being. One, the psychoevolutionary theory (PET) of Ulrich and colleagues (Ulrich, 1983; Ulrich et al., 1991), emphasizes emotions and dwells on how nature reduces stress reactions. In this model, stress is a set of physiological responses to any situation that threatens wellbeing. The second major theoretical approach is attention restoration theory (ART; Kaplan & Kaplan, 1989) which provides the foundation for our research question.

As stated by the Kaplans (Kaplan & Kaplan, 1989; Kaplan, 1995), ART focuses on directed or voluntary attention, which is defined as 'the ability to control distractions through the use of inhibitory mechanisms' (James, 1892). This kind of attention requires mental efforts and can be fatigued from overuse. Directed attention fatigue leads to the inability to focus and has several negative consequences, including performance errors, inability to plan, decreased sensitivity to interpersonal cues, increased irritability, even accidents. Entering a situation or environment that does not require reliance on directed attention but can instead permit fascination allows the mentally fatigued person to rest the inhibitory mechanism on which directed attention depends and so to recover the capacity to direct attention (Kaplan, 1995). Fascination stands for a kind of involuntary attention (James, 1892), i.e. attention that does not demand mental effort and which is attracted by stimuli having directly fascinating qualities (Ivarsson & Hagerhall, 2008: 108). Settings in which fatigued directed attention can recover are known as restorative settings. Examples of restorative settings are applied today in health-care facilities, as healing or restorative gardens for the sick, but their wider significance in the urban public realm remains insufficiently explored (Thwaites et al., 2005).

To be effective, such settings must have four properties: Being Away, Extent or Coherence, Fascination, and Compatibility (Kaplan, 1995). Restoration requires psychological and physical escape from aspects of one's usual environs, routines and situations (Being Away), immersion in a coherent physical or conceptual environment that is of sufficient scope to sustain exploration (Extent), effortless attention as drawn by objects in the environment or engaged in the process of making sense of the environment (Fascination), and a good match between personal inclinations and purposes, environmental supports for intended activities, and environmental demands for action (Compatibility) (Korpela et al., 2001: 576). All four characteristics are dependent on an interaction between the place and the observer.

Kaplan (1995) also draws a distinction between hard and soft fascination. Hard fascination is very intense, interesting one's attention and leaving little room for thinking things over. By contrast, soft fascination is of moderate intensity, enough to hold attention, although still leaving room for reflection. Both types of fascination can permit fatigued directed attention to rest, but settings with soft fascination enable the additional benefit of the opportunity for reflection.

Several groups of researchers have departed from ART in efforts to measure perceived restorative qualities in environments and to understand their restorative potential (Bagot, 2004; Berto, 2005; Han, 2003; Hartig et al., 1991, 1997; Herzog et al., 2003; Korpela & Hartig, 1996; Laumann et al., 2001).

The majority of studies on restorativeness have compared natural and urban environments, and they found that, in general, people did perceive natural environments as more restorative than urban environments (see, e.g., Hartig & Staats, 2006; Herzog et al., 2003;Laumann et al., 2001). However, there is little evidence of the restorative potential (i.e., restorativeness) of urban green spaces (see, e.g., Hansmann et al., 2007; Ivarsson & Hagerhall, 2008; Karmanov & Hamel, 2008; Nordh et al., 2009, 2011; Peron et al., 2002; Simonič, 2006).

A method for measuring the restorative outcomes of different typologies of urban green space is the perceived restorativeness scale (PRS) (Hartig et al., 1996). Over the past decades the PRS has been considered a reliable tool and employed in an increasing number of studies (Galindo & Hidalgo, 2005; Korpela et al., 2001; Korpela & Hartig, 1996; Peron et al., 2002; Purcell et al., 2001) to measure the degree of perceived restorativeness of natural and built environments (Pasini et al., 2009). The PRS is based on the ART (Kaplan, 1995) and commonly based on four main components, such as: "being-away", "fascination", "extent", "compatibility". In this study, we used a slightly modified version which splits "extent" into two components: "scope" and "coherence". Although the scale needs further examination regarding its psychometric properties, we considered the PRS method suitable for the purposes of this study.

2. METHODOLOGY

As with other previous studies on landscape perception, we based our methods on visual stimuli (Lafortezza et al., 2008). Ten colour photographs of different typologies of urban green spaces were used: five in the city of Bari (southern Italy) and five in a neutral-unknown place. The photographs spanned the range from minimum levels of naturalness (i.e., high level of man-made elements) to maximum levels (i.e., minimum of man-made elements). The photographs represented the following typologies: urban square, urban forest plantation, urban park, botanical garden, and periurban green area. This criterion was seen as particularly relevant, since it has been used in other research on restorative environments (Ivarsson & Hagerhall, 2008). The photographs were taken on sunny summer days with similar conditions in light and cloudiness.

Fifty undergraduate students of the University of Bari, Italy (25 males and 25 females), with age ranging from 19 to 30 years old, were involved in this study as respondents' questionnaire (June 2010**)**. Participants were asked to fill in a questionnaire to test the visual perception judgments for the selected ten photographs. The questionnaire made up of five parts. In the first part, respondents were asked to assess each photograph on an 10-item questions concerning the following attributes: open, safe, complex, accessible, sheltered, mysterious, spacious, bright, crowded and natural. The attributes were rated on a 1 to 5-point scale where 1 = "Not at all", 5 = "Very much". In the second part, respondents had to choose among couples of adjectives: pleasant/unpleasant, stressful/relaxing, monotone/stimulant, and depressing/exciting. In this case, judgments are made on a 1 to 5-point scale; for example, 1 = "very pleasant", 5 = "very unpleasant". In the section 3, participants had to fill the Perceived Restorativeness Scale (PRS), designed to measure the perceived restorative qualities of environments (Hartig et al., 1997). The Italian short version of the PRS was used (PRS/IT). The PRS is made up of 5 items and it measures the perception of 5 restorative factors: Being-

Away (BAWAY, "Spending time here gives me a good break from my day-to-day routine"), Fascination (FASC, "This place has fascinating qualities"), Coherence (COHE, "Things and activities that I see here are naturally integrated"), Scope (SCOP, "There is much to explore and discover here"), Compatibility (COMP, "In this place I can do things I like"). Two items not concerning the restorativeness measurement are also present. They concern familiarity (FAMI, "This place is familiar to me") and preference (PREF, "I like this place"). It is rated on a 5-point scale, where 1 = "Not at all", and 5 = "Very much". The total perceived restorativeness score (REST) is obtained from the mean of the five restorative qualities scores. For more details concerning the PRS, see Hartig et al. (1997). In the fourth and fifth part, respondents indicated on a 5-points scale (1 = "Not at all", 5 = "Very much") own degree of agreement with some statements concerning the relationship with nature (e.g., "I often feel distant from nature") and the environment (e.g., "Mankind can progress only by safeguarding the natural resources"). Finally, participants were asked demographic questions concerning gender, age, and residence.

The experiment took place in a neutral and quiet room without disturbance (noise, temperature too high or too low, other people, etc.). Each person assessed a total of 10 photographs, 5 of the city of Bari (1 photo for each green space typology) and 5 relating to another city (neutral city). The photographs were judged by individually following a give sequence: for half the subjects the sequence was "Bari - Neutral City", for the other half the sequence was "Neutral City – Bari". The photographs were shown one at a time and stayed on the computer screen while subjects made their judgements on the first three parts of the questionnaire (1, 2, 3). When the subjects had completed the questions concerning a picture, using as much time as they needed, the same procedure was repeated for the next picture. After assessing the last photograph, participants were asked to fill in the other parts of the questionnaire (4, 5 and personal information). The procedure took approximately 30 min to complete. Participation was voluntary and no monetary compensation was provided, except a T-shirt as gadget.

3. RESULTS AND DISCUSSION

3.1. Evaluating the perceived restorativeness of different urban green spaces typologies

In order to evaluate the restorative outcomes of different typologies of urban green spaces, we compared the data collected in Bari, through questionnaires, using one-way analysis of variance (ANOVA). For the scope, the mean item scores for each of the five restorative factors and restorativeness (REST) were computed for all typologies. In particular, REST was computed by averaging the five main components of the PRS (BAWAY, FASC, COHE, SCOP, COMP). As shown in Table 1, the results from ANOVA yielded significant differences (p<0.05) for all variables.

Table 1. One-way ANOVA of preference ratings.

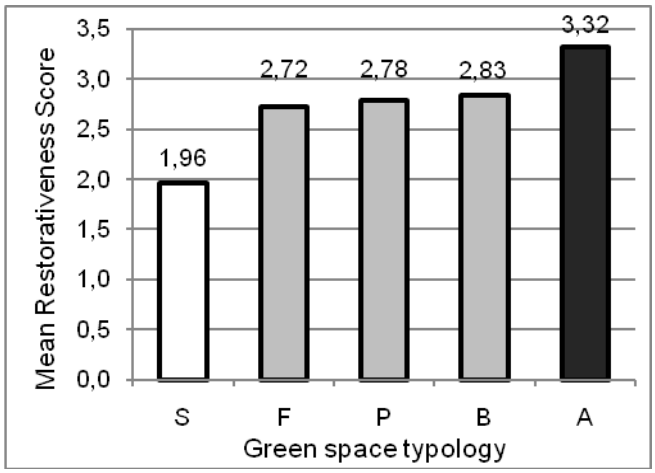
Restorative properties	Urban green space typologies	N.	Mean	Std. Dev.	Std. Error	ANOVA	
						F	Sig.
BAWAY	Urban park	50	3.28	0.970	0.137	14.154	0.000
	Urban square	50	1.98	0.845	0.119		
	Urban forest plantation	50	2.88	0.799	0.113		
	Periurban green area	50	3.32	0.253	0.177		
	Botanical garden	50	2.96	1.142	0.162		
	Total	250	2.88	1.119	0.071		

SCOP	Urban park	50	2.18	0.748	0.106	26.054	0.000
	Urban square	50	1.74	0.777	0.110		
	Urban forest plantation	50	2.44	0.837	0.118		
	Periurban green area	50	3.48	1.035	0.146		
	Botanical garden	50	2.88	1.154	0.163		
	Total	250	2.54	1.094	0.069		
FASC	Urban park	50	2.48	0.814	0.115	20.374	0.000
	Urban square	50	1.90	0.763	0.108		
	Urban forest plantation	50	2.60	0.926	0.131		
	Periurban green area	50	3.52	0.995	0.141		
	Botanical garden	50	3.04	1.212	0.171		
	Total	250	2.71	1.093	0.069		
COMP	Urban park	50	3.06	0.793	0.112	9.031	0.000
	Urban square	50	2.10	0.909	0.129		
	Urban forest plantation	50	2.74	0.853	0.121		
	Periurban green area	50	2.80	0.969	0.137		
	Botanical garden	50	2.38	0.901	0.127		
	Total	250	2.62	0.942	0.060		
COHE	Urban park	50	2.92	0.804	0.114	13.377	0.000
	Urban square	50	2.06	0.867	0.123		
	Urban forest plantation	50	2.96	1.087	0.154		
	Periurban green area	50	3.46	1.034	0.146		
	Botanical garden	50	2.88	1.043	0.147		
	Total	250	2.86	1.066	0.067		
REST	Urban park	50	2.78	0.609	0.086	21.688	0.000
	Urban square	50	1.96	0.629	0.089		
	Urban forest plantation	50	2.72	0.740	0.104		
	Periurban green area	50	3.32	0.802	0.113		
	Botanical garden	50	2.83	0.891	0.126		
	Total	250	2.72	0.856	0.054		

A rejection of the null hypothesis through ANOVA testing means there is a statistical evidence that not all means are equal. However, this test does not explain in which way they are different. Thus, it was necessary to conduct further statistical test or post-hoc. Post-hoc Duncan's tests indicated that the perceived restorativeness score (REST) for the periurban green area (3.32; $p< 0.05$) was significantly higher than the

perceived restorativeness score for the urban forest plantation (2.72; $p< 0.05$), urban park (2.78; $p<0.05$), and botanical garden (2.83; $p<0.05$). Moreover, the perceived restorativeness scores for these typologies were higher than the one for urban square (1.96; $p< 0.05$) (see Figure 1).

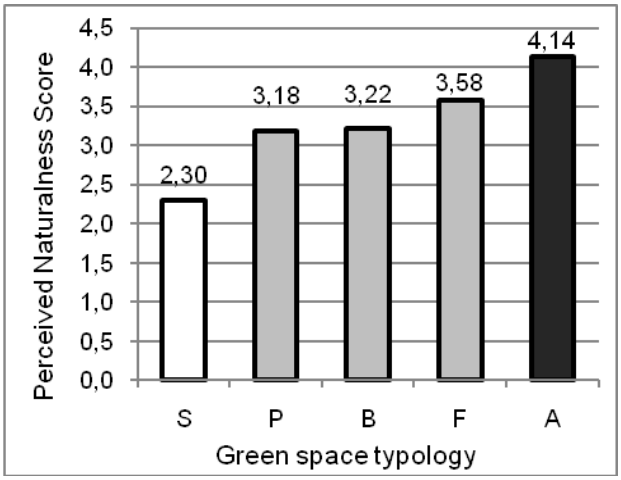
Figure 1: Mean restorative scores for the five typologies of urban green space[1].



