Core Areas 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 Island (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 of Core Areas.

2. Core Areas Requirements and their evaluation

In the design phase of the Core Areas, it is of great importance to acquire information on the presence and localization of the most relevant species of the project area, such as species inserted in the Annexes of Habitat and Bird Directives, and/or in the IUCN Red Lists. In fact, the size and location of Core Areas on the territory will have to take into account the needs of the individual species that insist on the project area, linked to their behaviour when faced with a condition of ecological fragmentation. However, the retrieval of such information is often particularly onerous and if this information is not available, the choice is to define the location and size of the Core Areas in order to satisfy the needs of as many species as possible.

For example, with regard to the conservation of saproxylic species, the minimum size of Core Areas depends on the specific characteristics of the insect communities and their habitat.

A study conducted in Greece suggested that the minimum size of protected areas for the conservation of saproxylic insects in Mediterranean forests should be at least 100 ha (Tsiora et al., 2013). However, other studies have shown that smaller core areas can still play an important role in biodiversity conservation.

Indeed, a study conducted in an oak forest in Spain showed that Core Areas of 5-10 ha can support a highly diverse saproxylic beetle community (Blanco-Moreno et al., 2014). Furthermore, another study conducted in a beech forest in Slovenia found that Core Areas of around 20 ha can support a high diversity of saproxilic beetles (Jurc et al., 2013).

However, it is important to note that the function of smaller protected areas may be limited to particular species of saproxylic insects and that the conservation of rare or threatened species may require larger protected areas. Furthermore, the conservation of saproxylic species also depends on other factors, such as habitat quality, the connectivity of protected areas and the presence of other environmental stressors.

In the forests that are taken as reference in the project it is not possible to identify Core Areas that have medium to large extensions. For this reason, the Core Areas which will be established in the project should have a minimum extension of 5 ha. This threshold represents the minimum condition to guarantee the functionality of a Core Area.

Where it is not possible to identify Core Areas with a minimum surface area of 5 hectares, the smaller Core Areas identified will be supplemented with contiguous areas that are in any case characterized by the reference habitat, until the minimum surface area of 5 hectares is reached.

In each forest stand, one or more Core Areas may be identified. The greater their number, the less need there will be to create linking IB.

The following is a schematic list of sequential conditions that we recommend taking into account when identifying Core Areas:

1. <u>Correspondence with the definition of the reference habitat (BOX 1)</u> - ***essential prerequisite***

This condition can be proven by analysing the following documents:

- Official map of Natura 2000 habitat types
- Forest stand description of a Forest Management Plan
- Satellite images
- SCI Management Plans
- Management Plans of reserves/protected areas

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.

2. <u>Maturity and temporal continuity of the forest stand</u> - *recommended prerequisite*

Core Areas should be identified in areas characterised by higher forest maturity compared to the rest of the stand under investigation. In fact, it is normally assumed that a mature or at least permanent forest has a greater capacity to host biodiversity.
This condition can be analysed through the study of:

- Quantitative data from a Forest Management Plan (stand age, dendrometric data such as average diameter and average height).
- Qualitative data from a Forest Management Plan (stand description)
- Qualitative-quantitative data from protected areas and Natura 2000 areas Management Plans
- Satellite images
- Historical orthophotos/documents
- LiDAR data (crown size, tree height)

3. **<u>High level of potential biodiversity</u> - *recommended prerequisite***

The most effective method for assessing this condition is the implementation of the Potential Biodiversity Index (IBP) in the stand under investigation. This method involves the observation in the field of 10 key factors that allows to assess forest stand capacity to host biodiversity independently of the biodiversity actually present. However, given the time currently available, it will not always be possible to apply IBP at this stage of the project.
Other useful information for tracing areas presumably characterised by a high level of potential biodiversity can be obtained indirectly through the analysis of:

- Qualitative information from studies on flora and fauna in the area of interest.
- Information regarding administrative limits. The presence of specific constraints e.g. due to the presence of Protected Areas can be an indication of good ecological conditions of the natural ecosystem.

3. Field surveys for the characterisation of Core Areas

Once the areas have been identified (in the case of the absence of a previously conducted IBP survey campaign), they will be characterised through the application of IBP surveys to be carried out both within the Core Areas and in a buffer area (200 meters radius) outside them.

4. Bibliographic references:

Tsiora, A., Megas, G., Tsiripidis, I., Stathas, G., & Nakas, G. (2013). Minimum size of protected forest areas for saproxylic beetle conservation in the Mediterranean region. Journal for Nature Conservation, 21(5), 300-306.

