LIFE21-NAT-IT-LIFE GOPROFOR MED 101074738
Improvement of the conservation status of forest habitats in the Mediterranean Biogeographical Region applying restoration and conservation techniques and close to nature management
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Biodiversity Islands and Habitat trees identification protocol

WP3 – Tools for CNF management

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1. The main features of ecological network according to LIFE GoProForMed

The project 101074738 - LIFE21 - NAT-IT-GOPROFOR MED foresees the implementation of ecological networks in forest planning.

The main aim is to create a permanent system for the conservation of forest biodiversity and of natural processes, elements which allow the maintenance of the vitality and functionality of the project's target forest habitats. The implementation of this permanent system, in fact, makes it possible to increase the connectivity between areas of greatest potential ecological interest, connecting them to each other without particularly hindering ordinary forest management.

This ecological network is made up of **Core Areas, Biodiversity Islands** and **Habitat Trees**. All the remaining wooded area is defined as an "**Edge Area**", which can also be managed for production purposes.

In the scientific literature we can find different definitions of each element of the ecological network.

Taking into consideration the different definitions, within the project the following key elements are defined as follows:

- **Core Area (CA):** an area characterized by a high functional and qualitative value for the conservation of biodiversity. This value is considered in relative terms with respect to the target forest stand. The Core Area represents an element that will be permanently maintained, and constitutes a node of the ecological network. The function of the Core Area is that of a source of diffusion of mobile species.
- **Edge Area (EA):** area occupied by the target habitat, outside and contiguous to the Core Areas, and coinciding with the surface indicated by the Project.
  In this area, the placement and implementation of the Biodiversity Islands (IB), which correspond to 5% of the Edge Area, and the identification of habitat trees (generally 10 for each IB) are envisaged. On the remaining surface of the Edge Area, forest management is proposed according to the continuous cover silvicultural approach. In each project site this approach will be tested through 4 different types of demonstration interventions, in areas of 1 ha located in the Edge area. The demonstration interventions are defined within the second level of application of WP 3.1
- **Biodiversity Islands (IB):** a small forest reserve, with the main aim to preserve deadwood for ecosystem conservation and for the conservation of species, especially saproxylic species. Together with Habitat Trees, IB connect Core Areas, favouring the dispersion of less mobile species and thus increasing the availability of highly natural areas. Within each IB, the presence of dead wood in different stages of decomposition, tree microhabitats and small gaps, are guaranteed as much as possible. Where necessary, these conditions will be fostered by means of active management that includes interventions aimed at increasing dead wood, favouring the growth of large trees and existing Habitat Trees through single-tree selection techniques and the creation of open areas ranging from 100 to 400 m^2. The IB that will be implemented in the project should have an area of at least 1 hectare and an average distance from each other of 200-300 m, to cover at least 5% of the project area.

  Within the project the IB can be of 2 types, depending on their evolutionary and structural complexity:
  - Conservative IB
  - Improved IB.

Each IB can be classified according to one of these 2 types on the basis of the results obtained in the characterization phase (Par. 4).
Finally, the project envisages landscape-scale analysis for the identification of areas with the greatest risk of fire (T3.2). The IB that will fall within these areas will be specially classified, and the silvicultural interventions will be different from those envisaged for the IB outside the areas at risk of fire

- **Habitat Tree (HT):** taking into consideration the different definitions found in the scientific literature, in the context of the project, a Habitat Tree (HT) is defined as "a standing living tree that provides at least one **tree microhabitat (TreM)** listed in a list of TreMs identified as “priority”. Alternatively, HT is characterized by at least 3 different microhabitats”.
  In the project’s framework, the function of HTs is to facilitate the movement of less mobile species (mainly invertebrates) between IB and Core Areas. To this end, the HTs will have to be spatially distributed in such a way as to favour their ecological connection. Where necessary, punctual interventions will be carried out to favour the development of these individuals.
  The selection criteria for HTs, their indicative number, their marking and characterization, are described in par. 5.

This document intends to provide guidelines aimed at identifying and materializing IB and HTs, and at characterizing IB from a structural and potential biodiversity point of view.

The interventions to be implemented in the IB and the interventions to favour HTs will be the subject of a specific document.

2. Identification of the area that will benefit from the ecological network (Edge Area)

The Edge Area will be identified through: i) the analysis of the forest stands belonging to the target habitat, ii) their territorial distribution with respect to the Core Areas and iii) their accessibility. This process will have to take into account the objective of maximizing the effectiveness of the ecological network that will be designed within it.

The ecological network will have to perform a defense function against future pressures or to enhance conditions that are already favorable for the conservation of biodiversity. In the first case, for example, the network will have the aim of promoting the exchange of species even in a management context that does not guarantee forest stands of particular ecological value on a stand scale (e.g. stands managed as coppices), while in the second case the function of the network will be to **improve** the movement of species within populations characterized by a high bio-ecological value (e.g. mature high forests with an irregular structure).

The surface of the Edge Area can indicatively be obtained by subtracting from the "Surface of intervention" indicated by the project, the surface of the Core Areas already identified.

This area should be cartographically delimited. Subsequently, it is possible to proceed with the identification of the IB and HTs within the Edge Area.