[1] The color differences of the histograms indicate the presence of significant differences between the mean values of REST for all urban green space typologies ($p<0.05$). Each color represents an homogeneous subset whose observations are not statistically different. S = urban square; F= urban forest plantation; P= urban park; B= botanical garden; A= periurban green area.

The perceived restorativeness scores for all typologies ranged from 1.96 to 3.32 on a 5-point scale: green space typologies with more natural elements (e.g. periurban green area) seem to promote restoration, whereas those dominated by built elements (e.g. urban square) have lower restorative potentials (Hartig et al., 1997; Laumann et al., 2001). Score for the periurban green area were significantly higher than those from other typologies: BAWAY (3.32; $p<0.05$), SCOP (3.48; $p<0.05$), FASC (3.52; $p<0.05$), COMP (3.06; $p<0.05$), and COHE (3.46; $p<0.05$). These findings indicate that the PRS is able to discern among urban green space typologies on the basis of the five components. On the other hand, the mean restorativeness scores of urban forest plantation, urban park, and botanical garden were not significantly different. This result suggests that these three typologies are seen as having uniformly moderate restorative potential. Looking at the differences of perceived naturalness for all urban green space typologies tested through the ANOVA, the results indicate that participants assessed botanical garden, urban park and urban forest plantation as having the same degree of naturalness (respectively, 3.22, 3.18 and 3.58; $p = 0.117$). The periurban green area obtained the higher mean score (4.14), whereas the urban square the lowest one (2.30) (see Figure 2).

Figure 2: Perceived naturalness scores for the five typologies of urban green space[1].



[1] The color differences of the histograms indicate the presence of significant differences between the mean values of perceived naturalness for all urban green space typologies (p<0.05). Each color represents an homogeneous subset whose observations are not statistically different. S = urban square; F= urban forest plantation; P= urban park; B= botanical garden; A= periurban green area.

3.2. Intra-typology evaluation of the restorativeness differences between two cases of study

Analysis of variance (ANOVA) was performed on the global PRS mean scores (REST) and on the five restorative qualities' mean scores, for every green space typology, between the city of Bari and the neutral city (city Cagliari). In the case of neutral city, the same pattern obtained for the city of Bari was found with the exception of one typology, urban forest plantation. Significant differences were observed for the perceived restorativeness mean scores (F = 10.922; p = 0.001) and 4 restorative properties: BAWAY (F = 5.159; p = 0.025), SCOP (F = 17.557; p = 0.000), FASC (F = 11.985; p = 0.001), and COHE (F = 4.516; p = 0.036). Only for compatibility (COMP) the results yielded not significant differences between the city of Bari and the neutral city (F = 1.529; p = 0.219) (see Table 2).

Table 2. Analysis of variance (ANOVA) of five PRS factors and restorativeness in urban forest plantation.

Restorative properties	Cases of study	N.	Mean	Std. Dev.	Std. Error	ANOVA	
						F	Sig.
BAWAY	Neutral city	50	3.30	1.035	0.146	5.159	0.025
	Bari	50	2.88	0.799	0.113		
	Total	100	3.09	0.944	0.094		
SCOP	Neutral city	50	3.22	1.016	0.144	17.557	0.000
	Bari	50	2.44	0.837	0.118		
	Total	100	2.83	1.006	0.101		
FASC	Neutral city	50	3.22	0.864	0.122	11.985	0.001
	Bari	50	2.60	0.926	0.131		
	Total	100	2.91	0.944	0.094		
COMP	Neutral city	50	2.96	0.925	0.131	1.529	0.219
	Bari	50	2.74	0.853	0.121		
	Total	100	2.85	0.892	0.089		
COHE	Neutral city	50	3.38	0.878	0.124	4.516	0.036
	Bari	50	2.96	1.087	0.154		
	Total	100	3.17	1.006	0.101		
REST	Neutral city	50	3.22	0.749	0.106	10.922	0.001
	Bari	50	2.72	0.739	0.105		
	Total	100	2.97	0.781	0.078		

Urban forest plantation of neutral city was rated reliably higher on all PRS factors (except COMP), and thus was perceived more restorative than urban forest plantation of Bari. Moreover, results showed that in neutral city urban forest plantation and periurban green area had uniformly high restorative potential.

These findings show that only in one case (urban forest plantation) participants judged differently two scenes of the same typology. Even in the case study of neutral city, mean PRS scores were the highest for urban green space typologies with more natural elements (e.g. peri-urban green area) in comparison to those with less natural elements (e.g. urban square). Therefore, the restorative outcomes of this research support

the theory that people find places with the most nature most restorative regardless of the environment a person is most attached to or more familiar.

4. CONCLUSION

Through this research, we aimed to evaluate the perceived restorative potential of urban and peri-urban green spaces typologies with different degree of naturalness. These mixed built and natural environments range from urban square, with hard ground cover and little vegetation, to periurban green area with much vegetation. The PRS showed that urban green spaces are likely to be restorative, which confirms previous results for other mixed natural and built environments (Peron et al., 2002). However, not all typologies contribute in the same way to the restorative process. The findings of this research indicate that the urban square has a low restorative potential whereas the periurban green area has a high restorative potential. The other urban green areas (botanical garden, urban park and urban forest plantation) were judged as moderately restorative environments. To this end, the PRS proved itself a reliable and valid measure to assess the restorative qualities of different types of environments. Restorative outcomes are consistent with those of previous studies which suggest that environments with more natural elements are more restorative than those with less natural elements (Cackowski & Nasar, 2003; Hartig et al., 1991; Kaplan, 1995; Karmanov & Hamel, 2008). Thus, this result strengthens notions about the degree of naturalness as significant factor for the restorative process (see Hartig et al., 1997). However, we can only make a broad generalization of this pattern, as the degree of built and natural character was not measured by using measurable geometric properties as in other studies (see Hagerhall et al., 2004; Hagerhall, 2005). Another limitation of our findings concerns the population sampled in this study. Only 50 undergraduate students participated, which do not always represent other age group. Thus, further research can settle this issue. Future studies need to collect more data on a greater number of examples within each urban green space typology, and to involve different participant categories.

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Spatial and temporal response of insect communities to fire disturbance in Mediterranean forests

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Summary

In response to continuous loss of biodiversity, recent study focused on the causes and consequences of fire on forest resources. The effects of fire on forest vegetation (composition and structure) are relatively well understood; however, little is known about the effects on insect community. We tested the short-term response (two years) of insect community to fire disturbance in Mediterranean forest ecosystem. We reported a case study in a forest area ("Il Quarto" - 600 ha) located in the "Alta Murgia" National Park, Apulia Region (southern Italy), where we established surveys transects over the entire burned area. Each transect contained six pit-fall traps to sample insect community. Using "distance from fire ignition" as explanatory variable, we developed a number of regression model and ANOVA tests to explain patterns of spatial and temporal variation in insect community. Overall we found a positive relationship between insect abundance and distance from fire ignition two years after fire. Most representative orders sampled were Lepidoptera and Coleoptera which showed a contrasting pattern in terms of abundance in relation to distance from fire ignition, i.e., Lepidoptera decreased with distance from fire while Coleoptera increased significantly. We discussed the implications of this study in terms of pre-fire and post-fire management of the forested area and concluded by addressing research needs in this emerging field.

Key words: wildfires, insect biodiversity, post-fire turnover, oak Mediterranean ecosystems

1. Introduction

Mediterranean forest ecosystems harbor a wide range of plant and animal species which make the Mediterranean biogeographical region one of the world's biodiversity hotspots (Myers et al. 2000; Lafortezza et al. 2005). A number of threats affect the integrity of forest ecosystems and landscapes in the Mediterranean, such as: fragmentation, human exploitation, pest outbreaks, invasion from exotic species, overgrazing and fire (Lafortezza et al. 2008). In particular, forest fires can have severe effects on ecological communities by causing direct mortality of animals and plants during the event or by modifying habitat characteristics and species turnover in the post-fire period (Whelan 1995). Among ecological communities, insects are good example of animals that can be directly affected by the heat and the smoke during fire and indirectly affected by the changes in forest structure and composition caused by fire (Rainio and Nimelä, 2004).

The effects of fire on insect community have been studied in grasslands (Larsen and Williams, 1999) and in forest habitats (Holliday 1984; Lyon et al., 2000; Villa-Castillo and Wagner, 2002). For example, Campbell et al. (2007) studied the effects of fire on floral visiting insects in oak forests and observed a relationship between insect abundance (or richness) and fire disturbance that reduced overstory trees density and increased the amount of herbaceous plant cover. Potts et al. (2003) analyzed changes in bee community structure following fire and observed that the abundance of bee declines steadily in the post-fire period.

Huntzinger (2003) explored the effects of fire management practices on butterfly diversity. Results from this study suggests that the reintroduction of fire increases attractiveness of the burn site for butterflies. In fire-adapted forests, maintenance of landscape heterogeneity seems to support butterfly diversity. Conversely, other authors observed temporary loss of insects after fire disturbance due to the change in vegetation/habitat pattern.

Nunes et al. (2006) characterized ground beetle community in two different Mediterranean ecosystems under prescribed fire treatments and found a decreasing tendency in species abundance and richness in burned plots in Pine stand habitat. In addition, both species abundance and richness were higher in the second year after fire than in the first.

While these studies provide evidence that fire intensity and its temporal pattern can alter insect diversity and species composition, they do not provide enough information on the ecological response of insect communities after fire disturbance (Paquin and Coderre, 1997). In particular, the short-term response of insect community to fire has been poorly explored in Mediterranean forest ecosystems, especially when considering the spatial and temporal relationship between the abundance of insects and distance from fire ignition (Larsen and Williams 1999; Ne'eman et al. 2000; Brandmayr et al. 2005). The consequences of forest fires on ecological communities are not uniformly distributed across space and time: depending on fire intensity and propagation, the effects can be circumscribed to a limited portion of the burnt forest area (i.e., ecosystem level) or be more widely distributed (i.e., landscape level). In both cases if we consider the ignition point as the starting point of forest fire propagation, the effects of fire on ecological communities, such as insects, are expected to follow a gradient from the interior to the exterior of the burnt forest area, with the exterior (unburnt forest area) having the highest level of abundance. At the same time, depending on the resilience of the ecological community (e.g., species turnover), the effects of fire are expected to change over time, with the highest effects in the short-time period (Reinhardt et al., 2006).

To shed light on these assumptions, we developed a study addressing the following question: does distance from ignition point explain patterns of spatial and temporal variation in insect communities?

We explored the relationship between insect abundance and distance from the ignition point over a two-year period time in a typical Mediterranean forest ecosystem (oak dominated forest). Using 18 pit-fall traps along 3 transects (running from the interior to the exterior of the burnt area), we collected around 2556 specimens belonging to 26 insect families. We used analysis of variance and developed a number of regression models to determine the spatial and temporal response of insect abundance to fire. In addition, we made a comparison between terrestrial *Coleoptera* and *Lepidoptera* and used results to elucidate the effects of forest fire on different *taxa*. We discussed the implications of this study in terms of post-fire management of the forested area and concluded by addressing research needs in this emerging field.

2. Materials and methods

The effects of forest fire on insect community was modelled by analysing changes in insect abundance in a forest area of about 600 ha (40° 55' 43.63" N; 16° 36' 52.05" E) located in the Province of Bari, Puglia, (southern Italy) within the "Alta Murgia" National Park. The landscape in this area stretches from 250 to an altitude of 410 m (mean 320 m) with forests dominated by the broad-leaved species *Quercus pubescens* (Willd.) and *Quercus coccifera* (L.). Other species include *Pistacia lentiscus* (L.), *Pistacia terebinthus* (L.), *Rosa canina* (L.), *Crataegus monogyna* (Jacq.) and *Phillyrea* spp, *Rhamnus alaternus* (L.), *Erica arborea* (L.), *Rubus ulmifolius* (Schott.), *Smilax aspera* (L.). Variation in the structure and composition of this forest is mainly determined by human-induced impacts, including coppicing and firewood collection (especially in the past), overgrazing and fires rather than natural disturbances (Lafortezza et al. 2008).

During the summer 2008, the forest in this area was affected by a major fire event, along the northern border, which interested approx. 260 ha (40%) of the total surface. Field data from local authorities, described this fire event as a crown fire of great intensity and high energy release (Elia et al. 2011). As a result, the fire caused a reduction of the canopy tree cover (tree mortality was around 95%). After the fire event, the area appeared as dominated by standing dead (oak) trees with large open areas covered by herbs and seedlings. In terms of management, the forest area was intensively coppiced and overgrazed in the recent past. The mean number of stumps per plant was around 4-5 shoots of small diameter and height. Before fire, the canopy cover was around 60-70%.