Blanco-Moreno, J. M., Garcia-Lopez, A., & Serrano, J. (2014). Saproxylic beetle assemblages in Mediterranean Quercus forests: effects of host tree species, forest management and saproxylic insect abundance. Insect Conservation and Diversity, 7(6), 539-549.

Jurc, M., Bavcon, J., & Kapun, B. (2013). The effects of forest management on the diversity and abundance of saproxylic beetles in a fagus forest. European Journal of Entomology, 110(1), 33-44.

Gigante D., Venenzoni R. (2009). Manuale Italiano di interpretazione degli habitati della Direttiva 92/43/CEE. https://hdl.handle.net/11391/148229

Annex 1

Core Areas identification - Outputs

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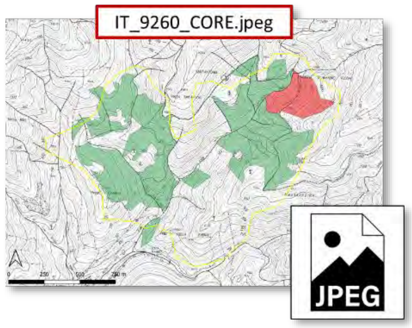
1. What outputs should be produced

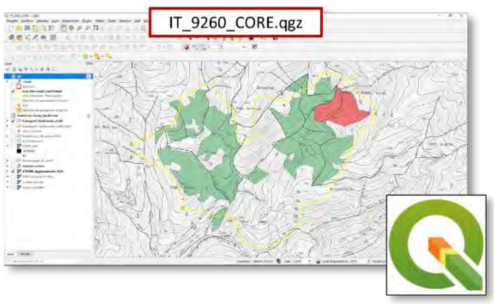
For each habitat and each project site, the following outputs should be produced:

1) .Pdf document in which all the analysis carried out for the identification of the Core Areas are described following the example reported in Annex 2

2) .Jpeg file with cartographic information related to: project area (as indicated in project proposal), habitat distribution, Core Areas



3) QGis project with following layers: **project area** (as indicated in project proposal), **habitat distribution** and **Core Areas** (at the moment it is not required a particular structure of the layers)

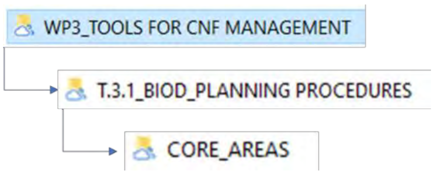


2. How and Where to store outputs and used material

All the outputs should be named as follow: "*country code_habitat code*_**CORE**" (Es. **IT_9260_CORE**)

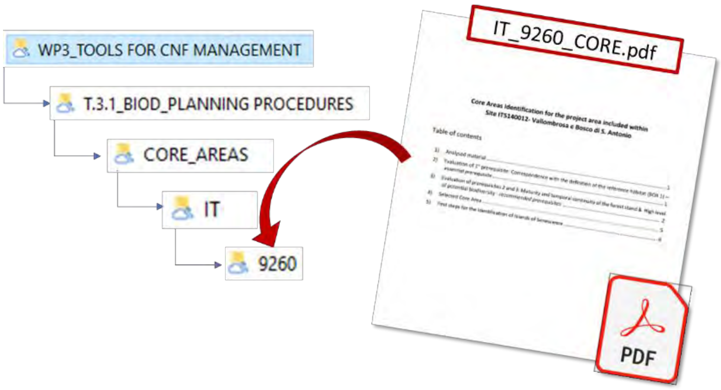
The outputs should be saved in our shared drive folder.

The **pdf report** and the **material analysed** (es. Forest Management Plan, SCI Management Plan, etc…) for the identification of Core Areas should be saved in:
GOPROFOR-MED\WP3_TOOLS FOR CNF MANAGEMENT\T.3.1_BIOD_PLANNING PROCEDURES\CORE_AREAS



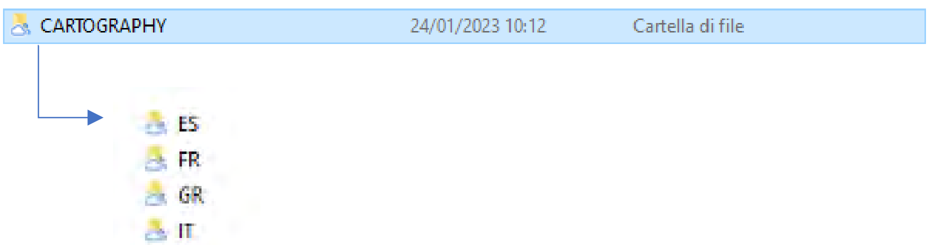
At this point you should save your files in your country folder, in the related habitat folder.

