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Monitoring Plan LIFE+ 11/NAT/IT/135

Maggio 2013

1. General concepts

The general goal of the monitoring plan is to design and implement a sampling strategy to highlight and quantify the effects of the concrete conservation actions carried out in project areas (Actions C) on forest structure and biological diversity, assessed under Actions A1 and A2.

In order to meet this objectives, the monitoring plan has been designed according to the following steps:

1. Preliminary spatial localization of the range of occurrence of target tree species (*Abies alba*, *Taxus baccata* and *Ilex aquifolium*) within beech dominated forest stands, in the intervention areas proposed in the project proposal; as target species do occur as sporadic/rare species in Natura 2000 Habitats 9210* and 9220*, in order to optimize sampling effort it is necessary to distribute sample plots where the probability of occurrence of these target species is higher;
2. spatial layout of sampling units in the areas above according to a sampling scheme and definition of sampling protocols for the collection of data on forest structure and on the composition and diversity of several taxa related to forest structure and management (vascular plants, epiphytic lichens, saproxylic beetles, saproxylic fungi and birds)
3. BACI approach to evaluate the effects of the concrete conservation actions carried out in project areas on biological diversity.

The spatial localization of *target* forest stands has been performed in the two National Parks *making the most of available information* on target species distribution in the two National Parks.

In Cilento e Vallo di Diano National Park (PNCVD) a previous research project ("Monitoring the old-growth forests network of the Cilento and Vallo di Diano National Park") focused on forest biodiversity established a monitoring network in the National Park using a systematic sampling grid, with sample plots located at the grid nodes of 500 × 500 m cells. Tree species composition data provided by this project was therefore analyzed to select, within project intervention areas, plots with the presence of target species, as further detailed on § 2. This *conservative approach* is justified by the need to optimize the use of an already established systematic spatial layout of sampling units (materialized in the field as permanent sample plots) also in view to enable, in the future, multitemporal analysis of biodiversity data on forest structure and composition.

In Gran Sasso and Monti della Laga National Park (PNGSML) and in the project area on Monte Motola within the Teggiano township (PNCVD), instead, no georeferenced data on target species occurrence was available at the start of the project. Therefore, a field survey was performed for the spatial localization of the range of occurrence of forest stands with the presence of target species in project intervention areas (see § 3). The localization of sampling points follows a tessellation stratified sampling design: the set of sample points was extracted using a 100 km square grid, for a total of about 19 geo-referenced points randomly located in square cells and fully covering the range of occurrence of target species observed within project intervention areas. This sampling design ensures the number of sampling units to match initial project proposal, but calibrated to the size of the actual range of occurrence of target species within project intervention areas.
As a result, the total number of sampling units selected in the two National Parks are in line to initial project proposal, i.e. 14 in PNCVD and 19 in PNGSML. The exact spatial location of sampling points is showed in §§ 2 and 3.

The monitoring plan will follow a BACI approach (Before/After, Control/Intervention) widely used in restoration projects and based on the comparison of the areas subject to concrete actions with areas left in their original status, before and after the interventions. The sampling performed in the Actions A1-A2 will provide the data to assign the 33 sampling units to reference, interventions, control areas based on the outcomes of the analysis performed under Action A3. The tentative number of monitoring plots to be distributed between reference, control and intervention areas in the two national parks is specified in § 3, Table 2.

The stands including the tartget species and with the highest levels of biological diversity and structural heterogeneity, will be used as *references* for the *interventions*. Analysis of the data collected in the assessment of forest and biodiversity levels will be also used to select *control areas* and *interventions areas* that should have comparable abiotic conditions, structural features and vegetation type.

The BACI approach coupled with the sampling strategy ensures a way quantify on an experimental basis, through the repeated monitoring of indicators in monitoring plots, the effects of the concrete conservation actions carried out in project areas.

2. PNCVD

a. Analyses of the existing data and selection of the monitoring areas

In the PNCVD a great body of data exist from previous projects. The data included in these dataset relative to the project areas were selected and analyzed with the aim of defining the monitoring protocol for the PNCVD.

For the SCI Alburni, where the habitat 9210* occurs, the plots were Taxus baccata and Ilex aquifolium was sampled were highlighted (Fig. 1, 2).

In the area within the township of Ottati eight monitoring areas already exist, of these two are characterized by the presence of both *Taxus baccata* and *Ilex aquifolium* and are located in the northern part of the intervention area, while *Taxus baccata* alone occurs in two monitoring areas, and *Ilex aquifolium* in three areas. In one of the monitoring plots none of the two target species occurs.

Based on these data, the existing monitoring areas resulted to fit the objectives of the FAGUS Life Project, and especially the areas in the northern part (plot ID 80-101) will likely be used as reference areas. Indeed these areas not only display the occurrence of both the target species but they are also by a relatively high degree of structural heterogeneity (high number of DBH classes with the occurrence of large living trees (see Tab. 1). Control and intervention areas will be defined according to the compositional and structural data collected during the ex-ante monitoring phase (action A1).

In the project area included in the township of Corleto Monforte all the existing monitoring areas resulted to include both the target species for the habitat 9210* (Fig. 2), therefore they are well suited for the projects aims. Of these four monitoring areas three will be selected in order to allow for a monitoring scheme that includes a reference plot, and a control/intervention pair of plots. On the other hand in the Motola project area three instead of four monitoring plots will be sampled in order to allow for a similar monitoring scheme. The three areas of the Project area of Corleto Monforte are those with the IDs 171, 184 and 194 (Fig. 2) in the forest monitoring network of the PNCVD, based on the occurrence of deadwood and of Large Living Trees (see Tab. 1).