We placed the study area across the border between the burnt and unburnt forest area (Fig. 1). Sampling of insect community was performed in three replicate transects during the Fall season in 2009 and 2010. Each transect included 6 sample sites, with each site 100 m farther apart from the others. The first three sites of each transect were in the burnt area (starting from the point where ignition approximately began: 40° 55' 43.63" N; 16° 36' 52.05" E), while the other three sites were in the forest at the edge of the burnt area (Fig. 1). Sampling sites consisted of wet pitfall traps (9 cm diameter) buried in the ground with the rim at surface level and baited with vinegar to attract, kill and preserve the insects that fall into it. To reduce the amount of rain and debris entering the trap as well as to keep out predators, the opening was covered by a sloped stone. During the survey period, each trap was visited every week and all specimens collected were moved in a plastic container filled with ethyl alcohol. All specimens were examined in laboratory and identified to the family level.

Using data from 2009 and 2010 we performed a number of regression models to assess the relationship between variables related to the number of individuals (insect abundance) and distance from fire ignition (m). In addition, we performed a series of single factor analysis of variance (ANOVA) to compare insect abundance across space (between class of distance 0-300m and 300m-600m) and time (between 2009 and 2010).

3. Results

A total number of 2556 specimens belonging to 8 orders and 26 families were collected during the survey period (Table 1). We caught two families of *Lepidoptera*, nine families of *Coleoptera*, seven families of *Diptera*, two families of *Orthoptera* and three families of *Hymenoptera*. Only one family was caught of *Dermaptera*, *Hemiptera* e *Blattodea*.

Overall, the most abundant orders were: *Diptera* (35.5%), *Lepidoptera* (34.3%) and *Coleoptera* (23.2%). The remaining specimens belonged to other orders, such as *Orthoptera (%)*, *Dermaptera*, *Hemiptera* e *Blattodea* and *Hymenoptera*.

Overall, insect abundance increased during the two survey years by 37.3%: 1077 individuals were collected in 2009 and 1479 individuals in 2010 (Table 1).

In order to assess the spatial and temporal variation of insect abundance in response to fire distance, we run a series of ANOVA single factor analysis by grouping sampled data based on distance classes (0-300 m and 300-600 m) and survey years (2009 and 2010). To further analyze the data obtain in our results and ascertain the significance of variance, we restricted the sample to *Coleoptera* and *Lepidoptera*. Results from the ANOVA analysis are showed in Table 2.

Table 1. Insect orders, families, total number of individuals and percentage of variation during the survey period (2009 and 2010).

Order	Family	2009	2010	Total
Lepidoptera	*Noctuidae*	667	204	871
	Nimphalidae	9	5	14
	Total	676	209	885
Coleoptera	*Carabidae*	79	98	177
	Staphylinidae	59	236	295
	Curculionidae	3	6	9
	Coccinellidae	1	—	1
	Crhysomelidae	4	10	14
	Anobidae	2	—	2
	Silphidae	—	4	4
	Scarabaeidae	—	3	3
	Tenebrionidae	—	92	92
	Total	148	449	597
Diptera	*Muscidae*	76	86	162
	Tabanidae	28	47	75
	Gasterophilidae	33	361	394
	Cecidomyiidae	39	180	219
	Bibionidae	3	3	6
	Syrphidae	2	—	2
	Tipulidae	—	36	36
	Total	181	713	894
Orthoptera	*Tettigonidae*	6	13	19
	Gryllidae	2	9	11
	Total	8	22	30
Hymenoptera	*Vespidae*	54	1	55
	Formicidae	5	81	86
	Ichneumonidae	2	1	3
	Total	61	83	144
Dermaptera	*Forficulidae*	—	3	3
Hemiptera	*Pyrrochoridae*	2	—	2
Blattodea	*Blattidae*	1	—	1

In terms of spatial variation, we observed not significant differences between the overall abundance of individuals collected in burnt (0-300 m) and unburnt (300-600 m) locations: This result emerged in both survey years: 2009 ($F = 0.44$, $p > 0.05$); 2010 ($F = 3.18$, $p > 0.05$) (Table 2). When restricting the analysis to *Coleoptera*, we found a significant difference between abundance of individuals in the two locations, with the highest level of abundance in the forest at the edge of the burnt area: 2009 ($F = 5.49$, $p < 0.05$); 2010 (F =

5.29, $p < 0.05$) (Table 2). When considering *Lepidoptera*, differences were not significant: 2009 (F= 0.38, $p > 0.05$); 2010 (F= 0.31, $p > 0.05$).

Table 2. The mean value of specimens abundance, were calculated for each class of distance (0-300m and 300-600 m). ANOVA tests compare means: i) between 2009 and 2010; ii) within 2009 and within 2010.

Observation	Factor		N.	Mean	Std. Dev.	Std. Error	ANOVA	
							F	Sig.
Insect community	2009	0-300	9	55.11	28.733	9.578	0.439	0.517
		300-600	9	63.67	26.010	8.670		
	2010	0-300	9	63.33	25.971	8.657	3.183	0.093
		300-600	9	92.89	42.369	14.123		
Coleoptera	2009	0-300	9	4.33	3.202	1.067	5.493	**0.032**
		300-600	9	12.11	9.427	3.142		
	2010	0-300	9	16.78	14.167	4.722	5.294	**0.035**
		300-600	9	33.11	15.902	5.301		
Lepidoptera	2009	0-300	9	41.11	25.157	8.386	0.382	0.545
		300-600	9	34.00	23.659	7.886		
	2010	0-300	9	12.33	4.637	1.546	0.314	0.583
		300-600	9	10.89	6.194	2.065		
Insect community	0-300	2009	9	55.11	28.733	9.578	0.406	0.533
		2010	9	63.33	25.971	8.657		
	300-600	2009	9	63.67	26.010	8.670	3.109	0.097
		2010	9	92.89	42.369	14.123		
Coleoptera	0-300	2009	9	4.33	3.202	1.067	6.607	**0.021**
		2010	9	16.78	14.167	4.722		
	300-600	2009	9	12.11	9.427	3.142	11.615	**0.004**
		2010	9	33.11	15.902	5.301		
Lepidoptera	0-300	2009	9	41.11	25.157	8.386	11.390	**0.004**
		2010	9	12.33	4.637	1.546		
	300-600	2009	9	34.00	23.659	7.886	8.037	**0.012**
		2010	9	10.89	6.194	2.065		

In terms of temporal variation, we found no significant differences between the overall abundance of individuals collected in 2009 and 2010, both in burnt (0-300 m) and unburnt (300-600 m) locations; that is: considering all individuals, insect abundance did not increase substantially in burnt and unburnt areas over

the survey period, although mean abundance values slightly increased: burnt area (2009 = 55.11, 2010= 63.33); unburnt area (2009 = 63.67; 2010 = 92.89). In the case of *Coleoptera*, we observed a significant difference between abundance of individuals in the two years, both in burnt and unburnt locations, with the highest level of abundance in 2010: burnt area ($F = 6.61$, $p < 0.05$); unburnt ($F = 11.61$, $p < 0.05$) (Table 2). When considering *Lepidoptera*, differences were also significant: burnt area ($F = 11.39$, $p < 0.05$); unburnt ($F = 8.04$, $p < 0.05$). However, the two insect orders showed a contrasting pattern in terms of mean abundance values: the abundance of *Coleoptera* increased during the survey period, while the abundance of *Lepidoptera* decreased.

To further explore these patterns of variation, we developed a number of regression models to determine the spatial and temporal response of insect abundance to fire. In Table 3, we illustrate the resulting models explaining the relationship between insect community, *Coleoptera* and *Lepidoptera* abundance and distance from the ignition point for the two years. Considering the overall insect community, the resulting models suggest a positive relationship between abundance and distance to fire: the farther the distance the higher the insect abundance (2009: $R^2 = 0.24$; 2010: $R^2 = 0.52$). However, slope values suggest a limited effect of distance on insect abundance and this could be explained by the contrasting response of different orders to fire: positive relationship (*Diptera* and *Coleoptera*) and negative relationship (*Lepidoptera* and *Hymenoptera*). For example, regression models suggest that the number of *Coleoptera* individuals raised during the survey period and was positively correlated (2009: $R^2=0.77$; 2010: $R^2=0.74$) with distance from fire ignition. On the other hand, *Lepidoptera* abundance decreased during the survey period and was negatively correlated with fire distance (2009: $R^2=0.33$; 2010: $R^2=0.24$). These results suggest that terrestrial *Coleoptera* were negatively affected by fire especially if we consider the original habitat changes as a consequences of disturbance (Table 3).

Table 3. Linear regression analyses of insect abundance (log-transformed) and distance from fire ignition, for Lepidoptera and Coleoptera.

Taxa	Year	Model	R^2
Insect community	2009	4.04 + 0.001 * dist	0.24
	2010	3.85 + 0.001 * dist	0.52
Lepidoptera	2009	4.02 - 0.001 * dist	0.33
	2010	2.71 - 0.001 * dist	0.24
Coleoptera	2009	0.85 + 0.003 * dist	0.77
	2010	1.91 + 0.003 * dist	0.74

4. Discussion

In this study, we provided evidence on the short-term response of insect communities to fire in Mediterranean forest ecosystems. Recent studies provided similar evidence for other biogeographical regions (e.g., boreal and tropical) and focused on the mechanisms underlying insects turnover after fire (Yanovsky and Kiselev 1996, Orgeas and Andersen 2001, Similä et al. 2002). Our results suggest the presence of spatial and temporal relationships between the abundance of insects and fire distance. Considering the overall insect community, we found not significant differences between the abundance of individuals collected during the survey period (temporal variation) in burnt (0-300 m) and unburnt (300-600 m) locations (spatial variation). However, by restricting the analysis on single insect orders we found significant spatial and temporal variations for *Coleoptera* and temporal variations for *Lepidoptera*. Fire affects the amount of sunlight

reaching the forest floor and the diversity and spatial distribution of plant and animal communities (Reed 1997; Dajoz 1998; Buddle et al. 2000; Moretti et al. 2002). One year after fire, our results indicate the prevalence of flying insects (*Lepidoptera*, *Hymenoptera* and *Diptera*) which benefit from the lack of canopy cover and the presence of ground-cover species. On the other hand, our data show a negative influence of terrestrial *Coleoptera* (e.g., *Carabidae* and *Staphylinidae*) probably due to lethal surface temperatures during the fire, loss of litter and predation (e.g. Sgardelis and Margaris 1993, York 1999, Nunes et al. 2000, Elia et al., 2011). In our study, the number of *Coleoptera* increased significantly during the survey period due to the changes in forest ecosystem structure and plant species turnover (Lafortezza et al., 2010). At this regards, Gandhi et al. (2001) suggest that fire residual patches provide important habitats for a number of terrestrial *Coleoptera*. Preservation of these patches is therefore essential to maintain terrestrial *Coleoptera* populations and increase landscape complexity. Our regression models provide evidence on the polarity of the relationship between insect abundance and distance to fire. In the case of *Coleoptera*, this relationship appeared to be positive: the farther the distance the higher the insect abundance; while for *Lepidoptera* the relationship showed a negative trend. *Lepidoptera* appeared to be attracted by fire residual patches and forest gaps due to their habitat preferences (Swengel, 1996). Several authors observed greater *Lepidoptera* abundance and richness in burn sites than in unburned controls (Huntzinger, 2003). In addition, Grundel et al. (1998) found that burn heterogeneity was required to maintain sufficiently complex canopy structure to ensure breeding, oviposition, foraging, and nectaring of *Lepidoptera*. High sunlight requirements are common for most butterfly species, and many butterfly species require multiple habitats to complete their life cycles. Thus recommendations of burn heterogeneity may be relevant in many other forested landscapes.

This study is valuable for improving our general understanding of the post-fire recolonization dynamics of insect communities in Mediterranean forest ecosystems (Santos et al., 2009). According to several authors (e.g. Muona and Rutanen 1994, Buddle et al. 2000, Moretti et al., 2004), most insects recover from fire disturbance within a short time period, especially in fire-adapted ecosystems (e.g. Mediterranean forests).

5. Conclusions

Fire disturbance influences the short-term response of insect abundance with positive or negative effects depending on the ecological traits and habits of *taxa*. Understanding these effects become crucial in highly-modified ecosystems, such as the Mediterranean forests. Fire disturbance is a key factor driving species turnover and natural forest succession in Mediterranean forest ecosystems and landscapes. Therefore this factor should be considered into forest management plans and practices. Forest management should prevent and limit the effects of fire, for example by using fuel models and silvicultural techniques (Lampin-Maillet et al., 2010). At the same time, forest management should preserve the integrity of forest ecosystems, thus creating heterogeneous mosaics of different successional stages.