Es. **IT_9260_CORE.pdf**:

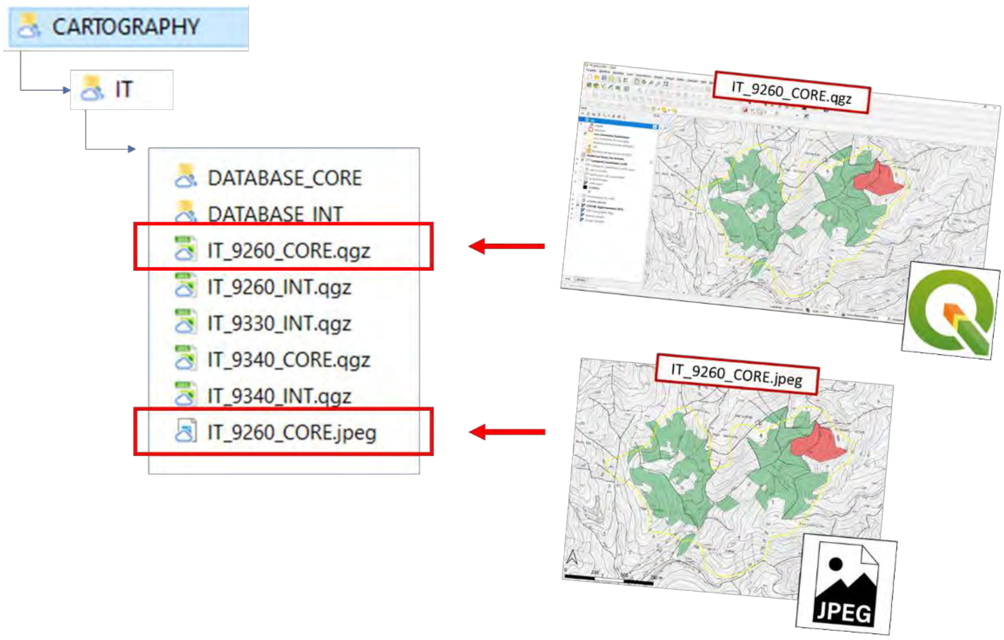


The **Cartographic material** (QGIS project and Jpeg file) should be saved in the "CARTOGRAPHY" folder:
LIFE GOPROFOR-MED\CARTOGRAPHY.

Both files should be saved in your contry folder:



Es. **IT_9260_CORE.qgz** and **IT_9260_CORE.Jpeg**:



All the material used to produce cartographic outputs (.shp files etc..) should be stored inside folder **“DATABASE_CORE”**.

Annex 2

Core Areas identification for the project area included within Site IT5140012- Vallombrosa e Bosco di S. Antonio

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1) Analysed material

For the identification of the Core Areas in the Sant'Antonio project area, the following documents were analysed:

- Management Plan of the Sant'Antonio Regional Forest Complex
- Tuscany Region Habitat Map
- Google Satellite Photo
- WMS Services Tuscany Region (Monumental Trees, Protected Areas Boundaries)
- Historical orthophotos
- LiDAR survey

2) Evaluation of 1° prerequisite: Correspondence with the definition of the reference habitat (BOX 1) – *essential prerequisite*

Firstly, the portion of habitat 9260 indicated in the Project Area (Grant Agreement cartographic annexes) and falling under the ownership of the beneficiary Tuscany Region, was identified.
To this end, information from the Forest Management Plan and from the official habitat map of Tuscany Region were cross-referenced.
This first operation shows that the area occupied by habitat 9260 within the Project Area and owned by the Tuscany Region has an extension of 79.8 hectares (Figure 1).