Township	Idpunto	n° DBH classes	DBH range	n° trees DBH > 40 cm	Snag volume	Standing dead tree volume	Stump volume	CWD volume
Ottati	80	12	62	12	0	0	0	0.4
Ottati	90	8	40	1	45.4	35.6	0	0
Ottati	100	5	51	1	1.1	23.9	0	0
Ottati	101	10	51	4	0	0	0	0.6
Ottati	68	5	23	0	28.1	54.6	0	0
Ottati	69	5	54	1	40.5	43.4	0	0.1
Ottati	79	5	22	0	45.9	58.5	0	0
Ottati	91	6	62	1	34.4	0	0	1.7
Corleto	171	10	44	20	0	48.1	0	0
Corleto	184	8	113	13	205.3	0	0	0.2
Corleto	185	10	46	5	0	0	0	32.1
Corleto	194	12	57	10	0	0	0	0

Table 1. Indicators of structural heterogeneity for the monitoring plots of the Alburni SCI.

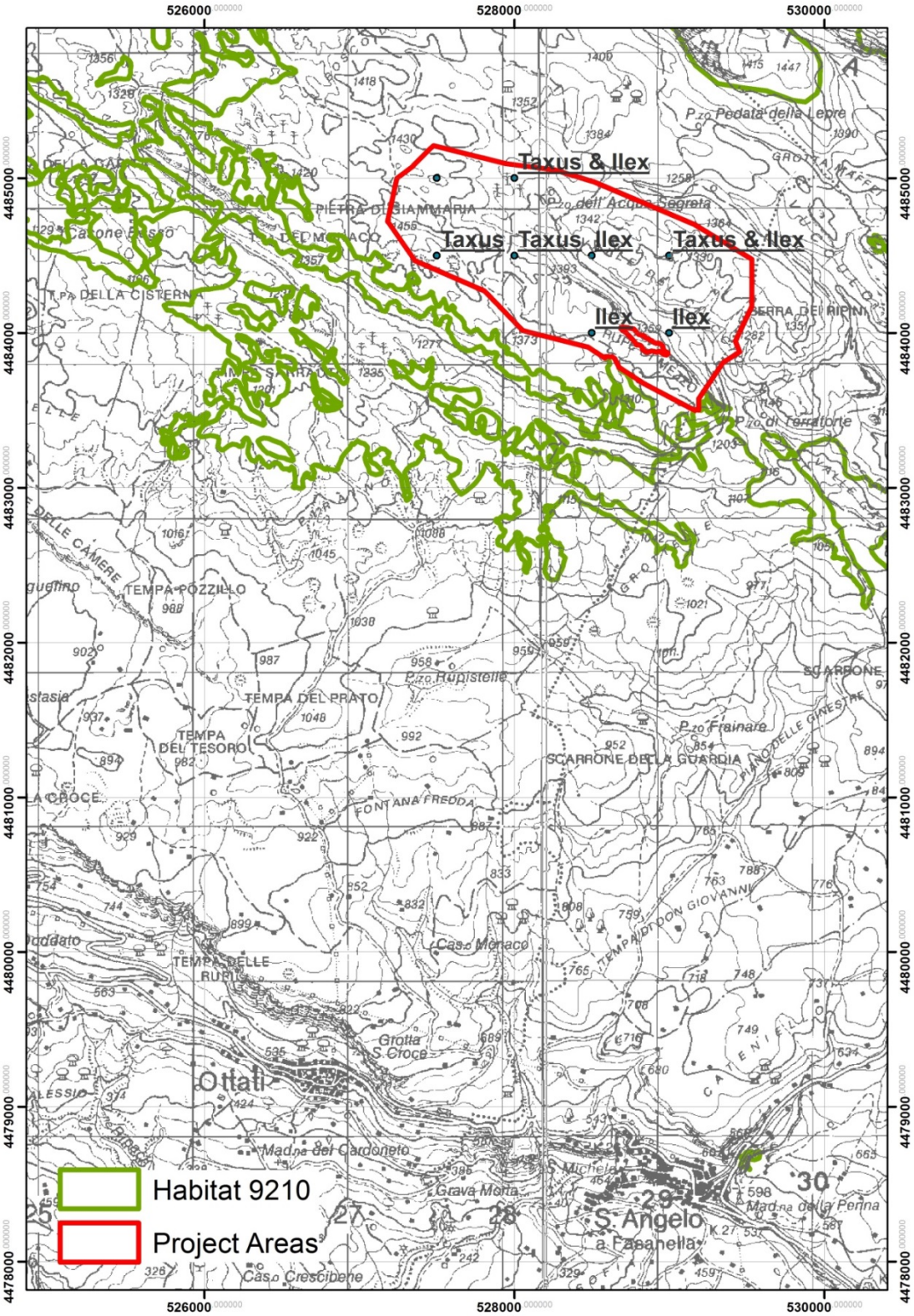
For the Motola project area data exist on the occurrence of Abies alba in the beech forest. In particular we analysed a phytosociological dataset and highlighted the relevès characterized by the mixing of these two species that fall within the project area. For this area, that is limited in size (only 28 ha), we used the same monitoring scheme as for the areas within the PNGSML, since its extent is in the same order of magnitude of the areas of interest identified in the PNGSML. A 100 meters grid was created and in each cell close to where the target species (in this case *Abies alba*) was reported a random point was selected.

Layouts of the monitoring areas for the PNCVD

Figure 1. Location of the existing monitoring areas in the project area included in the township of Ottati (the labels indicate the occurrence of the target species for the habitat 9210*).