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Development of a European forest biodiversity status indicator

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Summary

The European Environment Agency has released the Report "Development and harmonization of a Forest Status Indicator (FSI)", entirely developed by the Corpo Forestale dello Stato – Italian Forest Service (CONECOFOR Service), on the basis of a grant from the Agency in the framework of the Pan-European Process for the Implementation of Biodiversity Indicators SEBI2010, aimed at implementing the International Convention on Biological Diversity in Europe.

The objective of the report is to implement a new European forest biodiversity status indicator (FSI) obtained through elaboration and synthesis of current metadata and methodologies at European level. In particular, the work involved detailed collection of the metadata and harmonized methods available in European Networks. The following step was based on SEBI2010 (EG6) sub-indicators, developed progressively at the time of this study (naturalness, deadwood, tree condition, structure, vegetation) and their use as parameters of forest biodiversity in FSI. The last phase of the elaboration is a synthesis and interpretation of FSI parameters, expressed through "radar" graphs. Finally, simulations for a graphic representation of FSI were designed for two metadata collections: one for Italy and one for Slovakia, Spain and Germany.

FSI is based on qualitative attributes of the forest ecosystem, essential to evaluate the quantitative results of other biodiversity indicators, e.g. giving the correct significance to the observed trends in forest types cover. Nowadays, FSI is ready to be included and combined into the SEBI2010 headline macro-indicator "Trend in extent and composition of selected ecosystems".

Keywords: forest biodiversity, indicators, tree condition, deadwood, naturalness

1. INTRODUCTION

The *Pan-European Biological and Landscape Biodiversity Strategy (PEBLDS*) was developed to support implementation of the UN Convention on Biological Diversity at pan-European level, on the initiative of the Council of Europe (CoE) and the United Nations Environment Programme (UNEP). In this framework, the biodiversity resolution passed by the 5th Conference of the European Environment Ministers "Environment for Europe" (Kiev, 2003) includes a key target to develop a core set of biodiversity indicators by 2006 and to establish a pan-European biodiversity monitoring and reporting programme by 2008, with a framework of collaboration with the Ministerial Conference on the Protection of Forests in Europe (MCPFE). A pan-European Co-ordination Team, formed by the European Environment Agency (EEA), UNEP World Conservation Monitoring Centre (UNEP-WCMC), European Centre for Nature Conservation (ECNC) and the Expert Group leaders has been operating since 2004, having initiated its work by collecting available information. The work plan elaborated provides the logical framework for the activities required in order to ensure European coordination of the development and implementation of biodiversity indicators. The indicators will be applied in assessing, reporting on and communicating achievement of the 2010 target to

halt biodiversity loss. This activity is called *Streamlining European 2010 Biodiversity Indicators (SEBI2010*, European Community Biodiversity Clearing House Mechanism, 2006).

In this framework, an overall headline indicator called *Trend in extent and composition of selected ecosystems* has been developed by the SEBI2010 Expert Group 2. A specific *Forest Area Indicator* is ready for implementation, mainly based on quantitative data (trend of forest area, considering forest types), but for proper understanding and evaluation it needs to be complemented by a qualitative indicator, taking into account the status and trends of key characteristics of forest ecosystems, a *Forest Status Indicator (FSI*, Petriccione et al., 2007).

2. RESULTS

FSI, entirely developed by the Corpo Forestale dello Stato – Italian Forest Service (CONECOFOR Service) on the basis of a grant from the European Environment Agency, is based on the detailed collection of available metadata and harmonized methods (EU Forest Focus & UN/ECE ICPs, National Forest Inventories, Natura2000 National Reports, MCPFE Reports, etc.). It consists of a synthesis of surrogate measures (sub-indicators) for biodiversity (tree condition, deadwood amount and type, plant species composition, etc.) per forest type in Europe, with the aim of evaluating the results provided by the Forest Area Indicator, taking into account concepts like the quality, functionality and integrity of forest ecosystems. It will be based on sub-indicators identified at pan-European level (4th Ministerial Conference on the Protection of Forests in Europe, MCPFE) and implemented at pan-European (EU Forest Focus & UN/ECE ICP Forests) and National level (NFIs), as follows:

(1) EU Forest Focus & UN/ECE ICP Forests Level I: tree condition data on ca. 3000 points, since 1985 (continuously for 20 years); forest structure, deadwood and plant species composition on ca. 6000 points, since 2007 (pilot project BioSoil);

(2) EU Forest Focus & UN/ECE ICP Forests Level II: tree condition data on ca. 700 plots and plant species composition on ca. 500 plots, since 1995 (continuously for 10 years); deadwood data on ca. 100 plots, since 2006 (pilot project ForestBIOTA, Petriccione, 2004, Ferretti et al, 2006);

(3) National Focal Points: tree species composition and deadwood data from a number of NFIs all over Europe;

(4) Natura2000 National Reports: "conservation status" of a number of SCIs (47% of them including forests) all over Europe;

(5) MCPFE Reports and National data: "protected forests" amount.

Data are organized according to a revised and improved version of FTBA (*BEAR Forest Types for Biodiversity Assessment*), recently released by EEA.

The indicator is represented by radar diagrams including all sub-indicators/forest types/year (each diagram per each available year). Changes in the time and "distance" from target values can be easily recognized by the change in shape of the diagrams.

Testing of the developed methodology has been done on three key forest types (*Picea abies*, *Fagus sylvatica* and *Quercus ilex*-dominated forests), across three bio-geographical Regions (data from EU/ICP Forests Lev. II plots participating to the pilot project ForestBIOTA):

- Alpine Region (Picea abies forest): data from Italy, Germany and Slovakia;
- Continental Region (Fagus sylvatica forest): data from Italy and Germany;
- Mediterranean Region (Quercus ilex forest): data from Italy and Spain.

3. CONCLUSION AND PERSPECTIVES

FSI developing meets the requirements of SEBI2010 delivering data on changes over time of some key attributes of forest ecosystem in Europe; the emphasis on the qualitative aspects of biodiversity is policy relevant for management of the environment. Most of the data are harmonized at Pan-European level; in some cases they cover a period of 20 years, according to a systematic network which accurately represents all Europe and are easily available from international bodies (EU & UN-ECE). There is the possibility for up- and down-scaling of data collected at Level I and Level II. FSI is based on broadly accepted sub-indicators, it is very sensitive, being able to detect changes in the timeframes and on the scales relevant to the decisions. It can be updated regularly, if adopted at European level, on the basis of routine monitoring programmes. The available data are consistent in space and cover most EEA countries. The FSI, based on quantitative attributes of forest ecosystems, has been included in the SEBI2010 indicators, in the area *Trend in extent and composition of selected ecosystems.*

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High nature value forest areas: a proposal for Italy based on national forest inventory data

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Summary

The maintenance and the enhancement of High Nature Value (HNV) farming and forestry systems is a strategic objective of the European Rural Development Policy. The assessment of the effectiveness of rural development measures as regards this objective is a challenging task. The paper focuses on HNV forest areas and presents an approach to assess their baseline extent in Italy. The followed procedure is consistent with the guidelines provided by the European Evaluation Network for Rural Development. Basing on National Forest Inventory (NFI) data, sound estimations are provided of HNV forest area at national and regional level. The use of NFI data allows to ensure a homogeneous criterion for data collecting and processing on the national territory as required in the above mentioned methodological guidelines. Following this approach, overall the High Nature Value forest in Italy amount to 2,259,066 ha, which corresponds to 26% of the total forest surface area.

Keywords: High Nature Value, indicators, national forest inventory, rural development,

1. Introduction

The maintenance and the enhancement of High Nature Value (HNV) farming and forestry systems is a strategic objective of the European Rural Development Policy and the Managing Authority has to monitor and assess the effectiveness of rural development measures as regards to this objective. In order to perform the assessment, the European Commission has envisaged three indicators for High Nature Value farmland and forest areas, in the context of the Common Monitoring and Evaluation Framework for Rural Development 2007-2013 (see EC Reg.1974/2006): baseline indicator N. 18, result indicator N. 6 and impact indicator N. 5. The implementation of these indicators is a challenging task, mainly due to the complexity of the concept to be measured. This has proved to be particularly true for forest areas, to which the concept of *High Nature Value* has only recently been extended.

This situation led the European Commission to supply methodological guidelines in November 2008, aimed at supporting Managing Authorities during the process of implementation of the HNV farmland and forestry indicators according to a common scheme that can still be adapted to regional specificities (Beaufoy & Cooper, 2008).

HNV forests are defined as “all natural forests and those semi-natural forests where the management (historical or present) supports a high diversity of native species and habitats and/or which support the presence of species of European, and/or national, and/or regional conservation concern” (Beaufoy & Cooper, 2008: 30).

Thus, the following aspects should be considered:

- Natural and semi-natural forests, other than plantations;
- High diversity of native species and relative habitats;
- Presence of species that are particularly valuable for the preservation of biodiversity.

This paper presents an approach for the estimation of HNV forest area at national and regional level based on the information provided by the Italian national forest inventory, called "National Inventory of Forests and Forest Carbon Pools" (INFC). This approach allows to ensure a homogeneous criterion for data collecting and processing on the national territory as required in the above mentioned methodological guidelines.

2. Methodology

The estimation of HNV forest area in Italy both at national and regional level, was based on data available from national forest inventory database. The analysis focused on those attributes that are suitable to assess the indicators related to biodiversity, as defined by the Sustainable Forest Management monitoring system.

2.1 National forest inventory data

The second Italian national forest inventory (INFC- 2003-2007, reference year 2005) was funded by the Ministry of Agricultural, food and forestry policies (Mipaaf) and was carried out by two institutions, the Mipaaf National Forest Service (CFS), responsible for the overall organization and the operational aspects, and the Forest Monitoring and Management Research Unit of the Agricultural Research Council (CRA-MPF), responsible for the scientific aspects and the data processing. Data collection was performed on sampling points selected on the basis of a three phase sampling strategy (Tabacchi *et al.*, 2007). Field survey was carried out in two phases: the 2nd and 3rd phase aimed at assessing respectively qualitative attributes and quantitative attributes. The 2nd phase involved a larger sample, more than four times the 3rd one. The present study is based only on 2nd phase attributes, in order to assure a higher precision to the estimates referred at regional level.

The advantages of using INFC data are the following:

- Statistical sampling and homogeneous analysis throughout the Italian territory;
- Information consistent with international standards (FAO and MCPFE);
- Detailed analysis of certain aspects of forest biodiversity, for example thanks to a detailed forest classification;
- Possibility of repeating the inventory to collect updated information;

Disadvantages include:

- the data referring to single points cannot be extrapolated to areas: therefore, it is possible to estimate precisely the extension of national and regional HNV forests, but not their location (mapping of HNV forest areas can be done by the competent regional bodies);
- Uncertainty concerning INFC repetition timing.

In the light of these elements, at the moment it is deemed necessary to supply a baseline estimate of HNV forest areas based on the processing of more general information – of a qualitative nature – collected by the

INFC. In future years, on the basis of possible new data (e.g. INFC revision, ad hoc surveys or similar), it will be possible to have a more detailed analysis.

2.2 MCPFE indicators

The Sustainable Forest Management monitoring system, introduced by the Ministerial Conference on the Protection of Forests in Europe (MCPFE), includes biodiversity indicators that are useful to assess HNV forest areas. As shown in the following table 1, the national forest inventory is an important data source for assessing such MCPFE indicators.

Table 1. MCPFE indicators and 2nd phase INFC attributes to estimate HNV forest areas

MCPFE indicator	INFC attribute	Possible use for the estimation of the HNV forest area
Naturalness (4.3)	Forest category	Makes it possible to distinguish natural and semi-natural forests from plantations.
Introduced tree species (4.4)	Forest sub-category	Makes it possible to distinguish forests made up prevalently of autochthonous species.
Regeneration (4.2)	Origin of the stocking	Makes it possible to distinguish natural or semi-natural forests from reforestation and forestation
Protected forests (4.9)	Protected areas	Meets the criterion of presence of species that are particularly valuable for the preservation of biodiversity
Dead-wood (4.5)	Stand development stage	The volume of dead-wood is one of the parameters advised by the EC. Information about this indicator have been drawn from the 2nd phase INFC attribute "stand development stage".
Specific composition (4.1)	Forest sub-category	Tree diversity, though not a parameter advised by the EC, is deemed of considerable importance. Information about this indicator have been drawn from the 2nd phase INFC attribute "forest sub-category".

2.3 The classification of HNV forest areas

The structure of this classification considers as first "basic requisite for HNV forest areas" the exclusion of forests that are clearly of artificial origin (such as timber plantations) and exotic species stands . This prerequisite must be accompanied by a "high nature level" description related to the following main indicators:

- High Nature Value formations: the nature and conservation interest of the formation, drawn from the list of natural and semi-natural habitats envisaged in EEC Directive 92/43 ("Habitat Directive") and other considerations on the forest type;
- protected areas and stand structure: inclusion of the stand in a protected area of European, national or regional interest and structure of the forest stand (old and mixed-age stands are considered important for biodiversity conservation).