Country	Habitat	Habitat surface (ha)	Intervention Surface (ha)	Core area* (ha)	Edge area (ha)
IT	9340	4.694	1.700	1200	500
	9330	2.792	200	9	191
	9260	1.833	400	20	380
ES	9260	462	100		
	9330	275	120		
	9340	13.248	120		
	9530	2.131	160		
GR	9260	501	501		
FR	9340	19.119	300		

*Data updated for Italian sites

3. Identification of Biodiversity Islands

3.1 IB requirements

IB must be identified within the Edge Area on the basis of 3 criteria:

1. belonging of the forest population to the target forest habitat,
2. high level of potential biodiversity (current or attainable),
3. functional distance between the elements of the network.

3.1.1. Correspondence with the definition of the target habitat (BOX 1)

This condition can be verified directly in the field or through the analysis of the following documents:

- Official Habitats Map,
- Forest parcels description within a Forest Management Plan,
- Satellite images
- N2000 sites Management Plans
- Planning tools for any reserves/protected areas.

In case of strong habitat fragmentation, IB can be exceptionally distributed even in forest areas not belonging to the target habitat, in order to ensure the functionality of the ecological network (CA + IB + HTs). However, it is recommended to avoid placing elements of the network in artificial populations.

BOX 1 – Definition of target forest habitats (Gigante D., Venanzoni R., 2009)

9260 - *Castanea sativa* woods (CORINE Biotipes code: 41.9): Supra-Mediterranean and sub-Mediterranean *Castanea sativa*- dominated forests and old established plantations with semi-natural undergrowth.

9330 - *Quercus suber forests* (CORINE Biotipes code: 45.2): West-Mediterranean silicicolous forests dominated by *Quercus suber*, usually more thermophile and hygrophile than *Quercus ilex* and *Quercus rotundifolia* forests.

Sub-types:

45.21 - Tyrrhenian cork-oak forests *Quercion suberis*
Mostly meso-Mediterranean *Quercus suber* forests of Italy, Sicily, Sardinia, Corsica, France and north-eastern Spain. They are most often degraded to arborescent matorral.

45.22 - South-western Iberian cork-oak forests *Quercion fagineo-suberis*
Quercus suber forests, often with Q. *faginea* or *Q. canariensis*, of the south-western quadrant of the Iberian Peninsula.

45.23 - North-western Iberian cork-oak forests
Very local, exiguous *Quercus suber* enclaves in the *Q. pyrenaica* forest area of the valleys of the Sil and of the Mino (Galicia).

45.24 - Aquitanian cork-oak woodland
Isolated *Q. suber-dominated* stands occurring either as a facies of dunal pine-cork oak forests or in a very limited area of the eastern Landes.

9340 - Quercus *ilex* and *Quercus rotundifolia* (CORINE Biotipes code: 45.3) forests**:** forests dominated by *Quercus ilex* or *Q. rotundifolia*, often, but not necessarily, calcicolous.

Sub-types:

45.31 - Meso-Mediterranean holm-oak forests
Rich meso-Mediterranean formations, penetrating locally, mostly in ravines, into the thermoMediterranean zone. They are often degraded to arborescent matorral, and some of the types listed below no longer exist in the fully developed forest state relevant to category 45; they have nevertheless been included, both to provide appropriate codes for use in 32.11, and because restoration may be possible.

45.32 - Supra-Mediterranean holm-oak forests
Formations of the supra-Mediterranean levels, often mixed with deciduous oaks, *Acer spp*. or *Ostrya carpinifolia*.

45.33 - Aquitanian holm-oak woodland
Isolated *Quercus* ilex-dominated stands occurring as a facies of dunal pine-holm oak forests.

45.34 - *Quercus rotundifolia* woodland
Iberian forest communities formed by *Q. rotundifolia*. Generally, even in mature state, less tall, less luxuriant and drier than the fully developed forests that can be constituted by the closely related *Q. ilex*, they are, moreover, most often degraded into open woodland or even arborescent matorral. Species characteristic of the undergrowth are *Arbutus unedo*, *Phillyrea angustifolia*, *Rhamnus alaternus*, *Pistacia terebinthus*, *Rubia peregrina*, *Jasminum fruticans*, *Smilax aspera*, *Lonicera etrusca*, *L. implexa*.

9530 -(Sub)Mediterranean pine forests with endemic black pines (CORINE Biotipes code: 42.6): Forests of the montaneMediterranean level, on dolomitic substrate (high tolerance to magnesium), dominated by pines of the *Pinus nigra* group, often with a dense structure.

Sub-types:

42.61 - Alpine-Apennine *Pinus nigra* forests
Pinus nigra s.s. forests of the eastern Italian, Austrian and Slovenian Alps and of the Apennines;

42.62 - Western Balkanic *Pinus nigra* forests
Pinus nigra ssp. nigra of the Dinarides, the Pelagonides; Pinus dalmatica forests of the Dalmatian coastal areas;

42.63 - Salzmann's pine forests
Pinus salzmannii forests of Spain (Pyrenees, northern Iberian Range, sierra de Gredos, serrania de Cuenca, Maestrazgo, sierras de Cazorla, Segura and Alcaraz, calcareous periphery of the Sierra Nevada) and the Causses;

42.64 - Corsican larch pine forests
Pinus laricio forests of the mountains of Corsica (1000 to 1800 m) on granitic soils;

42.65 - Calabrian laricio pine forests
Pinus laricio var. calabrica forests of the Sila (Sila Greca,Sila Grande, Sila Piccola), the Aspromonte and Etna;

42.66 - Pallas's pine forests montane forests of *Pinus pallasiana* of Greece and the Balkan peninsula.