Figure 2. Location of the existing monitoring areas in the project area included in the township of Corleto Monforte (the labels indicate the occurrence of the target species for the habitat 9210*).

Figure 3. Location of the monitoring areas for the project area included in the towship of Teggiano located in the part of the project area where the occurrence of Abies alba was verified.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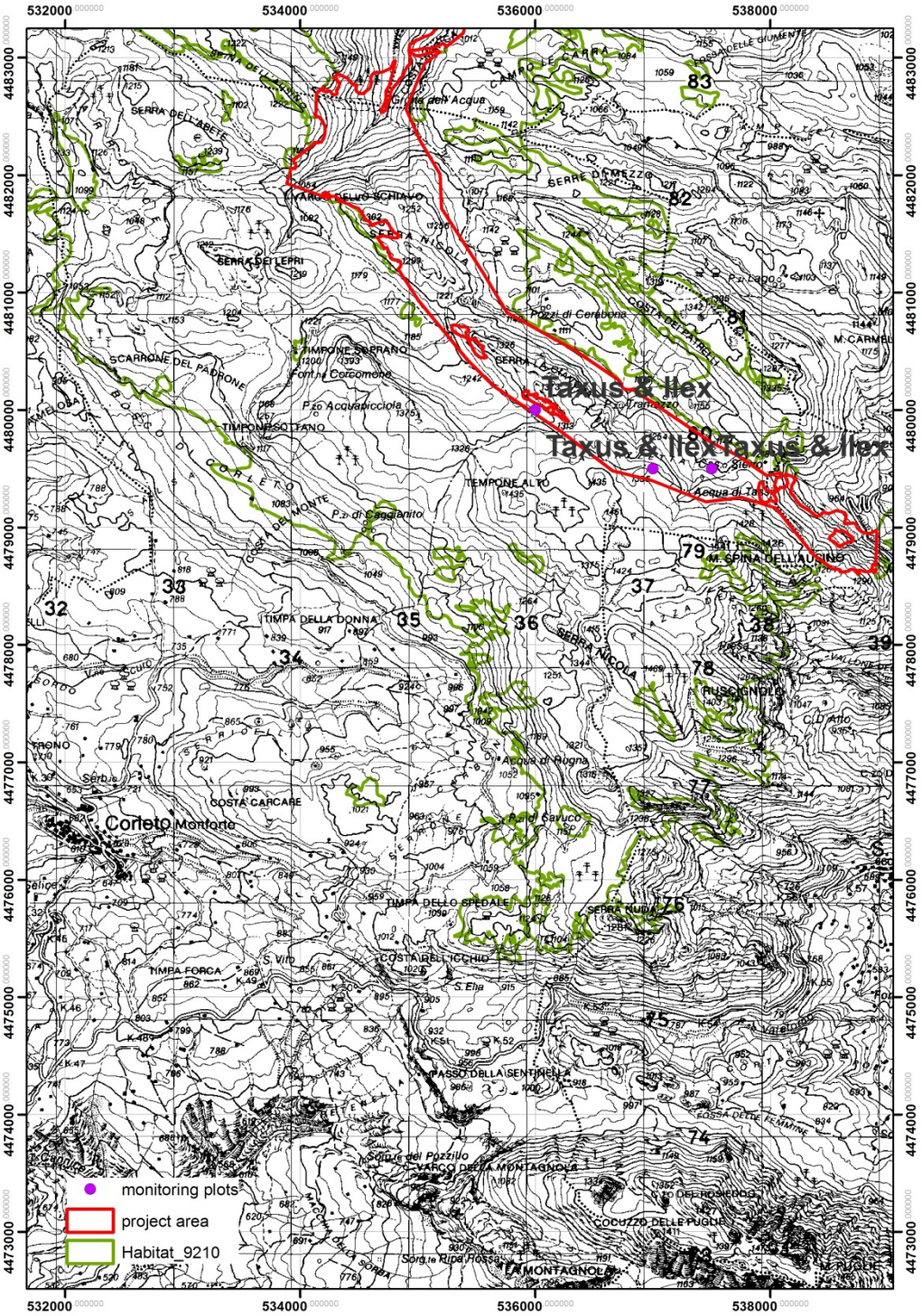
P.zo Podata della Lepre
P.zo dell'Acqua Segreta
P.zo di Terratorte
P.zo Rupistelle
P.zo Frainare
TEMPA POZZILLO
TEMPA DEL PRATO
TEMPA DEL TESORO
TEMPA DELLE RUPI
SCARRONE DELLA GUARDIA
SCARRONE
FONTANA FREDDA
Casa Monaco
Grotta S. Croce
Ottati
Mad.na del Cardoneto
Grava Monta
S. Angelo a Fasanella
Mad.na della Penna
Casa Crescibene
Habitat 9210
Project Areas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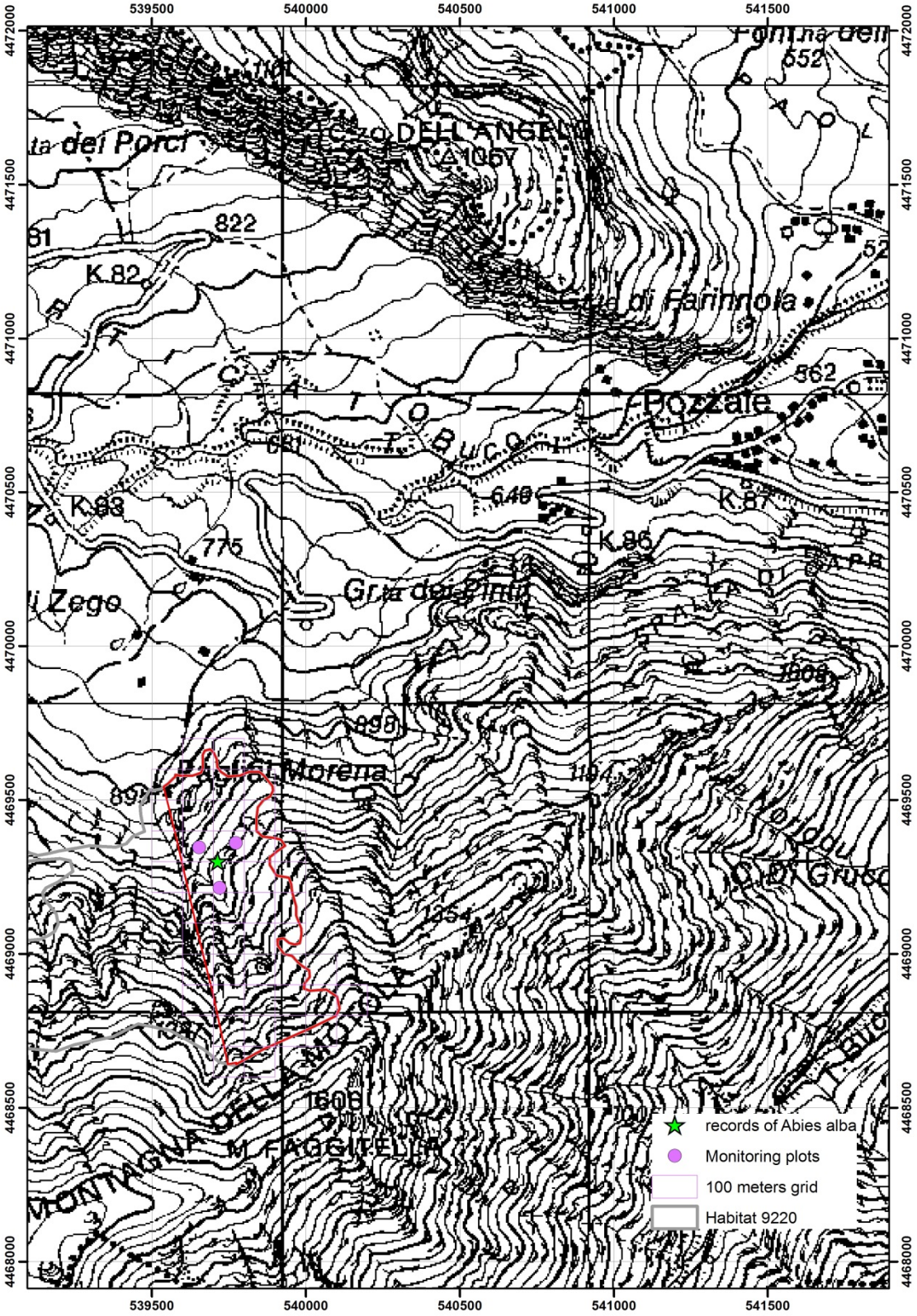
Taxus & Ilex
Taxus & Ilex
Taxus & Ilex
Corleto Monforte
monitoring plots
project area
Habitat_9210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Pozzale
Grta dei Pini
Pian Morena
records of Abies alba
Monitoring plots
100 meters grid
Habitat 9220