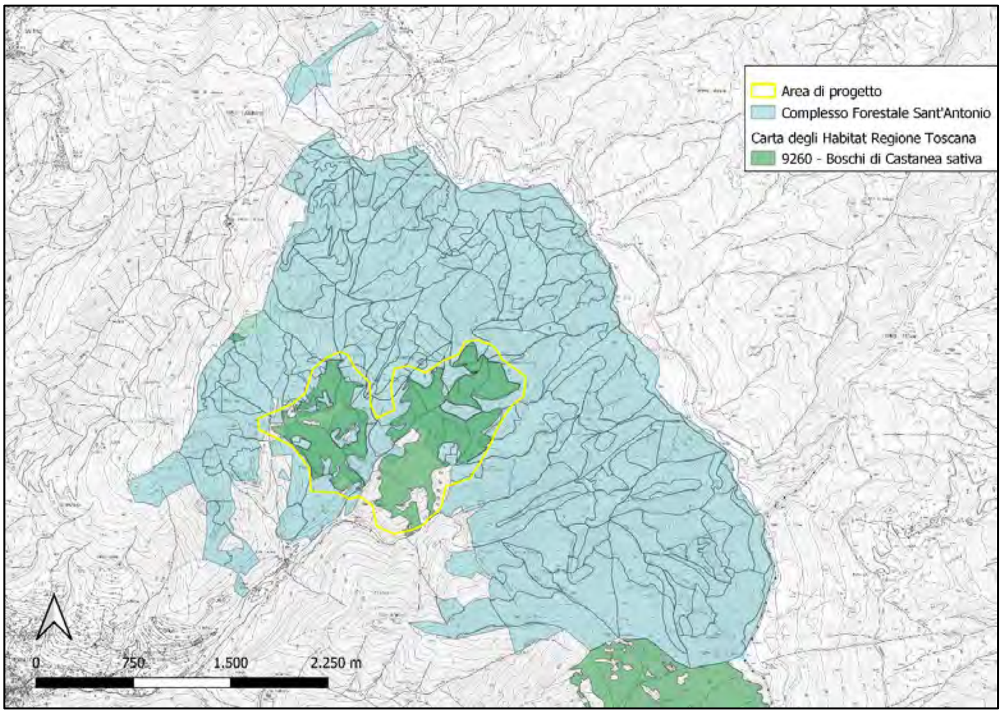
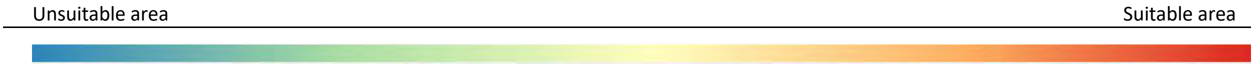


Figure 1. Cross-reference of information from Forest Management Plan and Habitat Map of Tuscany Region. The blue area shows the Sant'Antonio Forest Complex. The green areas show areas occupied by Habitat 9260. The yellow boundary indicates the project area.

3) Evaluation of prerequisites 2 and 3: Maturity and temporal continuity of the forest stand & High level of potential biodiversity - *recommended prerequisites*

Subsequent analyses were carried out on these areas to identify areas with the required maturity and ecological value.
In order to verify the maturity condition of the forest, data from the Forest Management Plan regarding the average diameter and prevailing age of the stands at the forest sub-parcel level were analysed.
For each parameter under observation, a cartographic image was produced using a graduated colour scale, according to which, the more the colour tends towards red, the more the characteristics of the area are considered suitable for selection as a Core Area.



This analysis showed that the stands with the most suitable characteristics for the purpose assigned to the Core Areas, occupy the eastern portion of the project area (Figure 2). These areas are characterised by stands with a prevalent age between 66 and 71 years (age at 2021) and an average diameter of 28-31 cm.
The western portion of the project area, on the other hand, is occupied by younger stands with smaller trees.

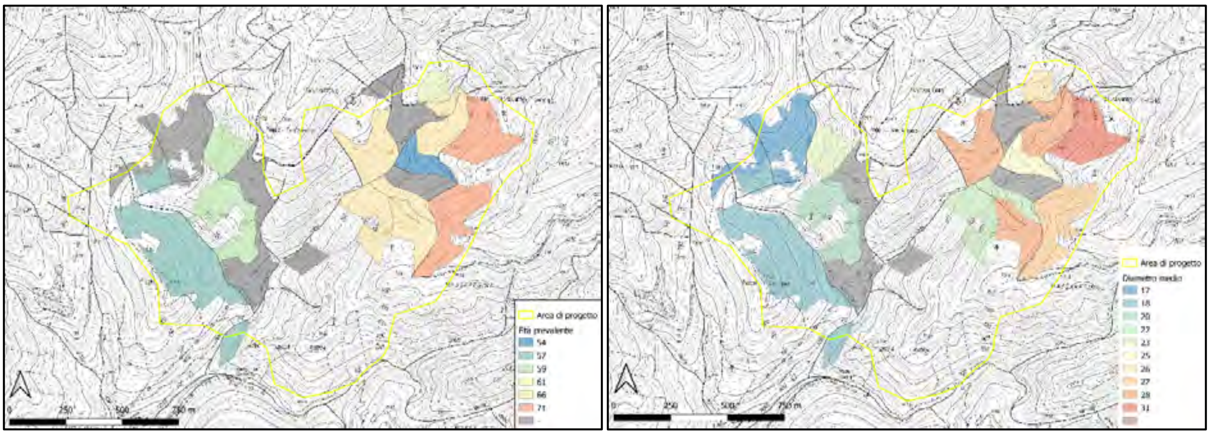


Figure 2. Survey on the prevalent age (left) and average diameter (right) of chestnut forests in the Project area (yellow boundary).