The adoption of the first indicator made it possible to consider High Nature Value forest formations included as habitats on the list in the Habitat Directive (Council Directive 92/43/EEC). In order to establish a correspondence between the forest subcategories identified by the national forest inventory (INFC) and the habitats included in the directive, reference is made to the interpretation manual in the context of Natura

2000 (European Commission, 2003) and, at local level, to various specific studies (Sindaco *et al.*, 2003; Lasen, 2006).

The habitats quoted in the directive, which appear to be present in Italy are not always of conservation interest when seen at the national, regional or provincial level. Therefore, in order to safeguard biodiversity, it is important to consider the local value of the single habitats.

This analysis tries to assess the value of forest formations that correspond to the units of the Habitat Directive by using a "rarity" criterion as regards the representativeness of the inventory unit (inventory category or subcategory) at regional level. In practice, categories or subcategories with an area below 10% of the regional forest area are considered as having High Nature Value. For correspondence between directive units and inventory units and their link with regional level "rarity", consideration has been given also to the natural range of the species in Italy and the description of the directive habitat. For this reason, various forest sub-categories were excluded from the HNV areas when, though the area was smaller than 10%, they were located outside the natural range of the species or in a region that does not correspond to habitats described in the directive.

To the formations identified with this procedure were added those deemed of conservation value anyway, even if they proved not to be rare in the administrative region considered.

These are a series of forest habitats quoted in the directive, that correspond to the following cases:

1. environments of special ecological interest for their biodiversity and the natural dynamics processes (high-altitude environments, plain environments, ravine and rocky environments, etc.), corresponding to determined forest sub-categories;

2. formations of bio-geographical and landscape interest present in various regions, identified with special forest sub-categories;

3. formations of bio-geographical and landscape interest with a presence limited to individual regions.

The second indicator made it possible to consider stands included in protected areas (national, regional or of European interest), for their intrinsic potential conservation value. Of these stands, only the ones that presented a forest evolution stage or a structure of nature interest, such as for example older-growth stages or irregular and uneven-aged structures, have been selected.

The criteria followed for the adoption of this indicator are the ones that conceptually correspond to those presented in the HNV farmland interpretation manual (Beaufoy & Cooper, 2008) .

3. Results and Discussion

3.1 Results

A method test, performed on INFC data, has led to classify as HNV forests approximately one fourth of Italian forests.

Table 2 shows the classification results considering the criteria illustrated above.

The forests classified as High Nature Value forests in Italy amount to 2,259,066 ha, which corresponds to 26% of the total forest surface area.

As regards Other Wooded Land, i.e. open forest stands with a crown cover between 5% and 10%, or low forest stands and shrubland, with a crown cover more than 10%, but that are not able to reach a minimum height of 5 m at maturity in situ (FAO, 2000), they carry a different weight in the various administrative regions and may represent stable stages in pioneer site conditions or may be evolving towards more or less

open forest structures. Generally, for these reasons, they are to be deemed of high nature value, irrespective of assessments linked to the indicators considered in this analysis.

Given a national average of 26% of HNV forests, higher percentages were found in many regions throughout the Country, mainly concentrated in Southern regions. This result may be interpreted as the combined effect of the presence of environments that differ very much from each other, which favors a great forest biodiversity (from Mediterranean-type to mountain and Alpine vegetation, which affects the second indicator) and of the inclusion of many forest stands in protected areas. A typical case is that of the Southern regions (Sardinia, Sicily and Apulia), where these elements concern a smaller forest surface area: there are few forests and they are often included in protected areas or made up of species of conservation interest.

Table 2. Results of HNV forest area assessment at national and regional level

DISTRICTS	FOREST				OTHER WOODED LAND	
	Total forest area	Forest area classified as HNV	s.e. %	Percentage of HNV area	Total OWL area	s.e. %
Piedmont	870,594	**218,961**	3.9	**25%**	69,522	7.2
Valle d'Aosta	98,439	**17,965**	13.5	**18%**	7,489	21.4
Lombardy	606,045	**177,418**	4.4	**29%**	59,657	8.2
Alto Adige	336,689	**79,704**	6.2	**24%**	35,485	9.9
Trentino	375,402	**77,839**	6.2	**21%**	32,129	10.3
Veneto	397,889	**138,944**	4.5	**35%**	48,967	8.3
Friuli-Venezia Giulia	323,832	**88,509**	5.7	**27%**	33,392	9.9
Liguria	339,107	**75,440**	6.3	**22%**	36,027	9.5
Emilia- Romagna	563,263	**107,738**	5.4	**19%**	45,555	8.5
Tuscany	1.015,728	**200,910**	3.9	**20%**	135,811	4.9
Umbria	371,574	**74,837**	6.4	**20%**	18,681	13.4
Marche	291,394	**47,937**	8.3	**16%**	16,682	12.8
Lazio	543,884	**158,870**	4.3	**29%**	61,974	7.3
Abruzzo	391,492	**110,066**	5.1	**28%**	47,099	7.6
Molise	132,562	**24,206**	11.8	**18%**	16,079	14.2
Campania	384,395	**113,672**	5.1	**30%**	60,879	7.3
Apulia	145,889	**57,447**	7.2	**39%**	33,151	10
Basilicata	263,098	**73,438**	6.5	**28%**	93,329	5.5
Calabria	468,151	**146,638**	4.5	**31%**	144,781	4.6
Sicily	256,303	**92,078**	5.8	**36%**	81,868	6.2
Sardinia	583,472	**176,450**	4.3	**30%**	629,778	1.8
ITALY	8,759,200	**2,259,066**	1.2	**26%**	1,708,333	1.3

3.2 Conclusions

The High Nature Value concept underlines the importance of agricultural practices linked to high levels of biodiversity, species and natural interest habitats.

In the case of forests, the definition of HNV forest areas highlights the importance of a type of management (historical and present) that supports a high number of species and habitats and/or the presence of species of nature interest and therefore does not deviate very much from that adopted for farmland. However, considering the peculiarity of the forest ecosystem (richness of species and communities that is greater than in farmland, long cycles and slower responses to environmental change, use of less intensive management practices), it is obvious that the two situations are different.

In a country like Italy that is characterized by a very extensive anthropic use of forests in past centuries, it seems reasonable to establish as "high value" features for forests, not only the presence of species or habitats of nature interest, but also elements of "conservative management" that safeguard natural development processes in forest ecosystems. Thus, the indicators considered attempt to underline the importance of certain structural characteristics that are fruit of a more or less active management (irregular and uneven-aged stands), but also of non-intervention (e.g., old-growth development stages of high forests and coppices), the latter being important for the natural evolution of the forest ecosystem natural dynamics. These stands take on a significant role particularly in the protected areas, that is in the areas where the general management of the landscape should be more protected than in more intensively utilized areas and where it is possible to give priority to safeguarding habitats and species.

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POSTERS

A case-study of a multifunctional urban forest in Belgium: the «Bois de Lauzelle»

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Summary

The Bois de Lauzelle is a private forest belonging to the Université catholique de Louvain, in Belgium. It covers an area of 198 hectares and is located in the heart of a highly urbanised region with a high level of economic development. Since its gradual acquisition by the University in the 1970s, the management has implemented flexible management practices while remaining oriented towards multiple usage, which meets the societal expectations of today.

The diversity of local conditions (e.g. soils, topographies, and woodland species) provides a wealth of landscapes which attracts a large number of visitors, but presents difficulties in its management. Management is oriented towards multi-functionality. The provision of access to the public (e.g. visitors, inhabitants, students, and researchers), conserving and restoring natural and semi-natural ecosystems, research and teaching, all count as key activities which ensure mutual exchange.

The human investment and consultation maintained with the different stake-holders (e.g. local residents, landowners, naturalists, walkers) are, in this case study, the key to the co-existence of different functions. The forest manager plays a key role; he doesn't merely provide technical services but, taking into account the potential of the environments, offers guidance to the different users on responsible forest management.

Keywords: multifunctional forest management, urban forest, teaching forest, social forest.

1. Introduction

Established in 1425, the Université catholique de Louvain (UCL) is one of the oldest European universities ; nearly 600 years later, it is host to more than 26,000 students! In the 1970s, the French-speaking part of the University was re-located to the agricultural plateau which was to become a new town: Louvain-la-Neuve. In conjunction with the creation of the town, different plots of forest were progressively acquired by UCL.

Today, the clustering of these forested areas makes up a woodland zone covering 198 hectares: the Bois de Lauzelle. It provides a range of amenities and services to local citizens, students, and researchers of the University, as well as to other visitors of the forest. Since the University sets itself three key aims, being

teaching, research, and service to society, it follows that these aims have also been transposed to the Bois de Lauzelle.

In the first section, we will describe the historical, physical, natural and socio-economic contexts of the Bois de Lauzelle. Then we will present the different features of this model forest, while focusing on the opportunities and challenges facing a management approach which aims to reconcile objectives based on differing visions. Finally, we will outline some of the lines of thinking necessary for the sustainability of this type of management.

2. Methodology

2.1 Context

2.1.1 Historic point of view

In common with most of the forests located in this region of Belgium, the Bois de Lauzelle came into existence following the dismemberment of the great charcoal forest which existed until the 18th century. This forest, principally broad-leaved and consisting of oak (*Quercus petraea* (Mattus.) Liebl. and *Quercus robur* L.), birch (*Betula pendula* Roth.) and alder (*Alnus glutinosa* (L.) Gaertn.) provided, from the earliest times of human habitation, rich economic resources to local inhabitants.

Following the different land-management systems in application since the Middle Ages, woodland plots then belonged to wealthy landowners and the clergy. In those times, forest was managed principally according to the system known as *taillis-sous-futaie* (trees grown above coppiced woodland) and afforded rights of use to the local population. Only after the promulgation of the first forest laws of 1854 were the first great plantations established, in the 1880s; these still exist today.

The arrival of UCL on the Lauzelle plateau was accompanied by a number of acquisitions in the 1970s, and UCL, out of concern for protection, applied for the listing of the Bois de Lauzelle. Having become a single entity, the Forest is protected by statute.

2.1.2 Physical context

The surface area covered by the Bois de Lauzelle is 198 hectares, made up of a single block of land. As a measure of comparison, the average area covered by a private forest in Wallonia is close to 2 hectares. The forest covers many small valleys oriented towards a larger central valley. It presents a variety of landscapes whose altitudes vary between 60 and 110 metres. Soils are generally acidic or sandy on the plateaus and silty on the slopes and the bottom of the valleys. The diversity of soils has over time led to a mosaic of woodland varieties.

2.1.3 Natural context

Many typical plant associations can be found: from groves of swamp alder to Atlantic acidophilous beech. Owing to the rarity of some of its habitats and species (Common Kingfisher (*Alcedo atthis*), Medium Spotted Woodpecker (*Dendrocopos medius*), Common Snipe (*Gallinago gallinago*)), the Bois de Lauzelle is protected by several pieces of legislation, amongst which that of the European network Natura 2000. Over 30 hectares have been voluntarily set aside by UCL as natural reserves. Certain ancient areas of heather moorland (*Calluna vulgaris* (L.) Hull) and/or open environments are in the process of being restored to ensure the preservation of animal and plant species. Wetland valleys are protected from development and entirely dedicated to water conservation and to established animal and plant species. Forest species are mainly broad-leaved (figure 1). Beech and oak predominate (59% of standing volume).

2.1.4 A changing socio-economic context

Since the construction of the city of Louvain-la-Neuve, the Bois de Lauzelle has been encircled by residential zones. To the north lies a golf course, the town of Louvain-la-Neuve lies to the south, whilst two important road systems circumscribe the eastern and western limits. The region is highly urbanised (40% of land area) and has a high population density, with the 20-30 year-old age group over-represented compared to other communes in Wallonia. Ottignies-Louvain-la-Neuve is characterised by its rapid population growth, having nearly doubled over the last 25 years. With more than 30,000 inhabitants in 2008, the commune has a density of 900 per square kilometre, some four times the average density for Wallonia (~200 inhabitants/km²).

3 RESULTS AND MEANS OF IMPLEMENTATION

3.1 Achieving the aims of the university

At the time of acquisition of the first forest plots by UCL, the approach to forest management aimed to be innovative, economic profitability not being the basis of management. The objectives of forest management have been modelled on the aims of the University: teaching, research, and service to society.