3.1.2 High level of potential biodiversity (current or attainable)

IB must be characterized by a high level of potential biodiversity to fulfil their ecological function. This feature can already be found at the time of planning, or can be achieved in the medium to long term. Therefore, some IB will not require particular interventions aimed at guaranteeing their functionality (Conservative IB); conversely, other areas will require improvement interventions to accelerate the processes that will lead to the objective function (Improved IB).

In the latter case, action will be taken to improve the score of the following IBP factors:

- **C – large standing deadwood,**
- **D – large lying deadwood,**
- **E – large living trees,**
- **G – open areas.**

As already mentioned, IB cannot be located in stands of recent artificial origin and in those stands that are located on limiting stations for trees growth.

For forests with growth restrictions, the following definitions are referred to:

- "Other Wooded Lands" as defined by FAO: territories with a tree cover of 5-10% of trees capable of reaching a minimum height of 5 m when mature *in situ,* or territories with a tree cover greater than 10% made up of trees that reach a height of 5 m when mature *in situ* or from shrubs and bushes;
- areas characterized by low fertility according to the definition of the IBP: areas where the site conditions prevent the trees from reaching the size thresholds of the Large Living Trees, i.e. trees with a minimum DBH of 47.5 cm in Mediterranean areas and 67.5 cm in of the Mediterranean mountain plain.

3.1.3 Functional distance between the elements of the ecological network

The ecological network conceived in the project and composed by CA, IB and HTs, is sized considering the movement range of some of the species that have less diffusion capacity such as some invertebrates. This space has been conventionally defined as 200 meters.

Therefore, to ensure that the ecological network can also facilitate movement for these taxonomic groups, its elements must be positioned at a maximum distance from each other of about 200 m, ensuring homogeneous coverage of the Edge Area.

3.2 Definition of IB number, dimension and position

IB are identified through the following steps:

1. calculation of the necessary number of IB of 1 ha to cover 5% of the Edge Area,
2. positioning of the IB on the map, considering a distance of 200 m between one and the other.

If the application of these criteria does not allow the Edge Area to be adequately covered throughout its extension, it is advisable to reposition the IB by acting on the number, their size (which in any case must cover a

minimum area of 1 ha) and the distance between and the other, in order to ensure a widespread effect of the ecological network on the entire Edge Area, keeping the coverage criterion of 5% fixed.

If from this operation the IB are positioned more than 200 m from each other, the identification of additional Habitat Trees will have to be foreseen, with respect to those envisaged by the project, in order to guarantee an ecological corridor connecting them.

The following table shows a theoretical example of the calculation of the number and size of the IB and the number of **additional** Habitat Trees necessary to ensure a coverage of 5% of a surface of 100 ha:

n. IB	IB surface	n. Habitat Trees
1	5,0	11
2	2,5	0
3	1,7	0
4	1,3	0
5	1,0	0

To simplify the future management of IB, it is advisable to make their borders coincide with already existing limits (e.g. roads or parcels limits of a Plan), or on physiographic limits easily identifiable in the field.

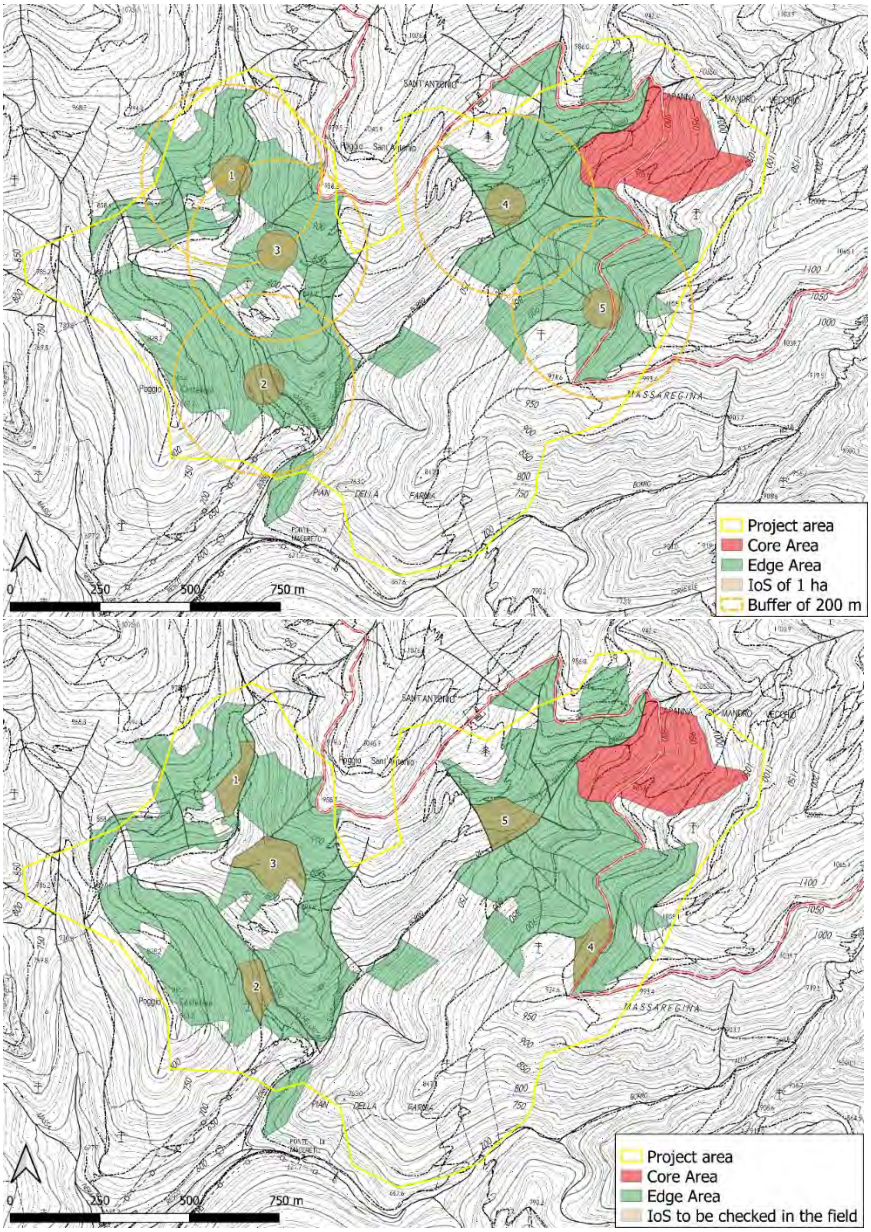
Intervention Surface (ha)	100
Core Area (ha)	8,42
Edge Area (ha)	91,58
n. IB of 1 ha needed to cover 5% of Edge Area surface	5