3. PNGSML

a. Project areas field surveys

During the early spring field surveys have been carried out by the DBA and DIBAF jointly to investigate the three project areas included in the Gran Sasso SCI for which scarce preliminary data existed on the location of the species targeted by the project.

The field surveys were carried out by the DBA and DIBAF with the support of the PNGSML that organized meeting with all the main stakeholders in the days of the field surveys. Especially meetings with representatives of the ASBUC Intermesoli and the ASBUC Pietracamela, respectively Mario Di Giammatteo and Sergio Marchegiani took place, as well as with the representative of the UTB of L'Aquila of the CFS (State Forestry Corps) Bruno Petriccione. Where possible the stakeholders were involved in the field surveys.

During the surveys special attention was paid to the occurrence of the target species for the habitats (Yew, Taxus and Holly) and GPS data were collected to record the presence or absence of the species.

The area that were surveyed with higher intensity are those for which the stakeholders or the staff of the PNGSML knew about the occurrence of the species or those considered more suitable for the conservation actions of the project.

b. Selection of the areas

Based on the data recorded during the surveys areas of interest were mapped within the original project areas taking into account all the information collected. Within these areas a 100 meters grid was created. Indeed due to the limited extent of the area of interest it was not possible to use a 500 meters grid, and a denser grid was found to be more suitable for the project aims (see Fig. 4-5-6).

A slight change in the distribution of the monitoring areas was necessary, since most of the Pietracamela project area was not suitable for the intervention since it was occupied by low density woodland or open areas or was characterized by very steep slopes that would make the interventions extremely difficult.

Therefore we decided to switch the number of monitoring areas between Pietracamela and Incodaro, where the area of interest was much wider.

Therefore the number of the monitoring areas is, as described in the project proposal 19 for the PNGSML and 14 for the PNCVD, though slight changes in the distribution among project areas were defined during the definition of the monitoring plan as synthesized in Tab. 2.

The coordinates of the monitoring plots are given in Appendix 1.