Every year, the university trains several hundred students in biological sciences, in ecology, or in forestry sciences. The Forest constitutes a real didactic laboratory which enables students to try out and put into practice the subjects taught. The recent initiative of the university to address a younger audience is also supported thanks to the Forest, which regularly welcomes more elementary students. By way of illustration, we can cite the opportunity offered to students to create glades, select the plantings, and to undertake dendrometric analyses under conditions approximating those of professional practice. A marteloscope (experimental set-up simulating tree marking) was furthermore installed in 2006 to allow students to simulate tree marking; this piece of equipment attracts students and professionals throughout Belgium.

University research is also at the heart of the Bois de Lauzelle. It has served as the experimental context for several final year research studies and doctoral theses. The scientific interest of the Forest appears undeniable. By way of example, one plot in the Forest forms part of the RENECOFOR European observation network of forest ecosystems. In this experiment, atmospheric fallout is collected and analysed to establish the degree to which forests are affected by pollutants. Research is also undertaken on silviculture of mixed plantings, on provenance trials, or methods of assessing the available light in forests.

Service to society is the third pillar of forest management. A large number of pathways have been created through the forest. As a result, the entire forest is open to the public. Thanks to updated signposting, to maps and information available on the Bois de Lauzelle website, several hundred visitors every day discover ecosystems and the way in which these are managed. Openness to the public is sustained thanks to large numbers of guided visits, the holding of forest sports events, and the hosting of school groups. The Forest also fulfils social and landscape roles valued by the general public, which would be appropriate for us to describe in more detail.

3.2 A useful laboratory in the forest sciences area

Like most European forests, the production of timber and wood fuel is one of the functions most commonly associated with forests. Every year in the Bois de Lauzelle, a cycle of cutting and thinning of the forest is programmed with the aim of reducing forest growth and producing quality timber.

To ensure the sustainable management of the resource, UCL has established a permanent inventory of forest resources. This allows the tracking of forest growth, its state of health, or the balance between the forest and wildlife populations. Another example of the partnership between research and management.

4. MAIN DIFFICULTIES ENCOUNTERED AND CONCLUSION

Reconciling different functions associated with a 200 hectare woodland area which is a focal point of strong anthropic pressure presents a number of difficulties. The first lies in the choice of aims. The timescale of modification and response of forest ecosystems often differs from that used in defining management objectives. Take, for instance, the function of timber production: whereas plantings and silvicultural practices are geared to the production of quality timber, there is nothing to indicate that this function will still be meaningful in a century's time. What is more, even if conservation of biodiversity has come to be seen as essential today, should we allow forest management be governed by this single consideration?

The policy opted for by UCL is to give priority to the diversity and equality of functions. In this instance, a trade-off is often necessary. The solution arrived at lies in consultation with representatives from different fields: naturalists, scientists, teachers, forestry experts, walkers, and local residents. This consultation process is intended to allow managers to devise and implement a plan for the management and development of the Forest.

Sometimes, functions are incompatible and require functional zoning. To conserve biodiversity efficiently, unified reservations have, for example, to be created and protected from any disturbance. This is a particular requirement imposed by the Natura 2000 network in Wallonia.

Public access is also an increasing problem. A keen awareness of the volume and type of activity is essential to undertakings affecting roads and pathways; this is a specific task to be accomplished.

In any case, the vulgarization and communication to the general public of initiatives implemented in the Forest are the pillars of multi-functionality, whether in the realm of nature conservation, access, management of invasive plant species, or in the selection of trees for cutting. This is the key role of the forest warden (direct route), or signposts, websites, and posted notices (indirect route). It is by means of the reciprocal transmission of knowledge - between public and management - that the forest ecosystem will be able to broaden the wealth of functions ascribed to it today. For the main challenge facing any forest manager is to assure that forests remain adaptable to the needs of future generations.

Figure 1 : Distribution of broad-leaved and resinous species in the Bois de Lauzelle in terms of absolute numbers and basal area. These data have been obtained from the permanent inventory in the form of circular experimental plots (situation in December 2003).

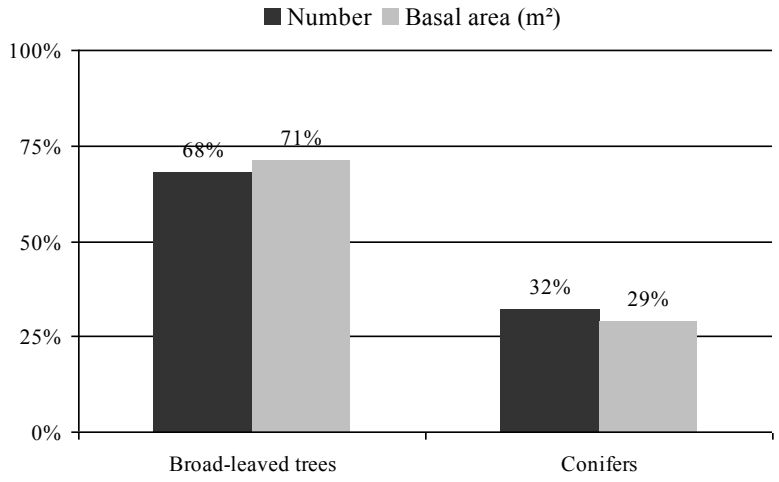

Figure 2: Example of information panel written in three languages and placed at the entrances to the Forest. It presents thematic walks adapted to the public (children, students, visitors).

Figure 3 : Paths converge at the level of the ponds, at the centre of the Forest. The banks are listed as an integrated reserve.

Biodiversity and truffles diffusion in a forest ecosystem: technological suitability and critical points in a case of data collection best practice.

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Summary

The truffle hunting is a practice based upon empirical e traditional conviction (Granetti et al., 2005) and a wanted mystery represents the very little that we know about it. Silence does not help the safeguard of truffles heritage, which, though a renewable resource, is tied to a complex and vulnerable forest eco system. Silence nevertheless help abuses of mavericks who are used to prey upon the forest. Data popularization of non-wood forest products, as truffles, have a remarkable task for a full understanding of the ecosystem and then for the conservation of biodiversity.

The forestry farm "Nocella" has run an assessment the of symbiotic plants and truffle quarries (cave) of a forestry new ecosystem developed on former fields of traditional cultivar. The A.A. present the drawn map of symbiotic plants and truffle quarries and explain methods and constraints to get the target. Meoni Anna Maria, psychiatrist and psychoanalyst is the owner of the forestry farm "Nocella". She has taken care of the conduction and selection process of a group of truffle hunters, reliable and motivated to dealing with a concrete experiment of best practice of collecting data during the ongoing actions of gathering truffles. Mr. Massimo Parrini has been the first assistant as hunter, trained and tested to search for truffles and mushrooms, recruited by the farm to ensure the spotting of symbiotic plants and truffle cave.

Keywords : truffle biodiversity forestation

1. Introduction

The rural farm " Nocella" changed in 1988 in forestry farm by the benefit of seat a side coming with PAC in order to help forestation of the rural fields. In 1988 the local mountain community institution was allowed to start a forestation plan (named P.I.M. 1988) on 14.090 ha. fields of the rural farm "Nocella" by courtesy of the owner . The planting plan was a ball planting (Pine and Cedar, Oak, Alder, European Mountainash, Walnut) naturalized with development zone. Only after 10 years sole one thinning was done restricted to the half East area. The new wood border oldest backwoods (N and S), where you cannot find truffle, and fields at seat a side (E and O). In the new resulting forestry, at least after 8 year, have been detected the following truffle species : Tuber aestivum and Tuber brumale and Tuber uncinatum, Tuber borchii and Tuber rufum, Tuber excavatum, Tuber indicum, Tuber Balsamia vulgaris and Tuber Genea fragrans. After the planting final test of the afforestation proceeding (2001), the Federal Governmental Institution has admitted the resulting backwoods as "Controlled Truffle Ground n.15 of Umbria Region". Sorry to say since October 2010 the environmental protection of this truffle ground went out, on the sole responsibility of the local mountain community institution, tanks, it was said, to the new federal regional policies with the aim to achieve more vote agreement, than educational policies to a sustainable forest management.

Any way since October 2001 to October 2010 the Forestry Farm "Nocella" in Ficulle (Italy) have had the chance of running the truffle ground first in aim to mark and define the localization of symbiotic plants and then to collect a daily detailed report on the amount of truffles gathered.

In ancient time the area was a backwoods. The rural socio economic development coming after was connected to a traditional farming to live on. The area has been slowly deforested and terraced and planted again with cultivar. The seeds as been selected by an unconscious experiment of sustainable agriculture based upon biodiversity. The afforestation process brought back to the ancient time but is still conserving memory of plants cultivar and introducing some new species not native.A peculiar biodiversity naturally joining with truffle symbiotic plants and truffle cave productivity.

2. Methodologies

We start plotting by a strip the plant we can identify by exterior natural marks suggesting truffle presence. Following finding out of a truffle presence the plant was confirmed and labeled by a random number on plastic label. The plant close to the truffle was meditated as symbiotic plant of that truffle.

Figure 1 : [photo of a symbiotic plant labeled]

Passing by spring 2008 to autumn 2010 the daily truffle gathered all around the plant labeled was collected apart in numbered bags. New plant unlabelled have been spotted in the same way before said. At home the weight of any bags was registered on an album with note of the truffles number, hunter and dogs cooperating to the hunt. The collected data are actually a data base reporting the truffle daily productivity of every symbiotic plant.

3. Results and discussion

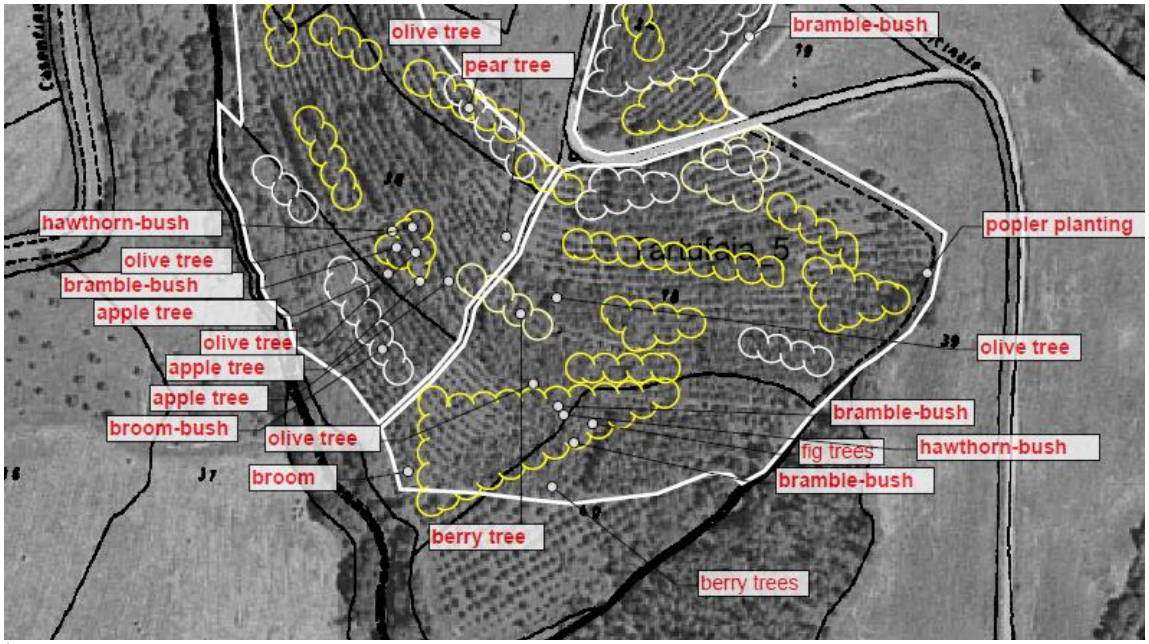
What we see, in the map we draw, is the increasing number of plant symbiotic (Figure 2).

Figure 2: detail of localization map symbiotic plant over 5 years[1]

[1] [the call out marks the year of new symbiotic plants founded out from 2006 to 2010]

The evidence of localization of the cultivar still present from former rural growing can be seen by the map of the areas of symbiotic plants.(Figure3)

Figura 3 : [detail map S corner : cave[1] and cultivar[2] presence.]



[1][circled area (cave) of truffle symbiotic plants]
[2][call out of cultivar in area of symbiotic plants]

Multivariate analysis (MVA) of the observed data suggest good reasons for more investigation of the climate and soil correlations and partly confirm anthropological story. The map we draw of the symbiotic plants show the evidence of new plants coming out every season, apparently not related to former forestry as for example thinning, which has to be considered environment external opportunity or threat to biodiversity (SWOT). The map we draw of the cave also show a progressive enlargement and confluence of the areas of productivity could be related to acting of wild animal (Salerni,E., 2010), as well as the localization of the former cultivar. Olive, vine, fig , mulberry, cherry, apple, pear, plum, walnut tree with ornamental liliaceae, broom, hornbeam, poplar cultivar, Bramblebush and Bramblerose and plenty of officinal closely regards the truffles cave in such a way that also wanted to be more investigated.