Example of IB identification for Sant'Antonio site (Italy).

The table shows the calculation of the Edge Area surface and the number of IB needed to cover 5%.

In the image above, hypothetical IB of 1 ha were distributed in order to cover the Edge Area in the most appropriate way. In the image below IB borders have been made to coincide, where possible, with the more easily recognizable limits in the forest.

IB 4 and 5 are positioned at a distance greater than 200 m. In this case, Habitat Trees will have to be identified and marked in order to connect the two IB.



Once identified cartographically, IB are inspected in the forest, in order to verify that the first two requirements mentioned above have been met (presence of the target forest habitat and high current or attainable potential biodiversity value).

In order to make the planned ecological network permanent, the boundaries of the identified IB and Habitat Trees will be marked in the forest.

4. IB characterization.

The characterization of IB consists in the implementation of dendrometric and IBP surveys, aimed at collecting the information necessary for the planning of the interventions envisaged by the project.

These interventions have the aim of improving or maintaining conditions of high potential biodiversity within the IB and are generally aimed at:

- ensure a quantity of lying and standing deadwood equal to about 10% of the living forest mass;
- ensure the presence of forest gaps of an overall surface between 1 and 5% of the IB area,
- locate and favour (when necessary) large living trees,
- locate and favour (when necessary) HTs.

	Factors to sample	Extractable information	Use of Information
Dendrometric survey	DBH Height Dendrotype Species	volume/ha	calculation of the amount of dead wood to be released (about 10% of the living mass)
		diameter distribution	Identification of the (actual or future) largest trees to be preserved for the future
		density (n. trees/ha)	useful for the characterization of the IoS, but not considered in the planning of the interventions
		specific composition	
IBP survey	Factor A Native species	specific composition	useful for the characterization of the IoS, but not considered in the planning of the interventions
	Factor B Structure	forest stratification	
	Factors C & D Standing and laying deadwood	quantity and distribution of dead wood	calculation of the amount of dead wood to be released (about 10% of the living mass)
	Factor E Large living trees	quantity and distribution of large trees	Identification of the (actual or future) largest trees to be preserved for the future
	Factor F TreMs-bearing living trees	frequency and variability of TreMs	Identification of actual and future habitat trees
	Factor G Open areas	extension and distribution of open areas	calculation of the amount of surface of open areas, necessary to reach an extention between 1 and 5% of the IoS surface area
	Factor H Time continuity	time continuity of the forest	useful for the characterization of the IoS, but not considered in the planning of the interventions
	Factor I Aquatic habitats	presence of aquatic habitats	
	Factor J Rocky habitats	presence of rocky habitats	

The method of applying both types of surveys is described in the following paragraphs (4.1, 4.2)

4.1. Dendrometric survey

The dendrometric survey for the IB structural analysis is carried out through the identification of **1 survey plot per IB hectare**.

The survey plots are circular plots with a fixed radius and have the objective of detecting approximately 30-100 trees. For this purpose, the plot radius is chosen depending on the stand density: 8 m in case of high density, 12 m in case of moderate density and 20 m in case of low density (horizontal distance).

For additional fractions of hectare, and in the event that the IB presents conditions of high structural variability of the forest population, the addition of 1 survey plot can be evaluated.

Material needed:

Dendrometric survey fieldsheet

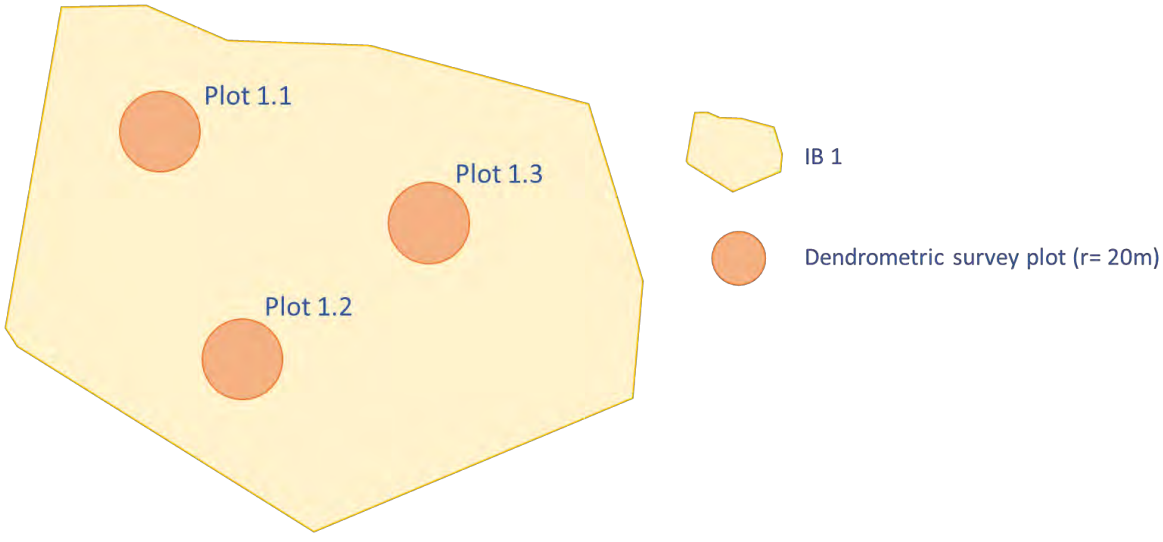
Caliper or Tree Diameter Tape

Vertex hypsometer

Non-permanent marking material (ex: marking crayons, chalks…)

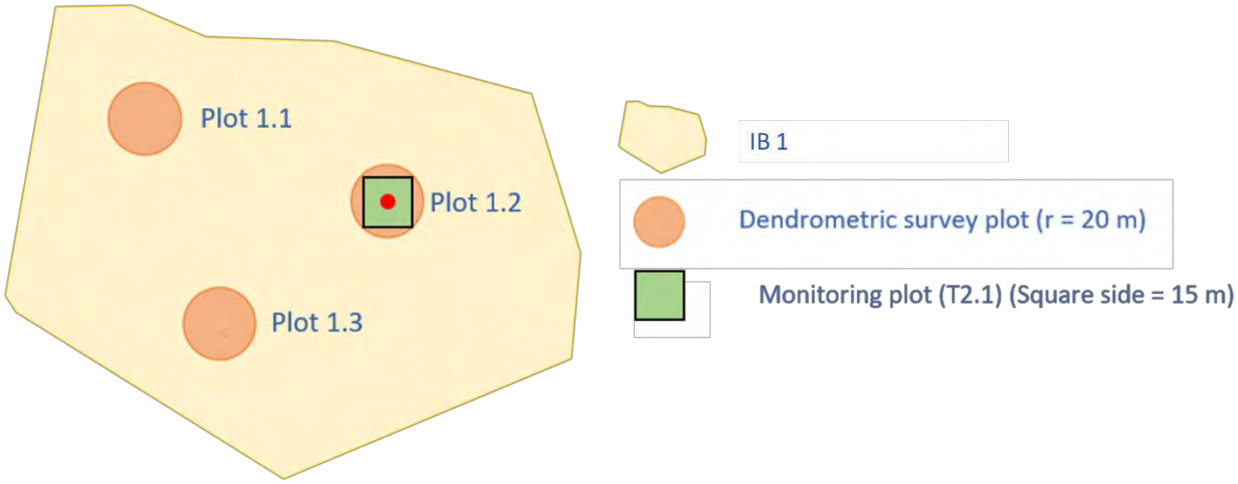
Dendrometric survey plots are positioned making sure to choose sites deemed representative of the average or prevailing situation of the IB and materialized on the ground by marking the boundaries and the centre.

For all the plants falling within the plot, the species, the Diameter at Breast Height (DBH), the dendrotype (coppice shoot, standard, tree originated from seed) and the status (dead or alive) are noted, while the height measurement takes place on sample plants (at least 20% of the total plants detected). This sample is proportionally distributed according to species, dendrotype and diameter class detected.



Example of dendrometric survey plots for a IB of 3,2 ha of surface (1 plot/ha)

In IB where monitoring plots of Task 2.1 (monitoring of flora, lichens and saproxylic insects) are present, 1 dendrometric survey plot is made to coincide with the monitoring plot of T2.1.



Example of dendrometric survey plots for a IB of 3,2 ha of surface (1 plot/ha), in IB where monitoring plots of Task 2.1 are present

In addition, the following data is entered in the survey fieldsheet, attached to this document:

- Project site name
- Date
- Surveyors
- IB identification code
- Survey plot identification code
- Coordinates of the survey plot centre (specify the reference system)

The survey requires at least 2 surveyors.

4.2. IBP survey

Material needed:

IBP fieldsheets, developed by the Centre National de la Propriété Forestière (CNPF), and adapted to the context of the involved Countries.

France: *Gonin P., Larrieu L., Baiges T., Palero N., Miozzo M., Corezzola S. : 2023 - Définition de l'Indice de Biodiversité Potentielle pour les forêts françaises (IBP FR v3.0). CNPF, INRAE Dynafor, CPF, DREAm Italia, 01/10/23, 12 p.*