PN	Project area	n° of reference plots	n° of control plots	n° of intervention plots
PNCVD	Ottati	2	2	2
	Corleto	1	1	1
	Motola	1	1	1
PNGSML	Pietracamela	1	2	2
	Intermesoli	1	3	3
	Incodaro	1	3	3

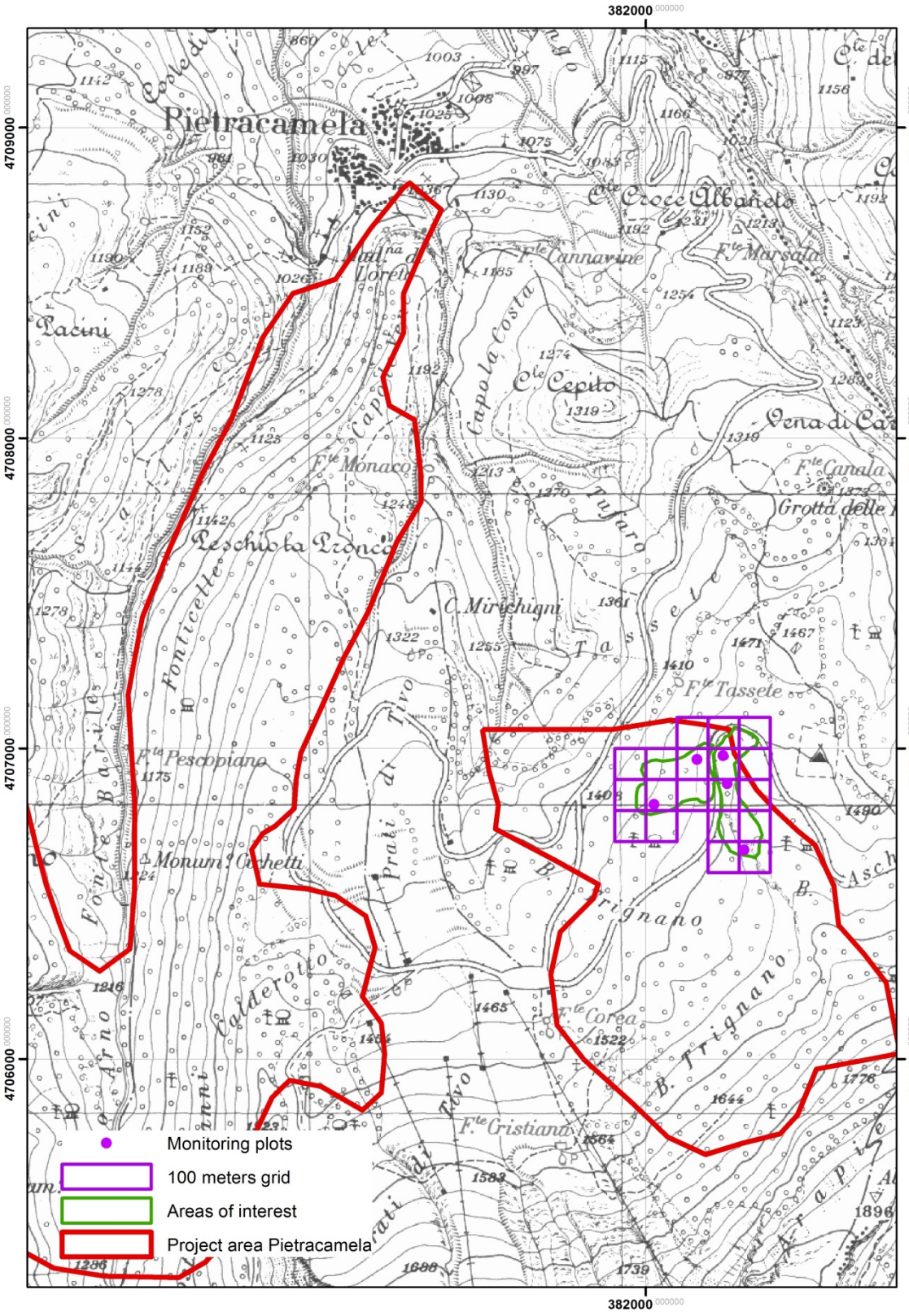
Table 2. Distribution of the monitoring areas in the Project areas as defined by the monitoring protocol.

Layouts of the monitoring areas for the PNGSML

Figure 4. Location of the monitoring plots in the project area of Pietracamela.

Figure 5. Location of the monitoring plots in the project area of Intermesoli.

