Data Article

An open and georeferenced dataset of forest structural attributes and microhabitats in central and southern Apennines (Italy)

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\textbf{A B S T R A C T}

Forests cover 30% of the Earth’s landmass, host 80% of the biodiversity on land, and represent one of the main sinks of carbon. Studying forest ecosystems and dynamics is more crucial than ever now that the climate is changing. On the other hand, forest structural attributes and microhabitats data acquisition is challenging, and require huge efforts.
Here we provide a georeferenced dataset of living trees, deadwood, and microhabitats referring to 199 plots (13 m radius), collected between 2012 and 2018, and located over six Apennine mountainous forest types across Italy. The dataset we provide promotes collaboration among researchers and improves the possibilities to analyze the evolution of forest ecosystems.

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Specifications Table

| Subject | Agricultural science: Forestry |
|----------|-------------------------------|
| Specific subject area | Dendrometric measurement; Living trees, deadwood, and microhabitats survey |
| Type of data | Geospatial point vector (shapefile) Table |
| How the data were acquired | The dataset was constructed through field measurements of 199 sample plots (radius 13 m) distributed in six Italian forests (Table 1. Living trees, deadwood, and microhabitats data were acquired through the application of specific protocols. The instruments we used to acquire data include a tree caliper, GPS systems, hypsometry, and a vertex. |
| Data format | Raw |
| Description of data collection | Fieldwork was performed for each of the 199 georeferenced sites to acquire data related to (i) the number and the volume of living trees, (ii) the volume of deadwood, and (iii) types and abundance of tree-related microhabitats on living and deadwood. The information is provided both at site and tree levels. |
| Data source location | Four Italian administrative regions (NUT2): Abruzzo, Molise, Campania and Calabria |
| Data accessibility | Repository name: Mendeley Data |
| Data identification number | 10.17632/nwsw7hv5t.1 |
| Direct URL to data | https://data.mendeley.com/datasets/nwsw7hv5t/1 |

Value of the Data

- This dataset can be used to analyze forest stand structures and microhabitat typologies in different Apennine mountainous forest types.
- We want to promote collaboration among researchers by making datasets available, this dataset will assist forest researchers to collaborate as well as to combine and extend their data for further analysis.
- This dataset will improve the possibility for forest researchers and managers of analyzing the evolution of forest ecosystems for long-term studies.
- We encourage repeating forest assessments in the same localities to evaluate the trends in ecological indicators over time and space.
- If integrated with the dataset we provided in Campanaro and Parisi [1], these data can be used to investigate the relationship between saproxylic and non-saproxylic beetle communities and forest structural attributes.

1. Data Description

We provide two different datasets: one at the plot level (both .xlsx and .shp formats) and one at the tree level (xlsx format). While the coordinates of each plot are available - and that is why we provide a shapefile for plots – the coordinates of each tree were not acquired. The description and the measuring unit of all the attributes included in the dataset are provided in Table 1. Furthermore, in some sites specific projects are underway, and not all the forest attributes are available (e.g., forest structure in the Matese area). Table 1 also includes information regarding the availability of data. The plot-level dataset contains 199 rows, one row for each of 199 sample plots located in central and southern Italy over six different regions, for which a detailed description is provided in the next section.

Tables 2 and 3 describe the dataset related to single-tree data, acquired in the six forest sites reported above. In particular, Table 2 provides information on the structural attributes, while Table 3 defines the tree-related microhabitat acquired at the plot level.
Table 1
Forest attributes and tree-related microhabitats per site description.