4. Conclusion and perspectives

The conduction of an operative team of truffles hunters with the aim of collecting data is quite unusual and there is no similar looking for it in references. Silence culture demand not to say where and when truffle is hunted. In fact due to the truffle hunt complexity joining human beings and dogs, only group activity can get the target of a real census of all the symbiotic plant in a defined large area and collect precious notes of changes in productivity, as long as gathering goes on no stop lasting years. Random sample or general amount seems no exhaustive standing to the truffles complexity ecosystem . The operating cycle of truffle hunting by mavericks as a matter of fact, by silence, detect the real governance and control of the ecosystem, managing, without knowing, an important non-wood product strictly related to biodiversity share. Professional and technical difficulties, investigating and describing biodiversity, mainly stick out from group dynamics (Meoni, 2004) more the member belong to radical different cultural background. (Meoni, 2009).

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The Forest and the Dune: eco-days to explore Cuma Forest

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Summary

The Mediterranean forests besides being a key resource in terms of raw materials have important ecological and environmental functions; the proper management of a forest is based on the balanced mix of ecological, economic, social and cultural activities. Due to their characteristics and their history, the Mediterranean forests were subject to degradation especially caused by uncontrolled urbanization of the area; these phenomena combined with climate changes, have significant adverse environmental effects, such as loss of fertility of soils, loss of biodiversity, erosion and desertification. With the creation of action plans for the forests, the European Union aimed at exploiting the forest resources of the European territory by maintaining and enhancing the multifunctional role of forests through the active management. In Italy the awareness of the sustainable use of forests resulted in the reduction of the use of forests for the sole purpose of production and the activation of a forest policy aiming at encouraging the systemic silviculture. The regional policy became more attentive towards environmental emergency pursuing the sustainable management of the forest areas, being a suitable governance to ensure bio-ecological, environmental and productive results, carrying out wide-ranging support in the community. In Campania the forest areas preserved by natural constraints represent 9.5% of the total national area of protected forest and are for the whole region, elements of the ecosystem, playing a role of protection of nature of microclimates also through green areas placed on the edge of urban areas as that carried out by the Regional Forest of the Phlegrean Area and Monte Cuma, included in the Regional Natural Park of Campi Flegrei, the forest sung by Virgil placed on the western edge of the city of Naples.

Keywords: ***urban forestry, landscape ecology***

1.Introduction

Since ancient times the Phlegrean territory was known for its immense coastal forests, and today, as reduced to a few hectares, Cuma forest besides constituting a significant biodiversity heritage, contains a wealth of history and culture that deserves to be enjoyed by the society. The forest is located a few kilometres from the city of Naples, one of the European areas having a highest population density and is served by Circumflegrea line that quickly connects it to the city centre; the railway station is located right in the middle of the 100 hectares of forest, in an almost magical place where you can reach the ilex forest, the dunes and the archaeological site, coming directly to the Acropolis of Cumae and the cavern of the Sibyl Cumana**.**

The restoration and upgrading of the Circumflegrea railway line was made by the Department for Agriculture, Forestry sector, in agreement with Sepsa Society, with the aim of enabling the easy accessibility of a site having a great natural and cultural value, such as the archaeological park of Cuma. The station is a true multi-purpose center; inside, in fact, there are rooms available for educational activities, lectures, visual pathways, as well as a guesthouse that can accommodate researchers and naturalists. Coming down from the Circumflegrea station, or along the dirt road leading to the entrance of the Forest, you still cannot imagine what you will find in the woods: much more than books, because the trees, ponds and nature will teach, allowing themselves to experience, things that no teacher can teach. In order to live an unforgettable experience, you first have to be ready to walk, to tread the ground slowly to be able to feel, with all the senses, what the forest has to tell us. In fact, you enter directly in the dense oak forest of the largest surviving forest which, long ago, stretched uninterrupted from Lake Fusaro to the mouth of the Volturno River. The Forest, which now belongs to the State property forest of Campania region, is almost exclusively made up of holms, an evergreen oak, while the area of scrub vegetation looks mainly heterogeneous in terms of species that comprise it and grow there. The very close coast, the dunes, the Mediterranean evergreen forest are in fact an important ecosystem with a delicate balance, so that Cuma beach is classified as a Site of Community Importance (SCI) and is part of the Regional Natural Park of Campi Flegrei, and as such it is subject to special rules of environmental protection.

2. Results and Discussion

For the urban area, Cuma Forest is an element of balance in the ecological function and plays a role of defense of nature and of the microclimate through the system of green areas placed on the edge of the city of Naples, edges that allow the biological connection among the anthropized areas and the external green areas. These functions are enhanced if they are well integrated with the recreational use, footpaths and the defense of the landscape framework referred not only to the decor of the areas of representation but also to the redevelopment of areas of transition with the countryside and the valorisation of buildings and historical and cultural areas. As an urban forest on the edge of an urban area, Cuma Forest comes within the group of agro-forestry biotypes. The enhancement of Cuma Forest represents for the city of Naples the recognition not only of excellence values but also of widespread and identity values, and the renewed policy for the promotion of cultural and natural forestry heritage involved natural, historical, landscape and cultural values able to develop tourism activities, as essential resources for the quality of life of the population being substantial for the urban economy. In this regard the Department of Agriculture of the Campania Region, Division of Naples Forestry, is organizing a program of eco-days to promote knowledge and fruition of this green area through many different activities, in collaboration with experts from cultural Associations and Unions, the exhibition by the suggestive title *the Forest and the Dune*, which proposes to the society to spend guided eco-tours At the discovery of the forest, its ecosystem, its biodiversity; as an example, the excursion on the coastal dune of Cumae looks like a path midway between earth and sea at the foot of the ancient lighthouse of the Roman harbor; in a pristine environment you can observe the undisturbed action of the wind on the landscape and the ilex forest can be visited by taking advantage of illustrations of flora and fauna as well as ecological features of the site and participating in multi-sensory and landscape interpretation activities. For children, it is proposed a fun way to learn and discover the secrets of the forest and its various environments through treasure hunts, eco-walks in the reconstructed prehistoric nature, adventure trails, and even lovers of theater and music will find reasons to come to the forest and follow interesting events which, in a so extraordinary natural context, become unique moments. Cuma Forest is still worth a visit even without special events; so even thought Guido Piovene, one of the most respected journalists and writers of the '900, who, during his *Viaggio in Italia* (*N. of T.: Trip to Italy)* wrote, "But Cuma is different from everything. Cuma is one of the highest places in the world, and if I were to direct a hurried traveler to know only three or four places of Italy, I certainly would include Cuma".

To experience Cuma Forest is a great opportunity for kids and for older people: it is an ideal opportunity to explore nature and the land in a different way to look at reality with open and curious eyes, to live unique experiences and acquire new knowledge.

The primary objective of the Department of Agriculture together with the Forestry Sector of Naples is to suggest to the lovers of natural beauties to explore new trails at the discovery of the forest in Campania.

7. AKNOWLEDGMENTS

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Woodland Ecosystem Services evaluation of Marecchia river basin (Italy)

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Summary

Ecosystem goods and services are essential to maintaining a healthy economy and liveable communities.

The aim of this paper is to analyze and classify woodland ecosystem services of Marecchia river basin in central Italy, to assign economic values to benefits derived from some ecological functions of the forests and finally how operating governmental instruments (e.g. Rural Development Plan, Environmental Action Plan.) that can allocate financings for projects focused on ecosystem services management approach (water protection, forestation, etc.).

The woodlands ecosystem services assessed relate to four aspects: soil protection, water regulation and purification and CO_2 fixation.

This paper provides a monetary valuation of these services by using replacement cost and avoided cost methods and how protected areas can contribute to maintain ecosystem services.

The study highlights the relative weight of some indirect values of woodland that can be compared with direct use values and which are at least the same as firewood production value.

Our work can contribute to the management of the woodland in maintaining ecosystem services.

Keywords: Ecosystem services, woodland, economic valuation, water cycle, carbon storage, soil protection

1. Introduction

Natural capital stocks and ecosystem services directly and indirectly contribute to human welfare (Costanza, 1997), however, these services are not well recognized and they are not automatically reflected in market prices.

This work aims to valuate some woodland ecosystem services based on the Total Economic Value concept (Cavatassi, 2004; Pearce, 2001) which contains the full range of economic forest use and non-use values linked to all different goods and services provided by forests.

Despite the opportunity of providing timber, food and other wood forest products (WFPs), the most important functions of forest ecosystem are maintaining the biological, geological, chemical and hydrological cycles; maintaining species and genetic diversity, purifying environment and preserving air quality.

This approach can be used to assess different development scenarios or management actions in which a sustainable use of natural resources allows maintenance of critical natural capital responsible for important environmental functions and which cannot be substituted by manufactured capital (Ekins et al., 2003). The study area is Marecchia river basin mainly located in the southern part of the Emilia Romagna Region.

2. Methodologies

4 ecological services provided by woodlands and different evaluation methods are considered in this paper (Tab. 1):

- water cycle as water regulation, supply and purification;
- soil protection as prevention of soil erosion;
- carbon sequestration.

Table 1. Categories of woodland ecosystem services, evaluation indicators and their assessing methods.

Category	Ecosystem Services	Evaluation method	Indicator	Formula and specification on parameters	References
Water	water regulation	avoided cost/ direct market price	woodland annual value of water regulation	cost for unit volume of water (€/m^3) **X** woodland area (ha) **X** Runoff (mm) (Precipitation-Evapotranspiration)	Xue and Tisdell, 2001; Hao et al., 2008
	water purification	avoided cost	woodland annual value of water purification	cost of water purification (€ /m^3) **X** woodland area (ha) **X** Runoff (mm) (Precipitation-Evapotranspiration)	Hao et al., 2008
Soil	soil protection	replacement cost	woodland annual value of soil fixation	erosion difference between woody land and non woody land **X** woodland area (ha) **X** cost for digging and transporting unit volume of earth cube (€ /m^3)/soil unit weight g/cm^3	Hao et al., 2008
CO_2	CO_2 storage	emission permit price	woodland annual value of CO_2 storage	CO_2 fixation capacity of woodland typology (tCO_2/ha) X CO_2 avoided value (€/tCO_2)	Goio et al.,2008; Guo et al., 2001; Xue and Tisdell, 2001;

2.1 Water regulation and purification

Forested watershed captures and stores water thus contributing to the quantity of water available and improving water quality by stabilizing soils and filtering contaminants. The complexity of the hydrologic cycle can be reduced to a simple formula in which runoff is the difference between precipitation input and evapotranspiration loss to the atmosphere (Bonan, 2008).

The average price for a unit (1 m^3) of water storage capacity and purification was obtained by local water administrator fees (Tab.1).

2.2 Soil protection

The functional value of soil protection is estimated by the economic loss arising from soil loss if erosion occurs (Mahmoudzadeh et al., 2002). The total amount of soil loss can be estimated by the erosion difference between wooded land and non-wooded land. The total amount of soil loss in the study area (Rusco et al.,

2009), multiplied by the woodland area, represents a reduction of erosion because the woodland exists in river basins (Xue and Tisdell, 2001).

This value is multiplied by average soil unit weight and cost for transporting and restoring unit volume of soil (Tab.1).

2.3 CO_2 fixation

Forests play an important role in capturing carbon (IPCC, 2007). According to the Kyoto Protocol, to reduce the emission of greenhouse gases the emission of carbon dioxide by anthropogenic activities is estimated together with the carbon stored in the vegetation.

The emission of a ton of carbon has direct value that could be gained by trading carbon credits determined in the domestic or international market (e.g. European Union Emissions Trading Scheme). Using this approach, the value of a sequestered ton of carbon is equal to the damage avoided by not releasing the ton of carbon into the atmosphere (Stern 2007). The carbon is stored in various pools in an ecosystem: IPCC (2003) identifies living biomass (aboveground and belowground biomass), dead organic matter and soil organic matter. Annual CO_2 fixation increase of aboveground biomass is described as following equation,

$$CO_2 \text{ aboveg} = VOB \times WD \times BEF \times CF \times 3{,}67 \qquad [2.3.1]$$

VOB= per-hectare volume of trees in cubic meters;

WD= wood density of trees (dry biomass per unit of tree volume);

BEF= ratio of total above-ground dry biomass to dry biomass of inventoried volume;

CF= ratio of elemental carbon from mass to dry biomass (IPCC-average value of 0,5);

Average growth (m^3/ha) of woodlands studied and basic wood density are also used with a root/shoot parameter (R) to calculate belowground biomass (Federici et al., 2007).

$$CO_2 \text{ beloweg} = VOB \times WD \times R \times CF \times 3{,}67 \qquad [2.3.2]$$

CO_2 sequestration of dead organic matter and soil organic matter were estimated considering the percentage of CO_2 sequestration in different pools in the study area according to the Italian Greenhouse Gas Inventory 1990-2007 (Romano et al., 2009) as shown below:

- living biomass: 43%;
- soil: 48%;
- dead organic matter: 9%.