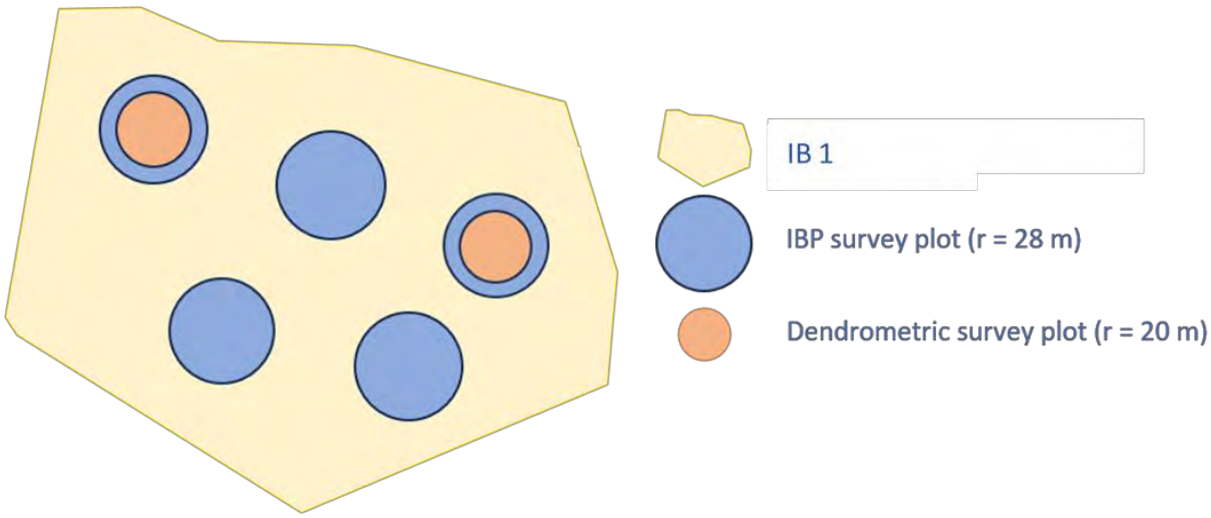
Italy: *Gonin P., Larrieu L., Miozzo M., Corezzola S. : 2023 - Indice di Biodiversità Potenziale (IBP IT v3.0): scheda di rilevamento. CNPF, INRAE Dynafor, DREAm Italia, 01/10/23, 12 p*

It is proposed to carry out the IBP analysis through a partial survey of the IB, adopting **circular survey plots with a radius of 28 m** (each corresponding to an area of approximately 2500 m^2), for a coverage of **at least 50% of the IB surface**.

IB surface (ha)	Plot radius (m)	Plot surface (m^2)	50% of IB surface (m^2)	**N° of IBP plot**
1	28	2463	5000	**2**
1,5	28	2463	7500	**3**
2	28	2463	10000	**4**
2,5	28	2463	12500	**5**
3	28	2463	15000	**6**

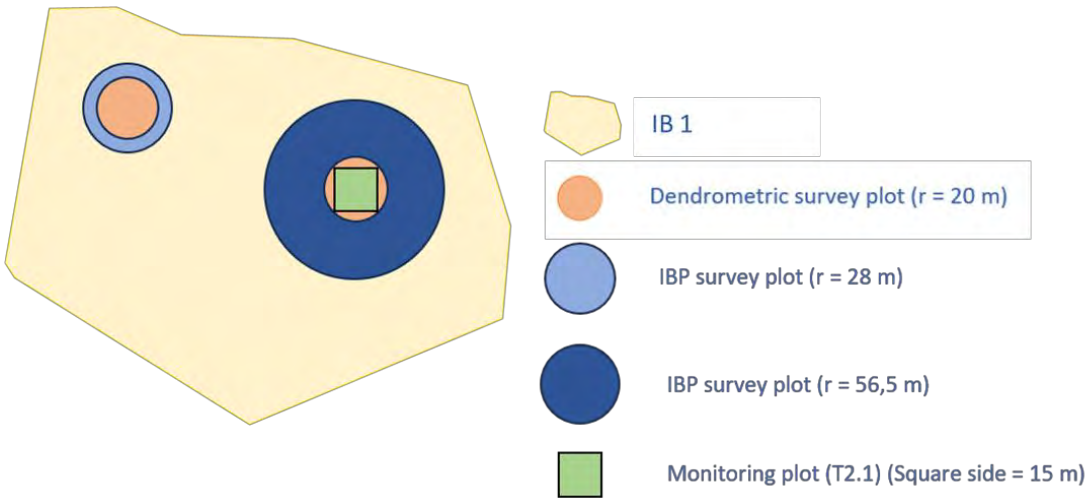
Example of calculation of N° of IBP survey plots, necessary to cover 50% of the IB surface

As regards the positioning of the IBP plots, these are made to coincide with the dendrometric survey plots.



Ex. for a IB of 2,5 ha: 2 dendrometric survey plots (1 plot/ha) and 5 IBP survey plots (covering 50% of IB surface)

In IB where monitoring plots of Task 2.1 (monitoring of flora, lichens and saproxylic insects) are present, 1 IBP survey plot is made to coincide with the monitoring plot of T2.1. In this case, this specific IBP plot must necessarily be of 1 ha (radius of 56,5 m): this will allow acquiring data to be correlated to the monitoring data. The number of remaining IBP survey plots must be sufficient to achieve 50% of the IB area. These remaining IBP plots first will to be positioned at the dendrometric survey plots. If IBP plots will outnumber the dendrometric survey plots, then the IBP plots can be placed subjectively in representative areas of the forest stand of the IB.



Ex. for a IB of 2,5 ha, with the presence of a monitoring plot T2.1: 2 dendrometric survey plots (1 plot/ha), 1 IBP of 1 ha (r = 56,5 m), corresponding with the T2.1 monitoring plot, and 1 IBP plot of r =28 m.