| Variable       | Description                                                                 | Measure unit | Site availability   |
|----------------|-----------------------------------------------------------------------------|--------------|---------------------|
| site           | name of the site                                                            | -            | GS, AS, BP, MT, CI, AM |
| acronym        | acronym of the site                                                          | -            | GS, AS, BP, MT, CI, AM |
| GS: Gran Sasso |                                                                             |              |                     |
| AS: Abeti Sopranì |                                                                          |              |                     |
| BP: Bosco Pennataro |                                                                        |              |                     |
| MT: Matease   |                                                                             |              |                     |
| CI: Cliento   |                                                                             |              |                     |
| AM: Aspromonte |                                                                             |              |                     |
| plot_ID        | identification number for each plot, per site. It is composed as "acronym_number of the plot" | -            | GS, AS, BP, MT, CI, AM |
| elevation      | elevation of the plot                                                        | m a.s.l.     | GS, AS, BP, MT, CI, AM |
| x              | Coordinates of the plot centre, longitude                                   | Standard UTM coordinates (WGS 84 33N - EPSG: 32633) | GS, AS, BP, MT, CI, AM |
| y              | Coordinates of the plot centre, latitude                                     | Standard UTM coordinates (WGS 84 33N - EPSG: 32633) | GS, AS, BP, MT, CI, AM |
| management     | managed/unmanaged/orchard                                                    | -            | GS, AS, BP, MT, CI, AM |
| canopy_cover   | canopy cover for each plot                                                  | %            | GS, AS, BP, CI, AM   |
| n_trees        | number of living trees per hectare                                          | -            | GS, AS, BP, CI, AM   |
| V_trees        | volume of living trees per hectare                                          | m³/ha        | GS, AS, BP, CI, AM   |
| BA             | basal area per hectare                                                      | m²/ha        | GS, AS, BP, CI, AM   |
| n_CWD          | number of coarse woody debris per hectare                                   | -            | GS, AS, BP, MT, CI, AM |
| V_CWD          | volume of coarse woody debris per hectare                                    | m³/ha        | GS, AS, BP, MT, CI, AM |
| n_SDT          | number of standing dead trees per hectare                                    | -            | GS, AS, BP, MT, CI, AM |
| V_SDT          | volume of standing dead trees per hectare                                    | m³/ha        | GS, AS, BP, MT, CI, AM |
| n_Stumps       | number of stumps per hectare                                                | -            | GS, AS, BP, MT, CI, AM |
| V_Stumps       | volume of stumps per hectare                                                | m³/ha        | GS, AS, BP, MT, CI, AM |
| n_Snags        | number of snags per hectare                                                 | -            | GS, AS, BP, MT, CI, AM |
| V_Snags        | volume of snags per hectare                                                 | m³/ha        | GS, AS, BP, MT, CI, AM |
| n_DDT          | number of dead downed trees per hectare                                      | -            | GS, AS, BP, MT, CI, AM |
| V_DDT          | volume of dead downed trees per hectare                                      | m³/ha        | GS, AS, BP, MT, CI, AM |
| n_mh_alive     | Per plot number of per hectare typologies of tree-related microhabitats sampled on living trees. | -            | AS, BP, AM*          |
| n_mh_dead      | Per plot number of per hectare typologies of tree-related microhabitats sampled on dead trees. | -            | AS, BP, MT, AM*      |
| n_mh_tot       | sum of n_mh_alive and n_mh_dead                                              | -            | GS**, AS, BP, MT, CI**, AM* |

Note:
* in AM, data on tree-related microhabitats is available only per “orchard” management.
* in GS and CI, data on tree-related microhabitats is not distinguished between living and dead trees.
### Table 2
Tree-level database description.

| Head          | Description                                      |
|---------------|--------------------------------------------------|
| site          | Name of the site                                 |
| acronym       | Acronym of the site                              |
| N2k_CDDA      | Natura 2000 or Nationally designated areas (CDDA) code |
| plot_ID       | Number of the plot, per each site                |
| man_type      | type of forest management                        |
| man_regime    | regime of forest management                      |
| EEA_type      | forest type according to European classification  |
| ID_tree       | Identification number per CWD in each plot        |
| sp_tree       | Tree species (latin name)                        |
| dbh_tree (cm) | diameter at breast height                        |
| h_tree (m)    | Tree height                                      |
| V_tree (m3)   | Tree volume                                      |
| BA_tree (m2)  | Tree basal area                                  |

| Head          | Description                                      |
|---------------|--------------------------------------------------|
| acronym       | Acronym of the site                              |
| plot_ID       | Number of the plot, per each site                |
| ID_stump      | Identification number per each SDT in each plot  |
| Origin (N/A)  | Origin of the stump, Natural or Artificial       |
| Dbase_stump (cm)| base diameter of each stump                      |
| Dtop_stump (cm)| top diameter of each stump                       |
| h_stump(m)    | height of each stump                             |
| Sp_stump      | Species of the stumps                            |
| decay_stump   | decay stage [3]                                  |
| V_stump(m3)   | volume of each stump in each plot                |

| Head          | Description                                      |
|---------------|--------------------------------------------------|
| acronym       | Acronym of the site                              |
| plot_ID       | Number of the plot, per each site                |
| ID_snag       | Identification number per each snag in each plot |
| Dtop_snag(cm) | top diameter of each snag in each plot           |
| Dbase_snag(cm)| top diameter of each snag in each plot           |
| h_snag(m)     | height of each snag in each plot                 |
| Sp_snag       | specie of each snag in each plot                 |
| decay_snag    | decay stage [3]                                  |
| V_snag(m3)    | volume of each snag in each plot                 |

| Head          | Description                                      |
|---------------|--------------------------------------------------|
| acronym       | Acronym of the site                              |
| plot_ID       | Number of the plot, per each site                |
| ID_DDT        | identification number of each DDT in each plot   |
| dbh_DDT (cm)  | diameter at breast height of each DDT in each plot |
| lenght_DDT (cm)| Length of each DDT in each plot                  |
| Sp_DDT        | specie of each DDT in each plot                  |
| decay_DDT     | decay stage [3]                                  |
| V_DDT (m3)    | volume of each DDT in each plot                  |
Table 3
Tree-related microhabitat definitions.