Forest CO_2 storage is a part of CO_2-related avoided cost. Some authors (ENCAP, 2005; Fankhauser, 1995; Goio et al., 2008) use an emission permit price of 20 €/ton CO_2.

2.4 Governmental Tools in ESs Management

We analyzed Rural Development Plan (2001-2006) and Environmental Action Plan (2002-2003) at regional scale to understand how they allocate financings for projects focused on reforestation and water regulation.

3 Results and Discussion

3.1 Economic values

The economic values of water conservation and purification, soil protection and carbon sequestration were estimated at 136.4 million Euro/year and according to some authors (Hao et al., 2008; Merlo and Croitoru, 2005) the greatest value was for water regulation and purification.

Protected areas (about 5000 ha) in Marecchia river basin provide for a value of about a third compared to total value.

Direct economic values include the benefits derived from timber or firewood which can be considered ecosystem goods. About 70% of the woodlands in the study area is managed as coppice and based on an estimate of 70 ton/ha (INFC, 2009) of timber production and a firewood price of 150 €/tonne (elaborated from Regione Marche, 2010) direct wood products value was estimated at 150 million Euro/year. Results are presented in Tab.2.

Tab. 2- Economic values of the woodland ecosystem services of the Marecchia river basin.

Type	**Ecosystem services**	**Value (Million €/y)**	**Value (€/ha y)**
Direct value	Firewood	**150**	10 507
Indirect value	Water regulation	91	4458
	Water purification	33	1605
	Soil protection	5.1	249
	CO_2 fixation	7.3	6670
Total indirect value		**136.4**	

3.2 Value of water regulation and purification

According to provincial administration data (Didero et al., 1990) the average runoff water conserved by the woodlands was estimated in 446 mm/y in Marecchia river basin.

Using the average price for 1 m^3 of water storage capacity as € 1/m^3 (HERA Pers. comm., 2008) water conservation value was estimated in 91 million Euro/y for water regulation as described in [2.1.1] and shown below:

$$Wr = 1\ (€/m^3) \times 20\ 396\ (ha) \times 445.8\ (mm) = 91\ Million\ €/y$$

Cost for a unit volume of water purification is obtained by local water administrator fees. It is € 0.4/m^3 (2008) and the total value for water purification service as expressed in [2.1.2] it is about 33 million Euro/y.

$$Wp = 0.4\ (€/m^3) \times 20\ 396\ (ha) \times 445.8\ (mm) = 33\ Million\ €/y$$

The importance of this study area, is linked to the development of coastal tourism. In the Province of Rimini, water consumption is strongly influenced by the change in population during the summer period: from about 300 000 residents (in the entire province) to about 15 million people from June to September, who demand a higher quantity of drinking water.

3.3 Value of soil protection

Assuming an average soil unit weight of 1.4 g/cm^3, the total amount of soil loss was estimated at 10 tonnes/ha per year for cropland and in 0.5 tonnes/ha per year for wooded land (average value derived from Rusco et al., 2009). This value can be multiplied by the cost of transporting and restoring unit volume of soil (Tab. I) estimated at € 41/m^3 (Regione Marche, 2010) as the relation [2.2.1] shown below:

$$Sp = 20\ 396\ (ha) \times 41(€/m^3) \times (10-0.5)(tonnes/ha)/1.4\ (g/cm3) = 5.1\ Million\ €/y$$

3.4 Value of CO_2 fixation

As described in [2.3.1 and 2.3.2] annual carbon sequestration of aboveground and belowground biomass (living biomass) was estimated about at 3.2 million Euro/y.

According to the Italian Greenhouse Gas Inventory, about CO_2 sequestration of dead organic matter and soil, total value of CO_2 storage was composed by different pools and it was estimated at 7.32 million Euro/year for the Marecchia river basin.

3.5 Governmental Tools in ESs Management

Rural Development Plan and Environmental Action Plan, at present, are not managed on the basis of the environmental, social and economic benefits given by the Ecosystem Services of the area concerned by the financed projects, because there is a lack of a coherent integrated strategy which addresses the ecosystem as a whole.

Indeed Environmental Action Plan (2002-2003) includes a contribution only of € 3 300 for actions located in urban areas while Rural Development Plan (2001-2006) provides a contribution of over € 90 000 for reforestation and natural and semi natural habitat conservation.

3.6 Discussion

This study applies a method for valuing some indirect use values of ecosystem services provided by woodlands and compare them with direct use. In decision making processes, it is necessary to give adequate weight to the natural capital stock that produces these services and increase mechanisms of economic compensation for the people who conserve ecosystem functions. If such values are left out of policy analysis, resulting policy will tend to overestimate the role of direct-use values (e.g. firewood), and underestimate the role of indirect-use values (soil protection, water regulation and carbon sequestration).

Even if not all components of indirect value are considered at this level of the research, we can confirm that direct use (e.g. timber, firewood) and ecological functions of woodlands have at least about the same value and in a geo-morphological context like the Marecchia river basin, forests conservation represents a tool to flood protection and water storage and retention.

This approach can help sustainable management of the forest, suggesting, for example, the transformation of a stock of deciduous trees into natural woodland to store carbon and to conserve biodiversity while maintaining wood forest products (firewood, timber for trade, etc.).

Quantifying ecosystem services in a spatially explicit manner, and analyzing tradeoffs between different management directions (i.e. Protected areas creation, conservation planning, soil consumption), can help to make natural resource decisions more effective, efficient, and defensible.

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A report on Italian *ex situ* conservation of plant biodiversity

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Summary

As a contribution to the International Year of Biodiversity, more than 235 researchers in Italy have worked together to assess and describe Italian ex situ biodiversity conservation of wild and cultivated plants, including forest species. The results of the work have been published in a 200 page report, available online.

The status of germplasm collections and germplasm banks (or other facilities for biodiversity conservation) were considered in the document, together with topical items like biodiversity and climate change, biodiversity and food, biodiversity and invasive species and costs of biodiversity conservation. State of the art technology, constraints and actions needed were reported for each subject considered.

The paper shows that, in most cases, critical situations are quite specific: for example the need for national legislation to preserve native plants; the incomplete implementation of existing legislation to better protect the forest sector; the lack of cryopreservation techniques for parts of the plant other than seeds, for species under threat of extinction or the financial constraints in the field of germplasm conservation. On the other hand, a number of problems are common to all sectors: lack of funds, insufficient coordination of activities and programmes within institutions, the need for shared protocols in many basic activities like germplasm collection, germination tests, seed storage, data management, etc. Even though a National Biodiversity Strategy has been launched in 2010.

The Institute for Environmental Protection and Research, ISPRA (Istituto superiore per la protezione e la ricerca ambientale), has coordinated this effort and has published the results in a document entitled: "La conservazione ex situ della biodiversita delle specie vegetali spontanee e coltivate in Italia", which can be downloaded from the ISPRA website (www.isprambiente.it/site/it-IT/Pubblicazioni/Manuali_e_linee_guida/Documenti/manuale_54_2010.html).The report has also been posted on the Convention on biological diversity website, on the 2010 International Year of Biodiversity page: www.cbd.int/2010/prints.

Keywords: biodiversity conservation, ex situ conservation, wild species, cultivated species, forest species

1. Introduction

The importance of *ex situ* conservation of biodiversity is established by article 9 of the Convention on Biological Diversity (CBD). Major documents like the EU Biodiversity Strategy to 2020 and the European Strategy 2008-2014 for Plant Conservation support such a concept. It needs to be emphasize that *ex situ* conservation is a complement to, not a substitute, for *in situ* conservation.

Current scenarios predict dramatic biodiversity losses, ranging, for example between 12 and 15% of the species of vascular plants by the year 2050. FAO report on Climate change and biodiversity for food and agriculture (2008) as well as other influent papers remark that *ex situ* conservation as an effective action to reduce the negative effects of climate change on ecosystems and biodiversity. ISPRA, in cooperation with

RIBES (National Italian Network to Improve Seed Conservation of Wild Native Species), BIOFORV (Forest Biodiversity and Forest Nurseries Italian Working Group), MIPAAF (Ministry of Agricultural, Food and Forestry Policies, Italy), MATTM (Ministry for the Environment, Land and Sea, Italy), CFS (State Forestry Corps, Italy), CNR (National research council, Italy), CRA (Agricultural Research Council, Italy) and University of Perugia (Italy), has coordinated a survey addressed throughout the Italian country to assess and describe Italian *ex situ* biodiversity conservation of wild and cultivated plants, including forest species: state of the art, weak topics, priorities, actions needed.

2. Methodologies

In order to assess and describe Italian *ex situ* biodiversity conservation of wild and cultivated plants, a call to participate in the report building was posted (2009) in the ISPRA website, this was followed by two operative meetings. The rest of the work was performed thanks to email exchanges and the use of an on line workspace. Collection and processing of information was based on the Countdown 2010 principles: scientifically-based data, transparency, autonomy, subsidiarity.

Scientifically-based data were wilfully provided by 235 researchers from 80 universities and research institutions that enabled to prepare a final strongly-shared and representative document on *ex situ* conservation of biodiversity in Italy while transparency was reached through the on line open invitation to all workers willing to participate as well as through the on line workspace used by authors to interact and to discuss during the work in progress.

There was a coordinator for each of the specific groups of plants (forest species, fruit species, ornamentals, etc) who interacted with an ISPRA coordination team.

3. Results and Discussion

The outs of the survey were published in the ISPRA handbook (Piotto et al., 2010) in which *ex situ* biodiversity conservation in native and cultivated plants, including forest species, is focused. Further to the specific groups of plants (forest species, ornamentals, cereals, etc) a number of related topics (role of botanical gardens, conservation facilities, relationship between *in situ* and *ex situ* conservation, etc) were considered as well.

A number of problems are common to all sectors: lack of funds, insufficient coordination of activities and programmes within institutions, the need for shared protocols in many basic activities like germplasm collection, germination tests, seed storage, data management, etc.

Forest species were divided in four sub-groups for a better comprehension of their specificities: conifers, broadleaves, shrubs and introduced species used in arboriculture. Main concerns and needed actions regarded the availability of funds; knowledge and know how; organisation, coordination and communication; conservation facilities as well as policy, regulations and rules.

From the many complaints and proposals, only a few of them are hereby listed:

Conifers and Broadleaves. The complete implementation of existing legislation (D. Lgs. 386/2003 “Attuazione della direttiva 1999/105/CE relativa alla commercializzazione dei materiali forestali di moltiplicazione”) is needed to better protect the forest sector. For better conservation policies, coordination and communication between forest sectors of Italian Administrative Regions need improvement. A good knowledge of germplasm banks management and activities is lacking. Exchange of data and information is not frequent, a kind of centralisation of the produced knowledge should be extremely useful. It should be useful to enhance links between public sector, research and private nurseries to improve quality and biodiversity conservation. Natural stands of *Populus alba, P. nigra* and *Q. robur* in the Po valley are at risk:

a strong *ex situ* conservation programme is needed to support the poor *in situ* conservation. Evaluation of the costs of policies inaction are needed (for example the case of not meeting the 2010 biodiversity target).

Shrubs. The relationship between *in situ* and *ex situ* conservation needs to be well described. Existing *in vivo* collections need to be supported by in vitro conservation, cryoconservation and DNA banks. On farm conservation has to be encouraged. Genetic diversity of main shrubs has to be assessed. Germplasm collections are poor for this sector and need to be enlarged. At national level, shrub species are not admitted to certification: this allows the introduction of non-native species which could be invasive.

Introduced species. Citizens have to be informed properly and with neutrality about introduced species to avoid alarm, however risk assessment procedures are strongly needed to determine their level of invasiveness.

ISPRA has coordinated this effort and has published the results in a document ("La conservazione *ex situ* della biodiversita delle specie vegetali spontanee e coltivate in Italia") which can be downloaded from the ISPRA website (www.isprambiente.it/site/it-IT/Pubblicazioni/Manuali_e_linee_guida/Documenti/manuale_54_2010.html). The report has also been posted on the Convention on biological diversity website, on the 2010 International Year of Biodiversity page: www.cbd.int/2010/prints.

This first report on Italian *ex situ* conservation of plant biodiversity is expected to be useful to the scientific sector, that could also continue updating and completing information, and may be considered as a tool to help policy makers in their decisions.

4. Aknowledgments

RIBES (National Italian Network to Improve Seed Conservation of Wild Native Species), BIOFORV (Forest Biodiversity and Forest Nurseries Italian Working Group), MIPAAF (Ministry of Agricultural, Food and Forestry Policies, Italy), MATTM (Ministry for the Environment, Land and Sea, Italy), CFS (State Forestry Corps, Italy), CNR (National research council, Italy), CRA (Agricultural Research Council, Italy) and University of Perugia (Italy) for their contribution to the Italian report on *ex situ* conservation of native and cultivated plants.

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