Given the availability of data from a LiDAR flight carried out in 2021, it was possible to carry out further analyses on the structure of the investigated stands, through which the large plants with a diameter greater than 67.5 cm (size criterion given for the E-factor in the IBP methodology) were estimated.

In Figure 3, plants that are likely to have a DBH greater than 67.5 cm have been highlighted in white, identified on the basis of DBH/H relationship by selecting trees with H greater than 27 m.

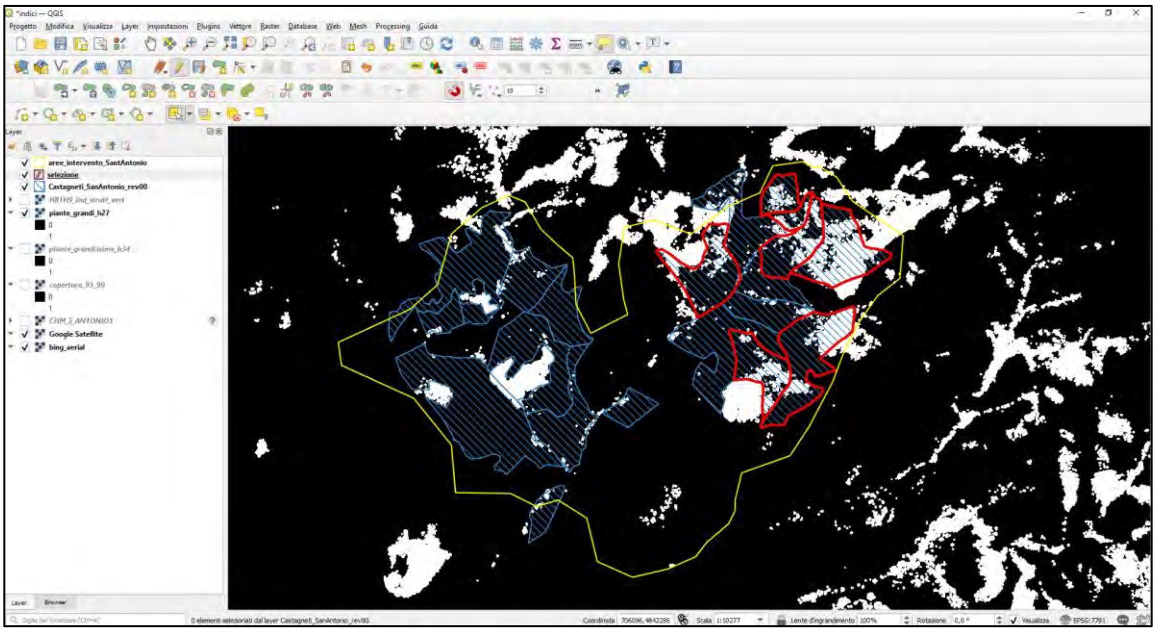


Figure 3. Analysis of LiDAR data; white color shows plants taller than 27 m.

This analysis was useful for identifying areas with a greater number of likely large trees (areas highlighted in red), a condition that indicates a greater maturity of the forest and presumably a higher level of potential biodiversity than other areas.

Further analysis of the LiDAR data was carried out in order to identify areas that might present good structural conditions in terms of forest cover openings. In figure 4, white areas mean areas where, in a possible application of IBP on circular plots of 0.5 ha, the **G-factor - open areas** would register the maximum score of 5, because they are affected by canopy openings between 1 and 5% of the survey area. In Figure 4, areas where good conditions in this respect are found were highlighted in red.