| Head      | Definition                                                                 | Head      | Definition                                              |
|-----------|---------------------------------------------------------------------------|-----------|---------------------------------------------------------|
| MW_1      | Occurrence of fruiting bodies of Fomes fomentarius                       | ML_1      | Woodpecker breeding cavities                           |
| MW_2      | Occurrence of fruiting bodies of Fomitopsis pinicola                     | ML_2      | Rot holes                                              |
| MW_3      | Occurrence of other fungal infection                                       | ML_3      | Concavities                                            |
| MW_4      | Crown broken < 50% of the crown broken                                    | ML_4      | Insect galleries and bore holes                        |
| MW_5      | Several main branches are broken: >50% of the crown broken                | ML_5      | Exposed sapwood only                                   |
| MW_6      | Broken fork: complete fracture of one of the two forking branches         | ML_6      | Exposed sapwood and heartwood                          |
| MW_7      | Broken stem: the crown is totally absent and very small living twigs have remained | ML_7      | Crown deadwood                                         |
| MW_8      | Substitute or secondary crown                                             | ML_8      | Twig tangles                                           |
| MW_9      | Lightning scar at least 3 m long and reaching the sapwood                 | ML_9      | Burrs and cankers                                      |
| MW_10     | Crack: cleft into the sapwood >50 cm long along the stem and at least 2 cm deep | ML_10     | Perennial fungal fruiting bodies (life span >1 y)      |
| MW_11     | Splintered stem: the split-up results in numerous scales of wood >50 cm long | ML_11     | Ephemeral fungal fruiting bodies and slime moulds      |
| MW_12     | Cavities with >5 cm aperture                                              | ML_12     | Epiphytic or parasitic crypto- and phanerogams        |
| MW_13     | Cavity string: at least three woodpecker cavities                         | ML_13     | Nests                                                  |
| MW_14     | Deep stem cavities: a tubular cavity with little or without mould         | ML_14     | Fresh exudates                                         |
| MW_15     | Cavities with mould of at least 8000 cm³                                  | ML_15     | Microsoils                                             |
| MW_16     | Mould pockets: space between loose bark and the sapwood                   |           |                                                         |
| MW_17     | Bark pockets: same structure as M16, but without mould                     |           |                                                         |
| MW_18     | Canker: proliferation of cell growth at least 10 cm in diameter           |           |                                                         |
| MW_19     | Bark loss: patches with bark loss of at least 5 cm caused by natural falling of trees |           |                                                         |
| MW_20     | Uprooted stump, with a minimum height of 1.20 m of the vertical root plate |           |                                                         |
| MW_21     | System of gallery of Scolytidae insects                                   |           |                                                         |
| MW_22     | Saproxylic insect holes                                                   |           |                                                         |
| MW_23     | Water filled rot hole on stump                                            |           |                                                         |

2. Experimental Design, Materials and Methods

2.1. Forest Landscapes in the Dataset

This dataset refers to six study areas, characterized by forest landscapes with different characteristics in terms of both geomorphological conditions (Table 4) and management (Fig. 2). Detailed information on these study areas is reported in Campanaro and Parisi [1], for which a summary is provided below.

From North to South, the first site is the Gran Sasso (about 70 ha), which is located in the central Apennines. It is representative of the European forest type 6.7.3, “Apennine-Corsican moun-
Table 4
Details of the six forest sites in the dataset.