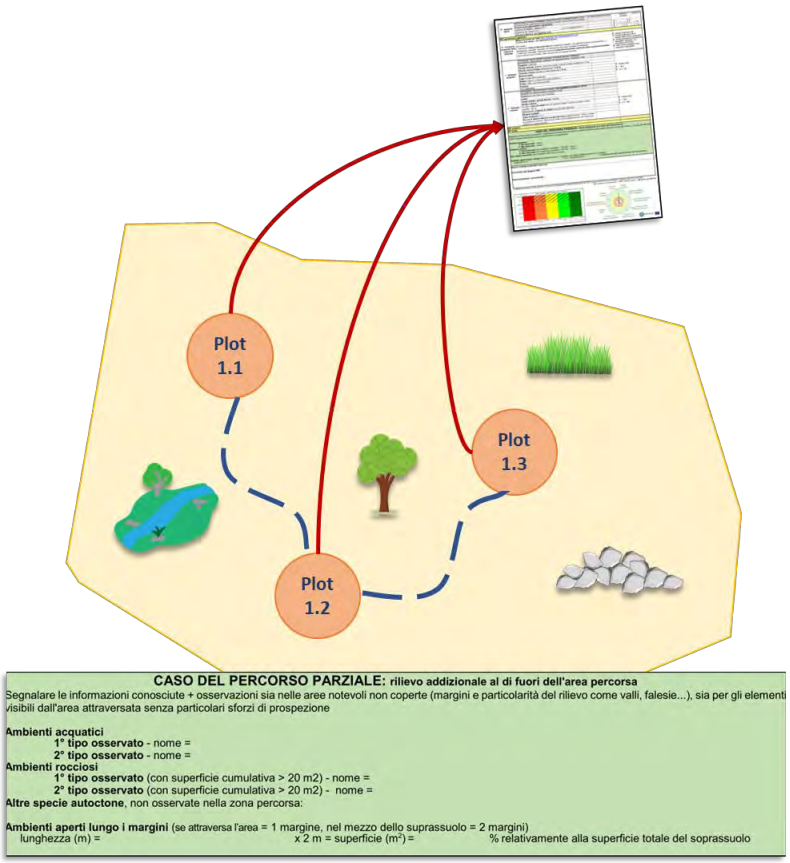
The map and the coordinates of the monitoring plots can be consulted at the following Drive path:

LIFE GOPROFOR-MED\CARTOGRAPHY\GENERAL\ALL_SITES.qgz.

One IBP fieldsheet is used for each IBP survey plot.

The kind of survey is unlimited, i.e., for each quantitative Factor, all the elements observed within the survey plot are noted on the fieldsheet.

As you move from one plot to another, all the elements, observed outside the plots, must be noted for factors **G – open areas, I – aquatic habitats, J – rocky habitats**.



For the purposes of characterizing the entire IB, at the end of the IBP surveys, the observations noted in each form will be reported and accumulated in a single fieldsheet.

The IBP score is then calculated retrospectively based on data collected across all IBP survey plots.

As regards the survey of the F factor – Tree microhabitats, all the types of TreMs encountered must be underlined on the survey form, without necessarily reporting their number (as in the picture below).

F - Alberi vivi con dendro-microhabitat (dmh)	Numero di alberi vivi portatori di dmh (autoctone o meno; contare un **massimo di 2 alberi/ha per gruppo** di dmh elencati di seguito, fino a un massimo di **8 alberi/ha**)		**0** : < 2 albero/ha **1** : ≥ 2 e < 3 alberi/ha **2** : ≥ 3 e < 8 alberi/ha **5** : 8 o + alberi/ha
	(1) Cavità formate da picidi		
	(2) Cavità del tronco con rosura (ø > 10 cm o > 30 cm se semiaperta o aperta)		
	(3) Fori di uscita e gallerie scavate da insetti (ø > 2 cm)		
	(4) Concavità (ø > 10 cm, prof. > 10 cm): dendrotelmi riempiti con acqua o concavità di radice o concavità con fondo duro del tronco o loro di alimentazione del picchio)		
	(5) Alburno esposto: tronco senza corteccia o lesione da fuoco (S> 600 cm² = A4) o corteccia parzialmente staccata (larghezza > 1 cm, profondità e altezza > 10 cm)		
	(6) Alburno e durame esposto: cima spezzata (ø > 20 cm) o branca rotta a livello del tronco (ø > 20 cm o S > 300 cm² = A5) o fessura (larghezza > 1 cm, profondità > 10 cm, lunghezza > 30 cm)		
	(7) Legno morto nella chioma: rami o cima morti (ø > 20 cm e L > 50 cm, o ø > 3 cm e > 20% della chioma morta)		
	(8) Agglomerato di succhioni o ramuli: scopazzo batterico (> 50 cm) o riscoppi (con > 5 succhioni)		
	(9) Crescita tumorale e cancro (ø > 20 cm)		
	(10) Corpi fruttiferi fungini perenni: Polyporales (ø > 5 cm)		
	(11) Corpi fruttiferi fungini effimeri: Polyporales annuali o Agaricales carnosi (ø > 5 cm o numero > 10)		
	(12) Piante e licheni epifiti o parassiti: muschi o licheni fogliosi / fruticosi o edera / liane (> 20 % del tronco per almeno uno di questi tipi), felci (> 5 fronde) o vischio (10 agglomerati > 20 cm)		
	(13) Nidi: grandi nidi di vertebrati (> 50 cm)		
	(14) Microsuolo (nella chioma presente a qualsiasi altezza nella chioma)		
	(15) Fuoriuscite di linfa e resina (fuoriuscita attiva > 20 cm)		

At the end of the survey, on the basis of the annotations, it is possible to assign a score to each of the 10 IBP factors.