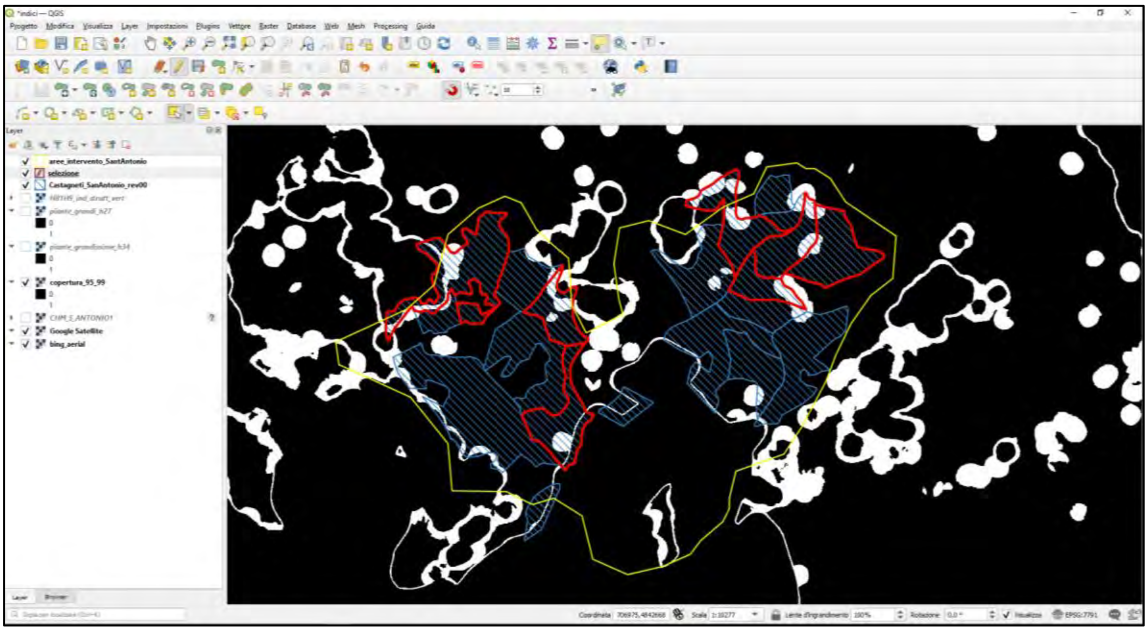


Figure 4. Analysis of LiDAR data; areas with red borders present good conditions in terms of forest cover openings.

The above analyses were subsequently cross-referenced with boundaries of the Protected Natural Area of Local Interest "Foresta di Sant'Antonio", considering the stands within them presumably characterised by more favourable environmental conditions for hosting a high level of biodiversity and therefore more likely to present the 3rd prerequisite of "High level of potential biodiversity".

From the intersection of these data, we selected areas highlighted in red in Figure 5 were selected as potential Core Areas, as they were characterised by the best conditions in terms of age, average size of individuals, presence of large individuals and they are included within the Protected Area boundaries.

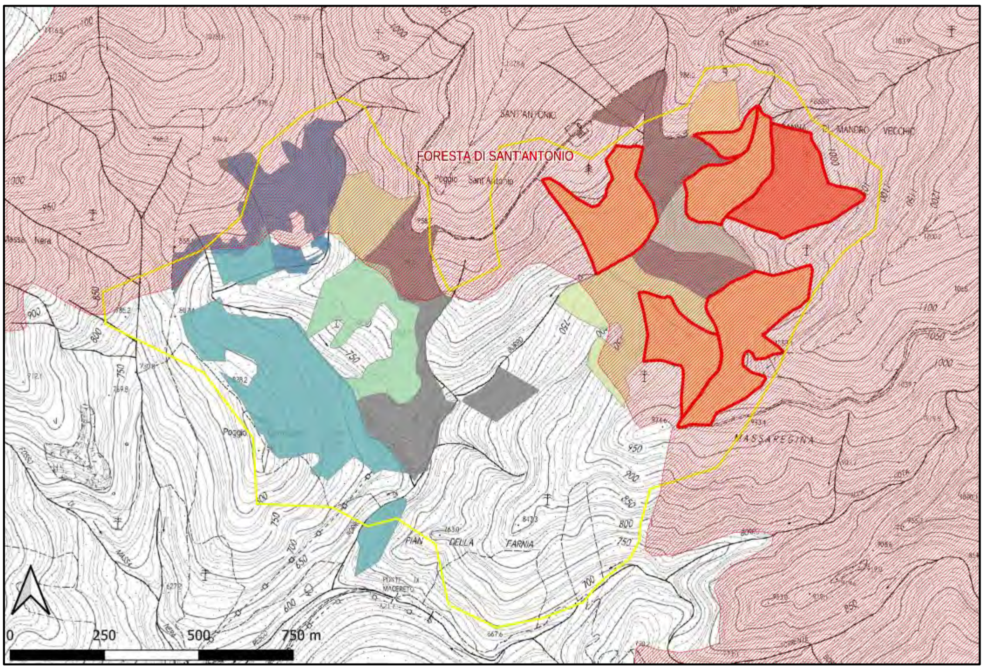


Figure 5. Overlay of prevailing age and mean diameter maps with Protected Area boundaries.

For the same areas, an analysis of current satellite images (updated to 9/2022) provided by Google and available historical orthophotos was then carried out, with the aim of verifying temporal continuity of the investigated stands (Figure 6).