Figure 6. Location of the monitoring plots in the project area of Incodaro.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4708000
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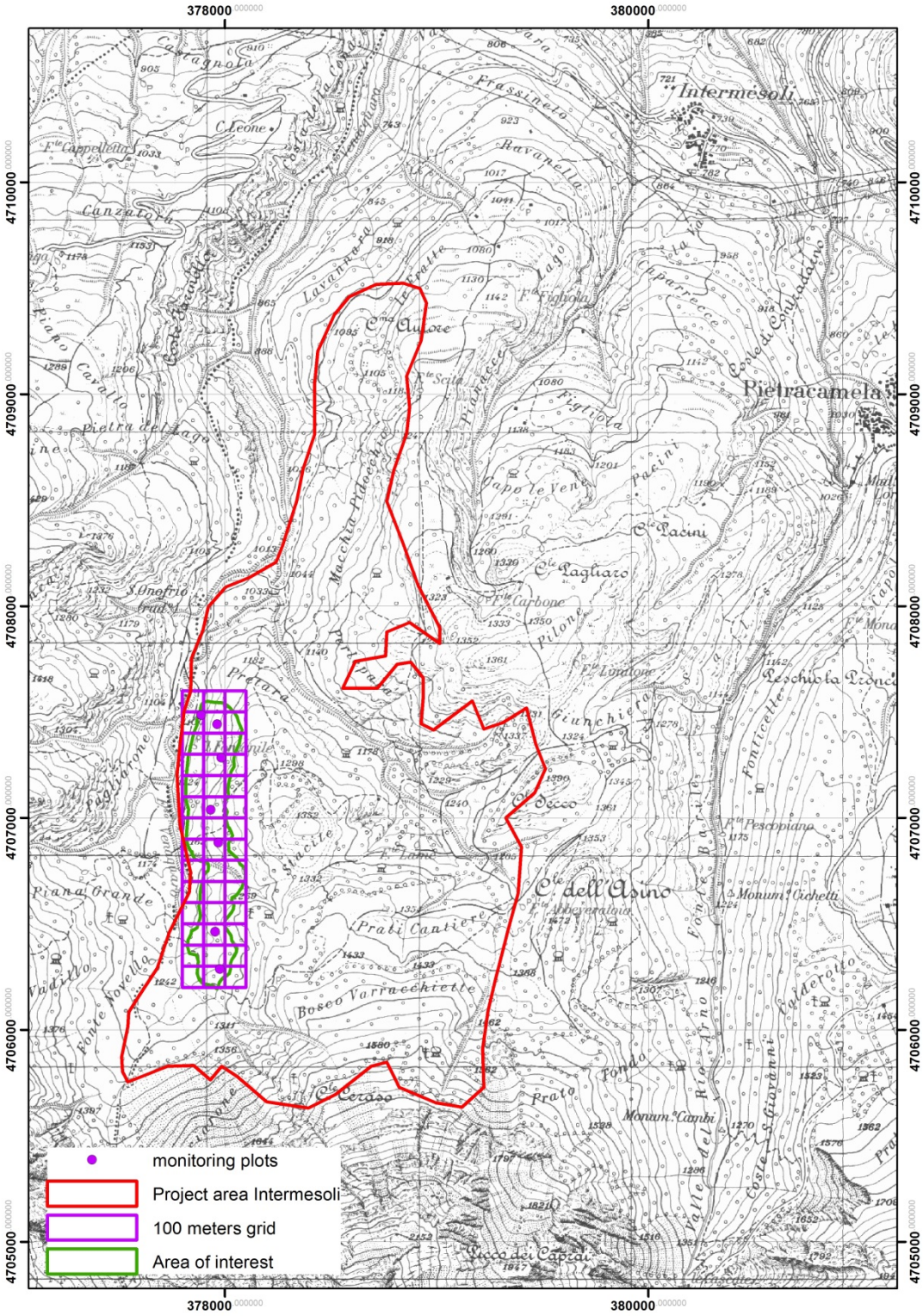
4706000
Pietracamela
Monte Corvo
Pacini
Fonticelle
Peschiola Pronca
Monaco
Capo la Costa
Cepito
Vena di Ca
Canala
Grotta delle
Mirichigni
Tassete
Pescopiano
Monumento Cachetti
Calderotto
Prati di Tivo
Corea
Cristiana
Trignano
Monitoring plots
100 meters grid
Areas of interest
Project area Pietracamela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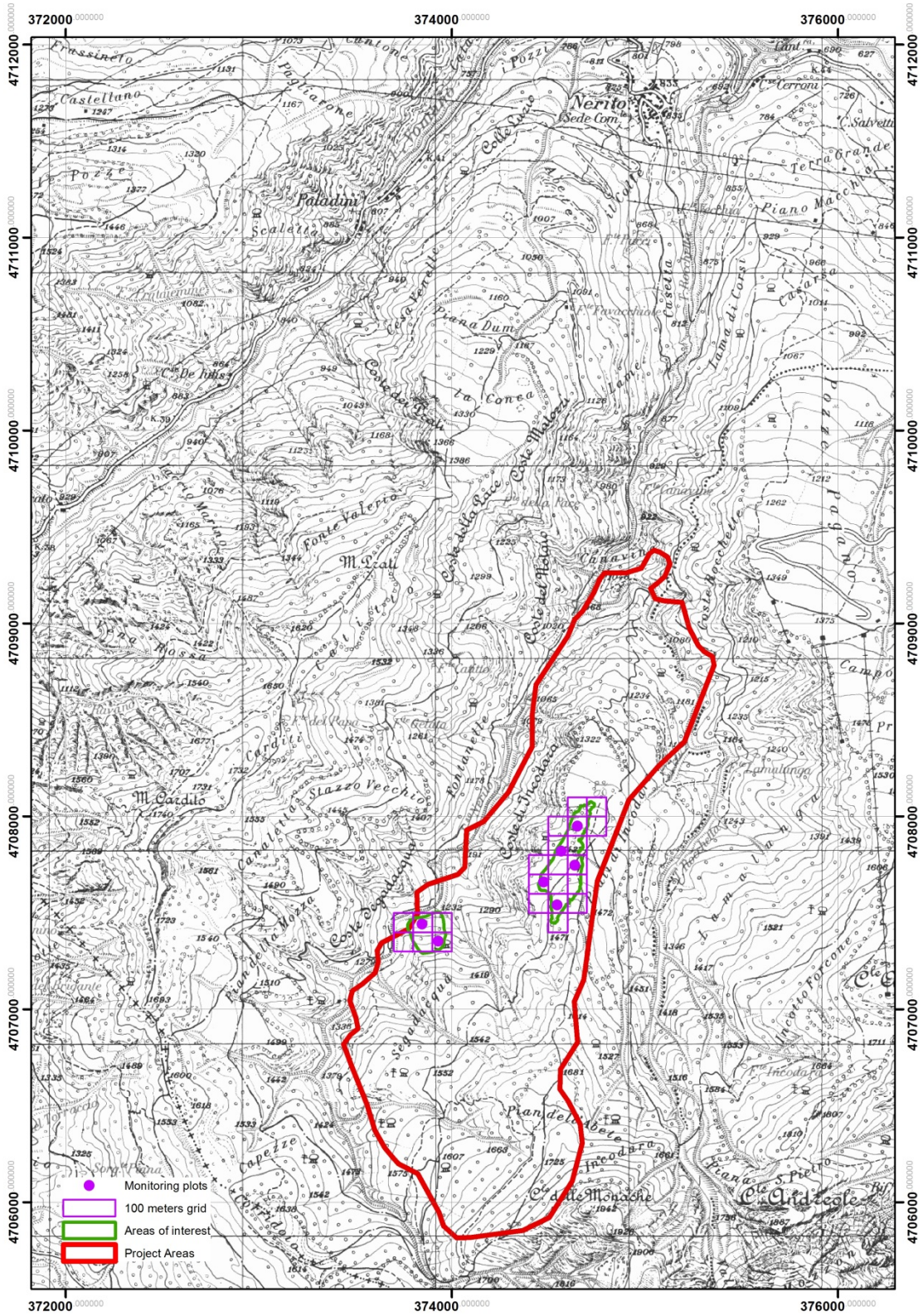
monitoring plots
Project area Intermesoli
100 meters grid
Area of interest