5. Definition, identification, survey and marking of Habitat Trees

Going back to the definition given at the beginning of the document, within the project a Habitat Tree (HT) is defined as "a standing living tree that, in its current state, bears either:

- at least one tree microhabitat (TreM) listed in a list of TreMs identified as “priority”, or
- at least one TreM found to be among the least frequent at site level, or
- at least 3 different TreMs

Priority TreMs are elements that:

a) have particularly long development periods (e.g. cavities in general),
b) are considered the rarest in general terms (e.g. fungal fruiting bodies on living trees, cracks, sap flows).

The list of priority TreMs, shown in Box 2, it was carried out on the basis of the scores given to each TreMs, according to the 2 criteria, unrelated to the context i) the replacement rate of the TreM type and ii) the degree of the rarity of the TreM type in managed forests (Larrieu et al. 2023, unpublished[1]). The TreMs reported are those that achieve a minimum score of 5,5 (out of 7).

The frequency of a TreMs at a local scale is important in order to preserve underrepresented TreMs or, conversely, to pay less attention to over-abundant types, and thus with a lower relative value in a local context. The local scale frequency is derived from the analysis of the IBP F-Factor ‘living trees with dendromicrohabitat’, applied in the IBs as described in Section 4.2.

Important: within the project, beyond the specific activities related to IBP and the implementation of marteloscopes, the classification of TreMs will always refer to the standard of the European Field Guide (Bütler et al., 2020[2]).

Within the project, HTs are selected according to:

- TreMs they bear,
- Their location.

Selection on the basis of microhabitats: the HT carries at least one "priority" microhabitat or at least 3 different microhabitat types according to the classification by Bütler et al. (2020)[2].

Selection based on position: as reported in par. 3.1.3, the ecological network (CA + IB + HT) is sized considering the displacement range of some of the species that have less dispersion capacity (such as some invertebrates), and this space has therefore been conventionally defined in 200 meters. Therefore, in order for the ecological network to fulfil the function of connecting these taxonomic groups as well, its elements, **including the HTs**, must be positioned at a **maximum distance of approximately 200 m** between them, ensuring homogeneous coverage of the Edge Area.

[1] *Larrieu L., Emberger C., Bütler R., Kraus D., Lachat T., Schuck A., Zudin S., 2023. Giving trees an ecological value: a scoring system based on Tree-related Microhabitats (TreMs). 6p.*

[2] *Bütler R.; Lachat T.; Krumm F.; Kraus D.; Larrieu L., 2020: Field Guide to Tree-related Microhabitats. Descriptions and size limits for their inventory. Birmensdorf, Swiss Federal Institute for Forest, Snow and Landscape Research WSL. 59 p.*

HTs number: the project provides for the identification of about 10 HTs for each IB, to which a further number of HTs can be added, if the IB are positioned at distances greater than the expected 200m. The HTs will be spatially distributed along corridors identified to favour the ecological connection between the IB and the CAs.

BOX 2 – Tree Microhabitats

Definition (TreM): a distinct, well delineated structure occurring on living or standing dead trees, that constitutes a particular and essential substrates or life site for species or species communities during at least a part of their life cycle to develop, feed, shelter or breed (Larrieu et al. 2018)[3].

Priority TreMs types
Grouped into the 7 forms identified da Bütler et al. 2020[2], following Larrieu et al. 2018[3].
All seven types are represented by at least one microhabitat.

1) **Cavities:**
   - Woodpecker "Flute"
   - Trunk-base rot-hole (closed top, ground contact)
   - Trunk rot-hole (closed top, no ground contact)
   - Semi-open trunk rot-holes
   - Chimney trunk-base rot-hole (in contact with the ground)
   - Chimney trunk rot-hole with no ground contact
   - Bark-lined trunk concavity
   - Hollow branches
2) **Injuries and exposed wood:**
   - Lightning scar
   - Fire scar
   - Bark shelter
   - Bark pocket
   - Crack
   - Fork split at the intersection
3) **Crown deadwood**
   - Dead top
4) **Excrescences:**
   - Burr
   - Canker
5) **Fungal fruiting bodies and slime moulds:**
   - Perennial polypore
   - Annual polypore
   - Pulpy agaric
   - Large pyrenomycete
6) **Epiphytic and epixylic structures:**
   - invertebrate nests
   - Bark microsoil
7) **Fresh exudates:**
   - Sap run

What to detect: for each HT is necessary to note:

[3] Larrieu L., Paillet Y., Winter S., Bütler R., Kraus D., Krumm F., Lachat T., Michel AK., Regnery B., Vandekerkhove K., 2018. Tree related microhabitats in temperate and Mediterranean European forests: A hierarchical typology for inventory standardization. Ecological Indicators 84 (2018) 194–207

- position,
- tree species,
- DBH
- all present TreMs.

How to mark: the only directive that we reserve the right to give is that the marking method should be permanent, in order to identify, protect and preserve the HTs in the long term, and possibly be able to plan interventions to favour them. We do not envisage a standardized system of symbols and/or colours to be used for marking since, operating in 4 different Countries and different forest sites, there is a risk of using symbols, codes or colours that are already used locally to indicate other elements (boundaries, parcels, elite trees, …).

Image in Bütler et al. (2013): example of a symbol for HT marking in a French public forest

6. Storage, processing and data management of IB and Habitat Trees

Dendrometric survey data, IBP survey data and HT data is archived in the corresponding databases provided by the coordinating partner of the project.

As regards the management of the IB, on the basis of the IBP results and the dendrometric data, the management lines of the area will be developed and the interventions deemed most appropriate (where necessary) will be identified in order to make/maintain the area functional to the ecological connection of the habitat.