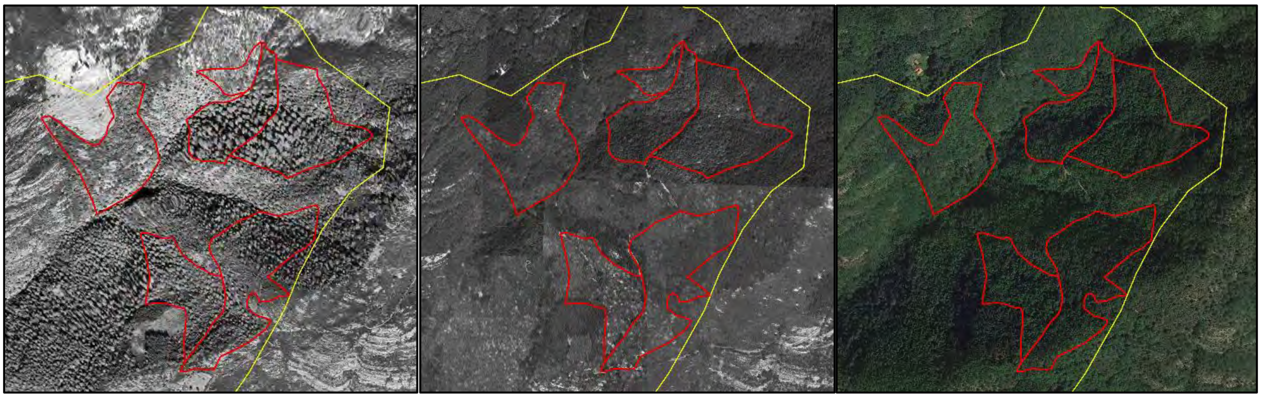


Figure 6. Comparison of historical orthophotos from 1954 and 1996 with Google satellite image of 2022.

From this analysis, it was possible to identify an area that was probably once managed for chestnut production. In fact, in the aerial photo of the 1954 GAI flight, in the north-eastern portion of the project area, we detected individuals characterised by particularly expanded crowns. The hypothesis of the presence of a fruit chestnut grove was verified through the analysis the Forest Management Plan information, from which it emerged that the area in question is currently occupied by an abandoned fruit chestnut grove in which large individuals are still present.

4) Selected Core Area

The analysis process described above has led to the selection of the area highlighted in Figure 7, corresponding to two sub-parcels for a total of 8,5 hectares that correspond to approximately 10% of the portion of the project area occupied by habitat 9260. The reason for choosing to make the boundaries of the Core Area coincide with the boundaries of the Forest Management Plan parcels, is to be found in the fact that the use of already established boundaries could considerably simplify future management activities.

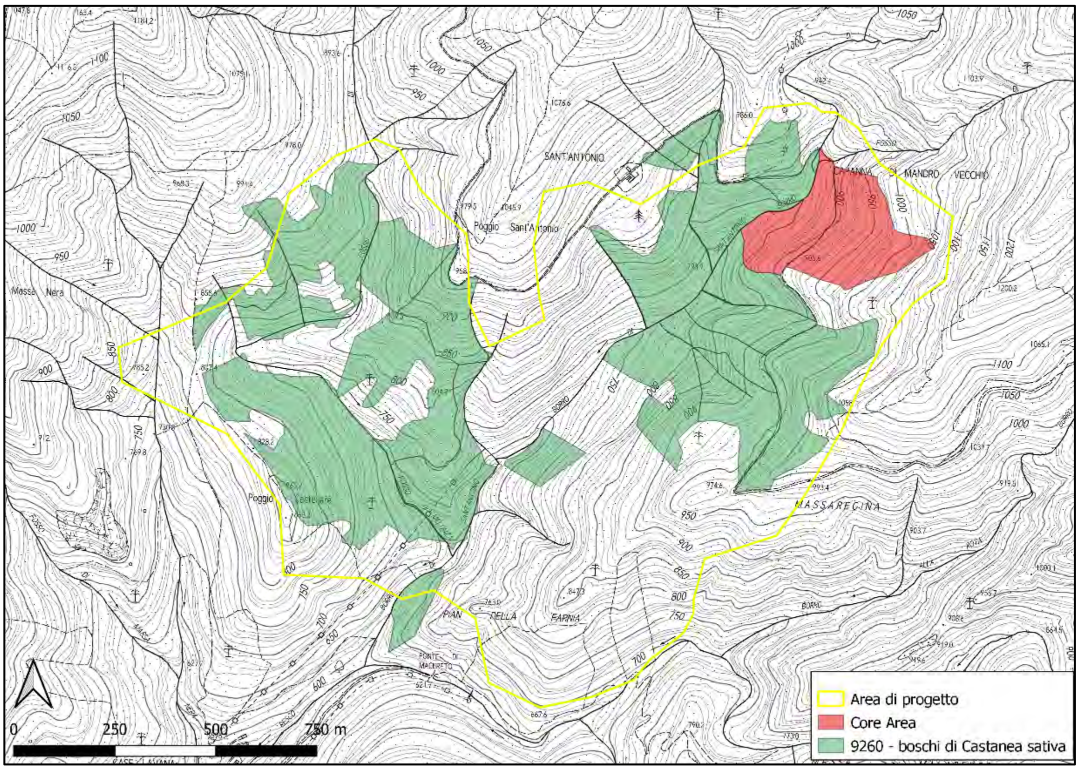


Figure 7. The red area shows the area selected as a Core Area for the Sant'Antonio forest complex.