372000
374000
376000
4712000
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4709000
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4707000
4706000
Monitoring plots
100 meters grid
Areas of interest
Project Areas

4. Sampling protocols

The sampling will be performed in circular plots of 20 meters radius with different subunits for each of the investigated taxon or attribute.

The sampling unit for forest structure will include three concentric circular areas of different radius: 4, 13 and 20 meters within which different structural attributes will be measured (see table 1).

The location of the areas will be reached through GPS, and through the use of traditional topographic instruments (compass and measuring tapes).

In the center of each area a metal stake with a metal plaque will be planted in the ground, the coordinates of this point will be recorded with submetric accuracy, through the repeated logging of the position data by the GPS.

In order to allow for the finding of the monitoring areas by the other expert teams, two objects in the immediate proximity of the center (trees or rocks) will be marked with red paint and their distance and azimuth from the center will be recorded.


Examples of the marked points near the center of the sampling units, where positions are being logged through GPS in PNCVD.

Sampling of the forest structure

The forest attributes that will be sampled during the monitoring are aimed at defining the following indicators:

- Diameter distribution;
- Tree species composition;
- Basal area and growing stock;

- Assessment of the quantity and quality of deadwood;
- Management history.

These indicators will be obtained through the sampling of the Attributes listed in Table 3.

Table 3. Protocol for the sampling of forest structure in the monitoring plots.

Attribute	Sampling protocol
Diameter at Breast Height (DBH)	The diameter at 1.3 meters from the ground will be measured for all the trees and shrubs within the three concentric circular areas: in the smallest (radius equals 4 meters) all the individuals with diameter equal or greater than 2.5 cm are measured; in the intermediate area (radius equals 13 meters) all the individuals with diameter of at least 10 cm are recorded; in the largest area (radius equals 20 meters) only the individuals with a diameter equal or greater than 50 cm are measured.
Species	The species name will be recorded for each of the trees or shrubs included in the DBH measurement.
Vitality class and standing deadwood	All the individuals for which the DBH measurement is performed will be assigned a vitality class out of four: • living; • living with senescing parts; • senescing or dead standing tree; • snag (broken at an height greater than 1.3 m).
Origin	All the individuals for which the DBH measurement is performed will be assigned a type of origin out of three: • seed origin; • sucker; • standard.
Height	Height will be measured for at least five individuals out of those whose DBH was measured.
Lying Coarse Woody Debris	In the intermediate sampling area (radius equals 13 meters) all the lying woody debris with minimum diameter equal or greater than 10 cm will be measured. For each piece the diameter at mid-lenght for the part that is within the sampling unit will be measured. For snags two diameters will be measured (at the base and at the upper end, considering only the part with diameter greater than 10 cm). For each piece a decay class out of five will be recorded according to Hunter (1990).
Management history	Presence or absence of recent management evidences (stumps, paths used for timber removal, etc.).

Sampling of biodiversity

Vascular plants

The sampling unit to be used for this taxonomic group will be the larger sampling unit used for forest structure (i.e. radius equals 20 meters).

This sampling will be performed according to species flowering periods, and especially the period of greater flowering will be selected in order to identify the maximum number of species at the species or subspecies level.

In each of the sampled units all the species occurring will be recorded, and a visual estimate of cover will be associated to each species according to a percentage scale in order to have an indication of its abundance and dominance.

Species nomenclature will follow Conti et al. (2005) and recent updates.

For the species that could not be identified in the field, a specimen will be collected and dried. The identification will be performed in the laboratory through use of identification keys (Pignatti, 1982; Tutin et al., 1964—1980, 1993) and comparison with specimens from *herbaria*.