| Site          | Acronym | Municipality (study area) | Coordinates N (decimals) | Coordinates E (decimals) | Altitude (m a.s.l.) | Number of sampling plots | European forest type [2]                                                                 | Management regime                                                                 |
|---------------|---------|---------------------------|--------------------------|--------------------------|---------------------|--------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Gran Sasso    | GS      | Pietracamela (TE)         | 42.5096 N                | 13.5679 E                | 1500                | 19                       | Apennine-Corsican mountainous beech forest (6.7.3)                                      | old high forest                                                                  |
| Abeti Soprani | AS      | Pescopennataro (IS)       | 41.860833 N              | 14.293611 E              | 1450                | 50                       | Apennine-Corsican mountainous beech forest (6.7.3)                                      | old high forest                                                                  |
| Bosco Pennataro | BP    | Vastogirardi (IS)         | 41.748889 N              | 14.197222 E              | 1100                | 50                       | Sessile oak-hornbeam forest (6.5.2)                                                    | high forest on old coppice                                                      |
| Matese        | MT      | Roccamandolfi (IS)        | 41.452222 N              | 14.350278 E              | 1700                | 60                       | Apennine-Corsican mountainous beech forest (6.7.3)                                      | mature coppice with standard; group system (high forest)                           |
| Cilento       | Cl      | Corleto Monforte (SA)     | 40.4705 N                | 15.4317 E                | 1250                | 14                       | Apennine-Corsican mountainous beech forest (6.7.3)                                      | mature coppice with standard; orchard; young coppice with standards               |
| Aspromonte    | AM      | Santo Stefano (RC)        | 38.18 N                  | 15.784167 E              | 1059                | 6                        | Chestnut forest (6.8.7)                                                                 |                                                                                 |
tainous beech forest” [2], with a dominant height of 27.73 m. Data collection in Gran Sasso was carried out in 2013.

Second, the Abeti Soprani experimental area covers 240 ha. This forest is an almost pure *A. alba* stand, associated with *Fagus sylvatica* L. at the highest altitudes, and with *Quercus cerris* L. at the lowest altitudes. The dominant height of the sampled stands is 25.38 m, while the average age is 120–130 years; the data was collected in 2012.

Third, the Bosco Pennataro is a broadleaved mixed forest (European forest type 6.5.2) located in the Molise administrative region, covering a surface of almost 300 ha (data collection year 2014). With a dominant height of 29.20 m, the forest is characterized by a mixture of old coppices, and patches of mature forest stands grown mainly from seeds. Further, the Bosco Pennataro forest is dominated by large and tall mature trees with a closed canopy.

Fourth, the Matese forest is an Apennine beech forest with *Taxus* and *Ilex* (European forest type 6.7.3). Data collection in Matese forest was carried out in 2018. As Bosco Pennataro, Matese forest is located in the Molise administrative region and covers almost 400 ha of the Roccamadolphi forests, which is included within the Special Areas of Conservation (SAC) (http://natura2000.eea.europa.eu) "La Gallinola - Monte Miletto - Monti del Matese" (Cod. IT 7222287), within the National Park of Matese.

Then, the Cilento site (about 70 ha), which is located in the southern Apennines, is representative of montane coniferous forests (prevalent European forest type 6.7.3); the dominant height of the forest is 25.75 m, and the data was collected in 2013.

Last, the Aspromonte site includes three different agroforestry systems dominated by chestnuts (European forest type 6.8.7), i.e., (i) young (2 years) and (ii) mature (11 years) coppices stands, and (iii) traditional fruit orchard (older than 80 years). These agroforestry systems are characterized by a dominant height of 11.34 m. Each of the analyzed management types extend for about 12 ha. In this site, data collection was carried out in 2017 (Fig. 1).
2.2. Data Acquisition

In each site, data were acquired on circular plots of 13 m of radius, located throughout different landscapes with diverse forest types. All sites followed a systematic aligned sampling scheme except for Gran Sasso and Cilento, where a systematic non-aligned sampling method was applied. For each sampling station, UTM datum WGS84 33N (EPGS 32633) coordinates and altitude were recorded using the Juno SB Global Positioning System. Living trees (minimum diameter at breast height, DBH, ≥ 10 cm) and deadwood (minimum diameter ≥ 5 cm) were measured, marked, and numbered. The information recorded on the plots comprised tree DBH and height, canopy cover (through visual estimation), and tree species (both for living and dead trees). Furthermore, dead downed trees, snags, coarse woody debris, and stumps were included in the survey, measuring their lengths, heights, and minimum and maximum diameters. Snags were
defined as standing dead trees, without crowns, with a minimum height of 1.3 m [3], while standing dead trees were characterized by the presence of crowns (dead branches and twigs) [3]. The volume of living trees, standing, and dead downed trees were calculated by the double-entry volume equation [7], while the volumes of snags, coarse woody debris, and stumps were calculated through the cone trunk formula [8]. The sampling protocol used refers to the one proposed in Burrascano et al. [9].

Ethics Statements

The authors declare that the present work did not include experiments on human subjects and/or animals.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT Author Statement

Francesco Parisi: Data curation, Conceptualization, Methodology, Writing – review & editing; Saverio Francini: Conceptualization, Methodology, Writing – review & editing; Costanza Borghi: Writing – original draft; Gherardo Chirici: Conceptualization, Methodology, Writing – review & editing.

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