PF	SF	Forest typology	Type of culture	Prevalent age	Mean DBH	G/ha	V/ha
36	2	Acidophilic chestnut	Transitional high forest	71	31	43	424
39	3	Acidophilic chestnut	Transitional high forest	66	28	31	372

5) First steps for the identification of Islands for Biodiversity

According to the project, the *IBs* should be strategically located on the territory in such a way that they function as a link between one Core Area and another, have an extension of 1 hectare and cover at least 5% of the project area.

In the specific case of the Sant'Antonio site, given the reduced extension of the project area, which led to the selection of only one Core Area, the *IBs* were distributed trying to cover the project area as homogeneously as possible, considering a minimum coverage percentage of 5% and an average distance between them of 200-300 m (represented in figure 8 by the buffer areas with radius 250 m around each *IBs*).

IBs 3 and 4 are separated by a higher distance than the mean distance suggested, due to the fact that the area which separates them is characterized by low fertility which makes it not suitable for the identification of *IBs*.

In this case, more Habitat Trees will be implemented in order to favour their ecological connection.

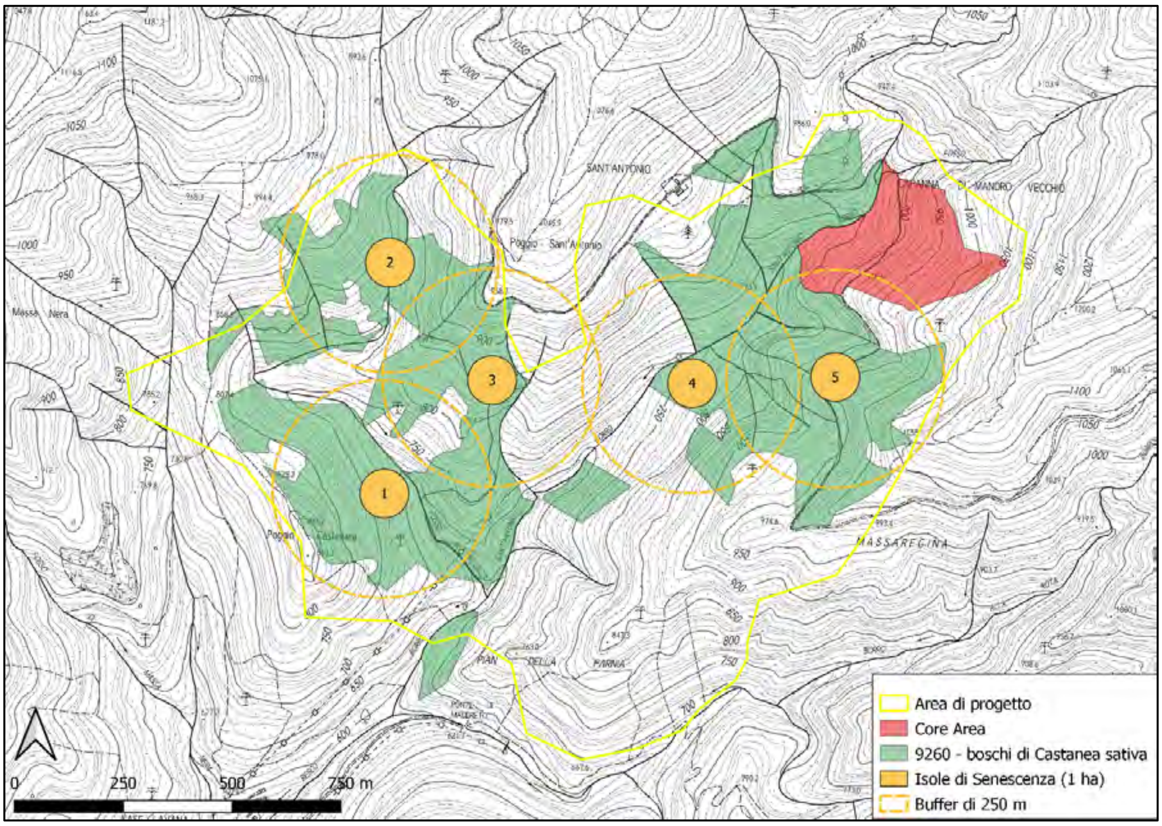


Figure 8. IBs of 1 hectare surface located at a mean distance of 250 m one to another.