Epiphytic lichens

Epiphytic lichen communities are influenced by several factors whose importance depends on the scale of the analysis, from the tree-level to the biogeographical scale. Forest management mainly acts at the stand level, where stand-age is known to be a key factor influencing epiphytic lichen communities. In order to evaluate the influence of forest management on lichen richness and frequency, the Lichen Diversity Value (LDV) (Asta et al. 2002) will be calculated based on the frequency of the species occurring on the sampling tree in 4 regular grids each made of five cells 10x10 cm in size located on the trunk at 100 cm from the ground according to the four cardinal points. The LDV will be then calculated as the sum of the frequency of each lichen species occurring within the sampling grid:

$LDV = \sum(\sum fi[North] + \sum fi[East] + \sum fi[South] + \sum fi[West])$,

where fi is the frequency of the species i within the sampling grid.

In each plot, only trees with a minimum circumference of 50 cm at breast height (DBH>15.9 cm) will be considered and a minimum of three trees will be sampled in each plot. The trees closer to the center of the plot will be chosen. This protocol follows the National guidelines defined in Nimis et al. (2001).

Most of the lichen species will be identified in the field. Critical specimens will be collected and identified in the laboratory on the basis of their macro- and micromorphological characteristics, following the keys by Smith et al., 2009, Clauzade and Roux (1985) and Wirth (1995). Chemical spot tests K (10% aqueous), C (satured aqueous bleach), KC (combination), Iodine, Nitric acid, Pd (5% alcoholic p-phenylenediamine) and

UV response will be performed when necessary. Chemotaxonomic analysis of the secondary compounds (lichen substances) of selected taxa (ex. Lepraria, Peltigera) was performed by means of thin layer chromatography (TLC).

The species will be checked with samples stored in the Herbarium of the University of Molise and in other lichen herbaria (RO, TSB, CLU, FI). Specimens whose identification is particularly difficult will be sent to international experts.

Saproxylic organisms

In addition to conservative aspects, saproxylic organisms play a major role in relation to the processes of wood degradation, contributing in a substantial way to the recycling of organic matter, the soil fertilization and the creation of vital habitats for numerous other organisms.

To preserve forest environments and, at the same time, to allow a biodiversity evaluation, sampling of saproxylic insects will be carried out with traps able to collect specimens, without altering the delicate balance of forest environments. These traps can also be provided for any comparison, eliminating the degree of subjectivity of a collection specialist.

The investigation regarding the insect saproxylic fauna will be carried out using two systems:

• *Window flight trap*, consisting of two panels of Plexiglas cross, of 60x40 cm, below which is positioned a funnel with a diameter of 42 cm which conveys the arthropods in a polyethylene bottle of 500 ml, filled with a solution of water and salt for the preservation of the material. This type of trap will be suspended near a tree at a height of 1.5-2 m from the ground.

• *Eclector*, made with bags, inside which are placed portions of wood at different stages of decomposition and connected to a vessel for the collection of emerging insects.

From June to September 2013, every twenty days the collection / replacement of the bottles and the sorting and preparation of specimens on special tags will be carried out.

Within each family, specimens will be identified at the species level.

The window flight trap will be located as near as possible to the center of the monitoring plot, hanged at a sound branch. The eclettors will surround deadwood in the first three decay classes of the Hunter (1990) scale (one deadwood piece for each class) within an area of 13 meters from the center of the plot.

The saproxylic fungi will be sampled in all deadwood pieces with diameter greater than 10 cm within the same circular area of 13 meters of radius.

Breeding Birds

The aim of the protocol is the execution of a program of semi-quantitative detection of breeding birds on a local scale, with the execution of listening points distributed in a representative manner on the areas affected by the project through a randomized sampling procedure. This program will be sent to the monitoring of nesting species of birds, with particular reference to those specially protected by European Directive (Fornasari, 1997).

The methodology consists of measurements carried out on the basis of the sample units of 1 km on each side, where they proceed to the execution of one point counts.

The selected method is that of point counts, the most suitable of standardized methodologies to operate detections. Altogether, it provides for the execution of a sample of approximately 40 points counts of 10 minutes (Fornasari et al., 1997). These samples will be compared in order to provide feedback on attendance and on numerical indices of breeding populations.

The methodology adopted will also compile semi-quantitative distribution maps.

Finally, the application of the technique of point counts with evaluation of the distances of the individuals surveyed (within and beyond a range of 100 m from the listening position) will make a numerical estimate of the consistency of breeding populations .

The conversion factors from counts made and estimated amounts will be obtained based on the sample of individuals counted in the fixed radius of 100 m from the listening point, radius that defines a known surface.

The surveys will be carried out in May-June period useful for detecting phenological nesting season.

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Appendix 1. Coordinates of the monitoring plots (Reference system WGS84 33N).

Project area	id_plot	est_nom	nord_nom
Ottati	68	527500	4484500
	69	527500	4485000
	79	528000	4484500
	80	528000	4485000
	90	528500	4484000
	91	528500	4484500
	100	529000	4484000
	101	529000	4484500
Corleto	171	536000	4480000
	184	537000	4479500
	194	537500	4479500
Motola	MOT1	539720	4469214
	MOT2	539772	4469360
	MOT3	539653	4469345
Pietracamela	PIE1	382027	4706820
	PIE2	382165	4706965
	PIE3	382316	4706673
	PIE4	382262	4706887
	PIE5	382249	4706977
Intermesoli	INT1	377889	4707485
	INT2	377965	4707442
	INT3	377977	4706286
	INT4	377955	4706463
	INT5	377933	4707038
	INT6	377983	4707283
	INT7	377970	4706883
Incodaro	INC1	373846	4707442
	INC2	373930	4707353
	INC3	374545	4707542
	INC4	374475	4707661
	INC5	374637	4707748
	INC6	374651	4707949
	INC7	374568	4707821